

SET NO: _____



Municipal Water District

San Diego County, California

**FINAL CONTRACT DOCUMENTS
FOR THE CONSTRUCTION OF:**

**DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4
UPGRADES
(D120096)**

SEPTEMBER 2023

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OLIVENHAIN MUNICIPAL WATER DISTRICT

San Diego County, California

CONTRACT DOCUMENTS FOR THE CONSTRUCTION OF

David C. McCollom Water Treatment Plant

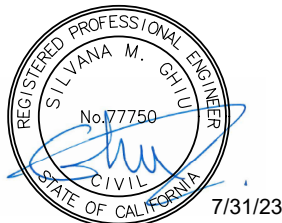
Stage 4 Upgrades

July 2023

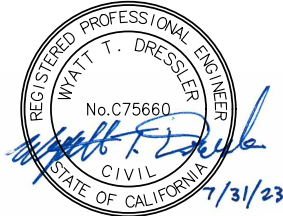
LARS

09/28/2023

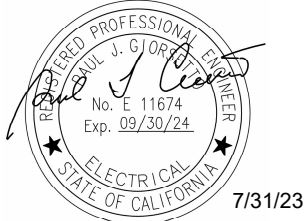
Lindsey Stephenson, P.E.
Engineering Manager



Silvana Ghiu, PhD, P.E.
Project Engineer, Hazen and Sawyer



Wyatt Dressler, P.E.
Structural Engineer, Hazen and Sawyer



Paul Giorsetto, P.E.
Electrical and I&C Engineer, TJCAA

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BID FORM CHECKLIST

(To be placed in the Bidder's Contract Documents in front of the Table of Contents)

Bid Form Page	Requirement	Initial
1 of 14	BID FORM- Fill out the form and acknowledge <u>all</u> addenda in the spaces provided at the end of the first paragraph	
2 of 14	BIDDING INSTRUCTIONS- Examination of the site and review of the Contract Documents has been completed	
2 of 14	BIDDING INSTRUCTIONS- Bid Schedule and all Bid forms are to be submitted with this Bid Form Checklist	
4 of 14	BID SCHEDULE- Fill out all items in the Bid Schedule, including dollar amounts in words and in numbers for each item	
6 of 14	DESIGNATION OF SUBCONTRACTORS- Fill in all information required on the form	
7 of 14	LISTING OF MANUFACTURERS- Fill in all information required on the form	
8 of 14	Fill in the type of Bid Bond enclosed in the first paragraph, and list all principals of the company in the third paragraph	
9 of 14	Fill in Bidder's license classification, license number, and all other information required in the fourth paragraph, including signature and date	
10 of 14	CERTIFICATE OF DRUG-FREE WORKPLACE- Fill in Bidder's name at the top and Certification section at the bottom of the page, including signature and date	
11 of 14	CERTIFICATE OF NONDISCRIMINATION- Fill in all information required on the form, including signature and date	
12 of 14	NONCOLLUSION AFFIDAVIT- Fill in all information required on the form including signature and date and provide notarization	
13 of 14	BIDDER'S EXPERIENCE- Fill in all information required on the form and provide signature and date at the bottom	
14 of 14	INSURANCE ACKNOWLEDGEMENT- Fill in all information required on the form and provide signature and date where indicated	
1 of 2	BID BOND- Fill in all required information including dollar amount	
2 of 2	BID BOND- Fill in all required information, provide signatures of the bidder and surety where indicated, provide notarization for principal of bidder and surety, and attach a certified Power of Attorney for surety	
Bid Notice 2 of 4	MARKING AND ADDRESSING BID ENVELOPE- Contract Documents are sealed in an envelope marked and addressed as required in this section	

Dated _____ Signature of Bidder _____

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PART I

BIDDING AND CONTRACT REQUIREMENTS

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NOTICE INVITING SEALED BIDS
FOR THE CONSTRUCTION OF
DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES
FOR THE
OLIVENHAIN MUNICIPAL WATER DISTRICT

NOTICE IS HEREBY GIVEN that the Board of Directors of said District invites and will receive sealed bids up to the hour of **2:00 p.m. on October 31, 2023** for the furnishing to said District of all transportation, labor, materials, tools, equipment, services, permits, utilities, and other items necessary to construct said work. At said time, said bids will be publicly opened and read aloud at the office of the Olivenhain Municipal Water District, 1966 Olivenhain Road, Encinitas, CA 92024, (760) 753-6466.

The District will conduct a Non-Mandatory Pre-Bid Conference at the Olivenhain Municipal Water District, 1966 Olivenhain Road, Encinitas, CA 92024, at **11:00 a.m. on October 11, 2023**.

All questions relative to this project prior to the opening of bids shall be directed to the District. It shall be understood that no specification interpretations will be made by telephone nor will any "or equal" products be considered for approval prior to award of the contract. Bidders are encouraged to submit their pre-bid questions as early as possible, in writing via email, so they can be answered in writing through an addendum if necessary. Pre-bid questions will be received, in writing to prebid@olivenhain.com, up to **2:00 p.m. on October 20, 2023**, after which they will not be answered.

Bids shall conform to and be responsive to the Contract Documents for the work. Contract Documents can be downloaded from the "Upcoming Projects and Planning Resources" link under "Construction Projects" on the home page of the District's website at www.olivenhain.com. Contract documents are not available at the District. It will be the Bidder's responsibility to download and acknowledge receipt of all addenda. If you wish to be placed on the plan holders list, please send your company name, contact person, contact phone number and email to prebid@olivenhain.com.

Each bid shall be submitted on the bid form furnished as part of the Contract Documents and must state the Contractor's applicable license classification, license number, license expiration date, name of license holder, and relationship to Bidder. The license classification required for this project is **Class A General Engineering**. Each bid must be accompanied by cash, a cashier's check, a certified check, or a bidder's bond executed by an admitted surety insurer. This bid guarantee shall be in an amount of not less than 10 percent of the amount of the bid and made payable to the order of or for the benefit of the District.

Said cash, check, or bond shall be given as guarantee that the Bidder will enter into a contract with the District and furnish the required payment and performance bonds and insurance certificates and endorsements if awarded the work, and will be declared forfeited if the Bidder

refuses to timely enter into said contract or furnish the required bonds or insurance certificates and endorsements if his bid is accepted. The bid guarantee of unsuccessful bidders will be returned by the District no later than 60 calendar days following the date of award of contract.

Each bid shall be sealed and delivered to District personnel at 1966 Olivenhain Road, Encinitas, CA 92024 on or before the day and hour set for the opening of bids. Bids shall be sealed in an envelope marked and addressed in accordance with Section 00810. Whether the bidder submits by mail or in-person, it is the sole responsibility of the bidder to see that his/her bid is received as specified by personnel of the Owner on or before the day and hour of bid opening. Bids not marked as being received by personnel of the Owner on or before the day and hour of bid opening will be rejected.

Each bid shall be sealed and delivered to District personnel at 1966 Olivenhain Road, Encinitas, CA 92024 on or before the day and hour set for the opening of bids. Bids shall be sealed in an envelope marked and addressed as follows:

BID FOR CONSTRUCTION OF:

DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES

OLIVENHAIN MUNICIPAL WATER DISTRICT
Attention: Prebid, Engineering Department
1966 Olivenhain Road
Encinitas, California 92024

IN-PERSON bids must be sealed and received as specified above by the district front office before the day and hour set for the opening of the bids.

MAILED BIDS shall be in sealed envelopes, shall be sent at bidder's risk via certified mail (or equivalent trackable delivery) with postage prepaid, shall be marked and addressed as indicated above, and received before the day and hour set for the opening of the bids. Any bidder electing to submit a bid by mail must notify the district prior to the bid opening at prebid@olivenhain.com of a mailed bid and provide the tracking number so the District can validate receipt.

ELECTRONICALLY transmitted bids are not considered sealed bids and will not be accepted.

Whether the bidder submits by mail or in-person, it is the sole responsibility of the bidder to see that his/her bid is received as specified by personnel of the Owner on or before the day and hour of bid opening. Bids not marked as being received by personnel of the Owner on or before the day and hour of bid opening will be rejected.

Bidders shall have successfully completed a minimum of five (5) similar process equipment projects during the last five (5) years performing the type and value of work required by this contract on public water systems/plants. Where the Bidder is a corporation or partnership, the entity must demonstrate at least five (5) years of successful experience with the work required by the contract. Bidders failing to demonstrate this experience may be rejected as nonresponsive at the option of the District.

Under the provisions of the California Public Works Apprenticeship Standards, Sections 1777.5, 1777.6, and 1777.7 of the Labor Code, a copy of the "Extract of Public Works Contract Award" has been included. This document will be filed with the California Department of Industrial Relations at the time of the award of the Contract.

The Board of Directors has obtained from the Director of the California Department of Industrial Relations a determination of the general prevailing rate of per diem, wages, and the general prevailing rate for legal holiday and overtime work in the locality in which said work is to be performed for each craft, classification, or type of worker needed. Not less than the determined rates shall be paid to all workers employed in the performance of the contract. Such rates of wages are on the file with the Department of Industrial Relations and in the office of the District and are available to any interested party upon request.

Pursuant to Public Contract Code Section 22300, the Contractor may substitute equivalent securities for retention amounts which this Contract requires. However, the District reserves the right to solely determine the adequacy of the securities being proposed by the Contractor and the value of those securities. The District shall also be entitled to charge an administrative fee, as determined by the District in its sole discretion, for substituting equivalent securities for retention amounts.

The Contractor agrees that the District's decision with respect to the administration of the provisions of Public Contract Code Section 22300 shall be final and binding and not subject to subsequent litigation or arbitration of any kind as to acceptance of any securities being proposed, the value of these securities, the costs of administration and the determination of whether or not the administration should be accomplished by an independent agency or by the District. The District shall be entitled, at any time, to request the deposit of additional securities of a value designated by the District, in the District's sole discretion, to satisfy this requirement. If the District does not receive satisfactory securities within 12 calendar days of the date of the written request, the District shall be entitled to withhold amounts due Contractor until securities of satisfactory value to the District have been received.

Pursuant to Section 995.710 of the Code of Civil Procedures, the Contractor may substitute any of the instruments specified in Code of Civil Procedure Section 995.710 for the performance and payment bonds required by the Contract Documents. All such substitutions shall be subject to review and approval by the District. Contractor agrees to pay all attorney's fees and all other fees, costs, and expenses incurred by the District in reviewing substitutes proposed by the Contractor and in preparing and implementing any agreements determined appropriate by the District to adequately protect District.

All bidders shall agree to obtain and maintain in full effect all required insurance with limits not less than the amounts indicated. Bidders who fail to comply with the insurance requirements of this contract may have their bids rejected as nonresponsive at the election of the District.

Pursuant to California Labor Code Section 6705, the cost of sheeting, shoring, and bracing of trenches, or equivalent method, where part of the job, shall constitute a separate bid item under these contract documents.

District shall award the contract for the Project to the lowest responsive, responsible Bidder as determined by the District based on the **total bid price for Schedule A**. District reserves the right to award the bid schedule, reject any and all bids, to waive any irregularity in the bids received and to award the Contract on the basis of the responsive bids

OLIVENHAIN MUNICIPAL WATER DISTRICT

Dated: 09/28/2023



LINDSEY STEPHENSON, P.E.
ENGINEERING MANAGER

BID FORMS

**BID TO
OLIVENHAIN MUNICIPAL WATER DISTRICT
SAN DIEGO COUNTY, CALIFORNIA**

**FOR THE CONSTRUCTION OF
DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES**

Name of Bidder: _____

Business Address: _____

_____ Phone No.: _____

TO THE GOVERNING BODY OF THE OLIVENHAIN MUNICIPAL WATER DISTRICT

Pursuant to and in compliance with your Notice Inviting Sealed Bids and the other documents relating thereto, the undersigned Bidder, being fully familiar with the terms of the Contract Documents, local conditions affecting the performance of the Contract, the character, quality, quantities, and scope of the work, and the cost of the work at the place where the work is to be done, hereby proposes and agrees to perform within the time stipulated in the Supplement to the General Provisions Section 00810 of the Contract, including all of its component parts and everything required to be performed, and to furnish any and all of the labor, material, tools, equipment, transportation, services, permits, utilities, and all other items necessary to perform the Contract and complete in a workmanlike manner, all of the work required in connection with the construction of said work all in strict conformity with the Plans and Specifications and other Contract Documents, including Addenda for the prices hereinafter set forth.

The undersigned acknowledges receipt, understanding and full consideration of the following
addenda to the Contract Documents:

Addendum No. _____	Date Issued _____
Addendum No. _____	Date Issued _____
Addendum No. _____	Date Issued _____

The undersigned as Bidder, declares that the only persons or parties interested in this bid as principals are those named herein; that this bid is made without collusion with any person, firm, or corporation; and he proposes and agrees, if the bid is accepted, that he will execute a Contract with the Owner in the form set forth in the Contract Documents and that he will accept in full payment thereof the following prices, to wit:

BIDDING INSTRUCTIONS
FOR THE CONSTRUCTION OF
DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES

Prior to the opening of bids, all questions relative to this project **shall be directed to Olivenhain Municipal Water District, Attn: Pre-bid. Bidders** are encouraged to submit their pre bid questions as early as possible, in writing to prebid@olivenhain.com, so they can be answered in writing through addendum, if necessary. **Pre bid questions will be received up to 2:00 p.m., on October 20, 2023 after which no questions will be taken or answered.**

Bidders shall submit information demonstrating relevant project experience on the Bid Forms included within these Contract Documents. Bidders failing to demonstrate this experience may be rejected as nonresponsive at the option of the Owner.

Bidders agree to obtain and maintain in full effect all required insurance with limits not less than the amounts indicated. Insurers must be authorized to do business and have an agent for service of process in California, have an "A" policyholder's rating and a financial rating of at least Class VI in accordance with the most current rating by A.M. Best Company. Bidders who fail to comply with the insurance requirements of this Contract may have their bids rejected as nonresponsive at the election of the Owner.

The Bidder's attention is directed to General Provisions Article 3-1 "Award of Contract or Rejection of Bids" in the General Provisions concerning the above conditions.

Bidders must satisfy themselves of the character of the work to be performed by examination of the site and review of the Contract Documents. After bids have been submitted, the Bidder expressly waives the right to assert that there was a misunderstanding concerning the nature of the work to be done. Any bid protests must be submitted within three (3) calendar days of the bid due date.

The Contract Documents contain the provisions required for the construction of the Project. Information obtained from an officer, agent, or employee of the Owner or any other personnel shall not affect the risks or obligations assumed by the Contractor, or relieve him from fulfilling any of the conditions of the Contract.

Bids shall be made on the Bid Form and Bid Bond included within these Contract Documents. Bidders shall designate the subcontractors and list the manufacturers of materials to be used in the Project on the Designation of Subcontractors form included with these Contract Documents. All subcontractors listed to perform any of the work must be licensed in the State of California. No single subcontractor may perform more than 25% of the work listed in the Bid Schedule unless specifically approved in advance by the District prior to the submission of bids. The Owner reserves the right to find a bid non-responsive in the sole discretion Owner if a Bidder lists any unlicensed subcontractors to perform any of the work. Submit with the bid the completed Bid Forms included within these Contract Documents. Completely fill out the one page Bid Form Checklist included in front of the Table of Contents and include it with the bid.

The Owner reserves the right to find a bid non-responsive in its sole discretion of a Bidder fails to complete or include any of the aforementioned certificates or acknowledgements.

The pay items listed in the Bid Schedules are described in Specification Section 01150 – Measurement and Payment.

In order for the Owner to consider a Bidder's bid and for a bid to be considered responsive, the bid schedule must be completed. If the bid schedule is not filled in, the bid will be determined to be non-responsive and will be rejected. The Owner reserves the right to reject any and all bids, to waive any irregularity in the bids received, and to award the Contract on the basis of the responsive bids.

Basis for the award shall be based on the total bid price for Schedule A.

BID SCHEDULE A**DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES**

Item	Description	Quantity	Unit	Unit Cost	Total Amount
1	General Conditions: contract bonds, insurance, permits, project management, mobilization of equipment, materials, and labor prior to starting the Work and demobilization and cleanup after completing all Contract Work. ¹	1	LS	\$ _____	\$ _____
2	Demolition. Furnishing all demolition activities	1	LS	\$ _____	\$ _____
3	Site Grading, Site Piping, Paving, Concrete Foundations, and All Other Miscellaneous Site Work	1	LS	\$ _____	\$ _____
4	Furnish Centrifuge equipped with Diverter Gate and New Diverter Gate for existing Centrifuge, and associated electrical panels complete as shown on the Drawings and described in the Specifications. (See Appendix A for equipment details and quote).	1	LS	<u>\$593,489</u>	<u>\$593,489</u>
5	Install Centrifuge, Diverter Gates and Electrical Panels complete as shown on the Drawings and described in the Specifications.	1	LS	\$ _____	\$ _____
6	Furnish and Install Centrate Pumps as shown on the Drawings and described in the Specifications.	1	LS	\$ _____	\$ _____
7	Furnish and Install Steel Centrate Storage Tanks as shown on the Drawings and described in the Specifications.	1	LS	\$ _____	\$ _____
8	Furnish and Install Polymer Day Tank, Polymer Dosing Skids, and Polymer Drum Racks with Containment System as shown on the Drawings and described in the Specifications.	1	LS	\$ _____	\$ _____
9	Relocate and Install one (1) Centrifuge Feed Pump as shown on the Drawings and described in the Specifications.	1	LS	\$ _____	\$ _____
10	All structural work required for concrete platforms and appurtenant items, bin rails modifications, winches furnishing, installation and testing, complete.	1	LS	\$ _____	\$ _____

BID SCHEDULE A

DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES

Item	Description	Quantity	Unit	Unit Cost	Total Amount
11	Startup and Performance Testing	1	LS	\$ _____	\$ _____
12	Operation and Maintenance Manuals	1	LS	\$ _____	\$ _____
13	Completion of Balance of Project Including All Work Not Specifically Called Out in Bid Items 1-12 for a functioning facility	1	LS	\$ _____	\$ _____

TOTAL AMOUNT OF BID SCHEDULE ITEMS A-1 THROUGH A-13:

\$ _____

TOTAL AMOUNT OF BID SCHEDULE ITEMS (IN WORDS):

Amounts shall be shown in both words and figures, where indicated. In case of discrepancy, the amount shown in words will govern.

The above prices shall include all labor, materials, removal, overhead, profit, insurance, and incidentals required to complete the work.

¹Mobilization is limited to 6% of the total bid price.

Note: By submission of this Bid, the Contractor acknowledges the two year guarantee as outlined in Section 5-14 of the General Provisions and has included said expenses as a part of this Bid.

DESIGNATION OF SUBCONTRACTORS

In compliance with the provisions of Section 4100 4114 of the Public Contract Code of the State of California, and any amendments thereof, each Bidder shall set forth below, the name, license number, and location of the mill, shop or office of each subcontractor who will perform work or labor, or render service to the Contractor in an amount in excess of one half (1/2) of one percent (1%) of the total bid, and the portion of the work which will be done by each subcontractor. All subcontractors listed must be licensed to perform the subcontract work in the State of California. No single subcontractor may perform work in excess of 25% of the total work listed in the Bid Schedule unless specifically approved by the District in advance of submission of the Bid. Bidders who list any unlicensed subcontractors on this form may have their bid rejected as non-responsive in the sole discretion of Owner.

If the Bidder fails to specify a subcontractor for any portion of the work in excess of one half (1/2) of one percent (1%) of the total bid to be performed under the Contract, he shall be deemed to have agreed to perform such portion himself, and he shall not be permitted to subcontract that portion of the work except under conditions permitted by law.

Subletting or subcontracting any portion of the work as to which no subcontractor was designated in the original bid shall only be permitted in case of public emergency or necessity, or otherwise permitted by law, and then only after a finding reduced to writing as a public record of the Owner.

Trade	% of Work To Be Done	Name of Subcontractor	License Number	Address

LISTING OF MANUFACTURERS

The Contractor shall submit this sheet with his bid, completed, to list the manufacturers of materials he intends to use. It shall be understood that where the Contractor elects to not use the material manufacturers called for in the Specifications, he will substitute only items of equal quality, durability, functional character, and efficiency as determined by the Owner. Contractor shall identify intended Manufacturer in table below.

Item or Material	Manufacturer per Specifications
Section 11200 Steel Water Tanks	A. Heritage Equipment Company B. or Equal
Section 11224 Inline Static Mixers	A. Westfall B. or Equal
Section 11240 Peristaltic Metering Pumps Polymer Dosing Skid	A. Blue-White Industries, Ltd. B. D&H Water Systems
Section 11315 Progressive Cavity Pumps	A. Netzsch Inc.
Section 11345 Crosslinked Polyethylene Storage Tank	A. Poly Processing Co.
Section 11363 Dewatering Centrifuge	A. Alfa-Laval Inc.
Section 13446 Electrical Actuators	A. Duff Norton (Supplied by Clearwater SS)
Section 15100 Ball Valves 4in and smaller	A. Asahi-America Inc.
Section 15100 Ball Valves larger than 4 in	A. Asahi-America Inc.bl
Section 15100 Butterfly Valves Section 15100 Pneumatic Actuator	A. Bray International Inc.
Section 15290 Centrifuge Diverter Gate	A. Clearwater SS (supplied by Alfa-Laval Inc.)
Section 13401 Flow Meters	A. Sparling Instruments, LLC.
Section 13401 Rotameters	A. Blue-White Industries, Ltd.

Substitutions shall be allowed only if requested in accordance with Article 5-10 of the General Provisions within 35 calendar days of the date the Contract is awarded. Should a substitution be allowed, there will be no increase in the amount of the bid originally submitted.

ACCOMPANYING THIS BID IS

(insert the words "cash", "a cashier's check", "a certified check", or "a Bidder's bond" as the case may be) in an amount equal to at least 10 percent of the total amount of the Bid, payable to the

OLIVENHAIN MUNICIPAL WATER DISTRICT

The undersigned deposits the above named security as a bid guarantee and agrees that it shall be forfeited to the Owner as liquidated damages in case this bid is accepted by the Owner and the undersigned fails to execute a contract with the Owner as specified in the Contract Documents or fails to furnish the required payment and performance bonds, and insurance certificates and endorsements. Should the Owner be required to engage the services of an attorney in connection with the enforcement of this bid, Bidder promises to pay Owner's reasonable attorneys' fees, incurred with or without suit.

The names of all persons interested in the foregoing bids as principals are as follows: (NOTICE If Bidder or other interested person is a corporation, state legal name of corporation, also names of the president, secretary, treasurer, and manager thereof; if a general partnership, state true name of firm, also names of all individual partners composing firm; if a limited partnership, the names of all general partners and limited partners; if Bidder or other interested person is an individual, state first and last names in full; if the Bidder is a joint venture, state the complete name of each venturer).

The Owner has determined the license classification necessary to bid and perform the subject contract. In no case shall this Contract be awarded to a specialty contractor whose classification constitutes less than a majority of the project. When a specialty contractor is authorized to bid a portion of the work of this contract, all work to be performed outside of the contractor's license specialty, except work specifically authorized by the Owner, shall be performed by a licensed subcontractor in compliance with the Subletting and Subcontracting Fair Practices Act commencing with Section 4100 et seq., of the Public Contract Code. See Business and Professions Code Section 7059.

The Contractor's license classification(s) required for this project are as follows:

CLASS A – GENERAL ENGINEERING

It is the Owner's intent that "plans," as used in Public Contract Code Section 3300, is defined as the construction Contract Documents, which include both the Plans and the Specifications.

Bidder warrants and represents that it has the required experience performing the type of work required by this Contract.

Bidder warrants and represents, under penalty of perjury, that license(s) required by California State Contractor's License Law for the performance of the subject project are in full effect and proper order. Bidders must state, under penalty of perjury, the Contractor's applicable license classification, license number, license expiration date, name of license holder, and relationship to Bidder. Any bid not containing this information may be considered nonresponsive and may be rejected by the Owner.

Bidders relying upon licenses of Responsible Managing Employees (RME) or Responsible Managing Officers (RMO) agree to provide the Owner with all information it determines necessary to verify that the Bidder complies with California State Contractor's License Law.

DIR Registration Number: _____

License Classification: _____

License Number: _____

Expiration Date: _____

Name of License Holder: _____

Relationship to Bidder: _____

Name of Bidder: _____

Signatures: _____

Dated: _____, 20 _____

NOTE: If Bidder is a corporation, the legal name of the corporation shall be set forth above, together with the signature of the officer or officers authorized to sign contracts on behalf of the corporation and the corporate seal; if Bidder is a partnership, the true name of the firm shall be set forth above, together with the signature of the partner or partners authorized to sign contracts on behalf of the partnership; if the Bidder is an individual, his signature shall be placed above; if the Bidder is a joint venture, the name of the joint venture shall be set forth above with the signature of an authorized representative of each venturer.

CERTIFICATE OF DRUG-FREE WORKPLACE

BIDDER: _____

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

1. Publish a statement notifying employees that unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance is prohibited and specifying actions to be taken against employees for violations, as required by Government Code Section 8355(a).
2. Establish a Drug-Free Awareness Program as required by Government Code Section 8355(b), to inform employees about all of the following:
 - (a) The dangers of drug abuse in the workplace,
 - (b) The person's or organization's policy of maintaining a drug-free workplace,
 - (c) Any available counseling, rehabilitation and employee assistance programs, and
 - (d) Penalties that may be imposed upon employees for drug abuse violations.
3. Provide as required by Government Code Section 8355(c), that every employee who works on the proposed contract or loan:
 - (a) Will receive a copy of the company's drug-free policy statement, and
 - (b) Will agree to abide by the terms of the company's statement as a condition of employment on the contract or loan.

CERTIFICATION

I, the official named below, hereby swear that I am duly authorized legally to bind the Bidder to the above described certification. I am fully aware that this certification, executed on the date and in the county below, is made under penalty of perjury under the laws of the State of California.

OFFICIAL'S NAME: _____

DATE EXECUTED: _____ EXECUTED IN COUNTY OF: _____

OFFICIAL'S SIGNATURE: _____

TITLE: _____

CERTIFICATE OF NONDISCRIMINATION

1. During the performance of this contract, Bidder and its subcontractors shall not unlawfully discriminate against any employee or applicant for employment because of race, religion, color, national origin, ancestry, physical handicap, medical condition, marital status, age (over 40) or sex. Bidders and subcontractors shall insure that the evaluation and treatment of their employees and applicants for employment are free of such discrimination. Bidder and subcontractors shall comply with the provisions of the Fair Employment and Housing Act (Government Code Section 12900 et seq.) and the applicable regulations promulgated thereunder (California Administrative Code, Title 2, Section 7285.0 et seq.). The applicable regulations of the Fair Employment and Housing Commission implementing Government Code, Section 12900, set forth in Chapter 5 of Division 4 of Title 2 or the California Administrative Code are incorporated into this contract by reference and made a part hereof as if set forth in full. Bidder and its subcontractor shall give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other agreement.
2. This Bidder shall include the nondiscrimination and compliance provisions of this clause in all subcontracts to perform work under the contract.

THE UNDERSIGNED CERTIFIES THAT THE BIDDER WILL COMPLY WITH THE ABOVE REQUIREMENTS.

BIDDER NAME: _____

CERTIFIED BY:

NAME: _____ TITLE: _____

SIGNATURE: _____ DATE: _____

NONCOLLUSION AFFIDAVIT

State of _____)
) ss.
County of _____)

I, _____, being duly sworn, deposes
and says that he or she is _____ of

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

Signature of Bidder: _____

Subscribed and sworn to before me on this _____ day of _____
_____, 20__.

BIDDER'S EXPERIENCE
(attach additional pages as needed)

Name of Bidder: _____

License Number: _____

DIR Registration
Number: _____

Bidders shall have successfully completed a minimum of five (5) similar process equipment projects during the last five (5) years performing the type and value of work required by this contract on public water systems/plants. Additional sheets may be provided. Projects not similar in scope, fee, and complexity will not be considered as representative of this project.

Project Name , Location and equipment installed	Prime or Subcontractor to the Project	Project Owner's Name, Address, & Phone No.	Cost of Bidder's Work	Date Completed
--	---	--	--------------------------	----------------

I declare, under penalty of perjury, that the foregoing is true and correct.

Dated: _____, 20__

(Signature of Bidder)

INSURANCE ACKNOWLEDGMENT

On behalf of the Bidder making this bid, the undersigned warrants and represents that the Bidder has carefully read and understood all of the insurance requirements of the Contract Documents and has included the full cost of providing insurance meeting all requirements of the Contract Documents in the bid. The minimum insurance coverage shall be set forth in the Supplement to the General Provisions Section 00810.

Upon request by Owner prior to the time of Award, the Bidder agrees to promptly provide Owner with letters from insurance companies meeting the requirements of the Contract Documents verifying that they are prepared to issue insurance to Bidder meeting all requirements of the Contract Documents. The failure of Bidder to provide Owner with this proof of insurance prior to the time of Award shall entitle Owner to reject the Bidder's bid as nonresponsive and to Award the bid to the next lowest Bidder at the sole discretion of Owner.

The failure of Bidder to provide Owner with insurance meeting all requirements of the Contract Documents within 15 calendar days after the Award, shall constitute a material breach of the Contract, entitling Owner to terminate the Contract and call the bid bond.

By dating and executing this Insurance Acknowledgment, Bidder hereby accepts all terms and conditions of this Insurance Acknowledgment and agrees to be bound by all of its terms.

Dated: _____, 20____

(Name of Bidder)

(Signature)

(Typed Name and Title)

(BLANK)

BID BOND

We, _____ as Principal, and
_____ as Surety, jointly and severally, bind
ourselves, our heirs, representatives, successors and assigns, as set forth herein, to the

OLIVENHAIN MUNICIPAL WATER DISTRICT

(herein called Owner) for payment of the penal sum of _____ Dollars
(\$ _____), lawful money of the United States. Principal has submitted the accompanying
bid for the construction of

DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES

If the Principal is awarded the Contract and enters into a written contract, in the form prescribed by the Owner, at the price designated by his bid, and files two bonds with the Owner, one to guarantee payment for labor and materials and the other to guarantee faithful performance, in the time and manner specified by the Owner, and carries all insurance in type and amount which conforms to the Contract Documents and furnishes required certificates and endorsements thereof, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

Forfeiture of this bond, or any deposit made in lieu thereof, shall not preclude the Owner from seeking all other remedies provided by law to cover losses sustained as a result of the Principal's failure to do any of the foregoing.

Principal and Surety agree that if the Owner is required to engage the services of an attorney in connection with the enforcement of this bond, each shall pay Owner's reasonable attorney's fees incurred with or without suit.

Executed on _____, 20__

PRINCIPAL

By: _____

(Seal if Corporation)

Title: _____

(Attach Acknowledgment of Authorized Representative of Principal)

Any claims under this bond may be addressed to:

_____ (name and address of Surety)

_____ (name and address of Surety's
agent for service of process in
California, if different from above)

_____ (telephone number of Surety's
agent in California)

(Attach Acknowledgment)

SURETY

By: _____
(Attorney-in-Fact)

NOTICE:

No substitution or revision to this bond form will be accepted. Sureties must be authorized to do business in and have an agent for service of process in California. A certified copy of the Power of Attorney must be attached.

AGREEMENT

THIS AGREEMENT, made and entered into by and between the

OLIVENHAIN MUNICIPAL WATER DISTRICT

hereinafter referred to as "OWNER" and

_____ ;

a corporation under the laws of the state of _____

;

a partnership composed of _____

_____ ;

a joint venture composed of _____

_____ ;

an individual doing business as _____ ;

hereinafter referred to as "CONTRACTOR."

OWNER and CONTRACTOR agree as follows:

- (1) **SCOPE OF WORK:** CONTRACTOR will furnish all materials and will perform all of the work for the construction of the

DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES

in accordance with the plans and specifications and other contract documents therefor.

- (2) **TIME OF COMPLETION:** The work shall be completed within the times set forth in the Supplement to the General Provisions Section 00810. Time is of the essence.
- (3) **CONTRACT SUM:** OWNER will pay CONTRACTOR in accordance with the prices shown in the Bid Form.
- (4) **PAYMENTS:** Monthly progress payments and the final payment will be made in accordance with the General Provisions as modified by the Special Provisions. The filing of the notice of completion by OWNER shall be preceded by acceptance of the work made only by an action of the Governing Body of OWNER in session.
- (5) **COMPLIANCE WITH PUBLIC CONTRACTS LAW:** OWNER is a public agency in the State of California and is subject to the provisions of law relating to public contracts. It is agreed that all provisions of law applicable to public contracts are a part of this Contract

to the same extent as though set forth herein and will be complied with by CONTRACTOR.

- (6) **CONTRACT DOCUMENTS:** The complete contract includes all the contract documents set forth herein, to wit: Notice Inviting Sealed Bids, Bid Form, Bid Bond, Agreement, Performance Bond, Payment Bond, Contractor's Certificate Regarding Workers' Compensation, Certificate of Insurance (Workers' Compensation and Employer's Liability), Insurance Endorsement (Workers' Compensation and Employer's Liability), Certificate of Insurance (Liability), Insurance Endorsement (Liability), Certificate of Insurance (Builders' Risk "All Risk"), Insurance Endorsement (Builders' Risk "All Risk"), General Provisions, Special Provisions, Standard Specifications, Standard Drawings, Referenced Permits, Drawings, Plans, and also Addenda thereto and supplemental agreements.

This Agreement is executed by the OWNER pursuant to an action of its Governing Body in session on _____, 20____, authorizing the same, and CONTRACTOR has caused this Agreement to be duly executed.

Dated: _____, 20____ By: _____
(Authorized Representative of Owner)

Title: _____ GENERAL MANAGER

Dated: _____, 20____ _____
(Contractor)

By: _____
(Authorized Representative of Contractor)

Title: _____

(Seal if Corporation)

(Attach Acknowledgment for Authorized Representative of Contractor)

APPROVED:

(Attorney for OWNER)

Date

CERTIFICATE OF CONTRACTOR

I, _____, certify that I am a/the

[designate sole proprietor, partner in partnership, or specify corporate office, e.g., secretary] in the entity named as CONTRACTOR in the foregoing contract.

I hereby expressly certify that the name of the entity to which I am associated is _____

_____;

that this entity is in good standing and has complied with all applicable laws and regulations, and that I have been expressly authorized by the proper parties in this entity to execute this contract on behalf of the above-named entity.

(Signature)

ATTEST:

Name: _____
(Please Print)

Title: _____

(BLANK)

PERFORMANCE BOND

We, _____ as Principal,
and _____ as Surety, jointly and
severally, bind ourselves, our heirs, representatives, successors and assigns, as set forth herein,
to the

OLIVENHAIN MUNICIPAL WATER DISTRICT

(herein called Owner) for payment of the penal sum of _____

_____ Dollars (\$ _____
) ,

lawful money of the United States. Owner has awarded Principal a contract for the construction
of

DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES

THE CONDITION OF THIS OBLIGATION IS SUCH that if the Principal shall in all things abide
by and well and truly keep and perform the covenants, and agreements in the said contract, and
any alteration thereof made as therein provided, on his part to be kept and performed at the time
and in the manner therein specified, including all guarantees of workmanship and/or materials
for a two (2) year period, and shall indemnify and save harmless the Owner, District, the
Engineer/Architect, the Owner's Representative, and their consultants, and each of their
directors, officers, employees, and agents, as therein stipulated, this obligation shall become
null and void, otherwise, it shall be and remain in full force and effect.

Surety agrees that no change, extension of time, alteration, or addition to the terms of the
contract, or the work to be performed thereunder, or the plans and specifications shall in any
wise affect its obligation on this bond, and it does hereby waive notice thereof.

Principal and Surety agree that if the Owner is required to engage the services of an attorney in
connection with the enforcement of this bond, each shall pay Owner's reasonable attorney's fees
incurred, with or without suit, in addition to the above sum.

Executed in three original
counterparts on

_____, 20__

PRINCIPAL

By: _____

(Seal if Corporation)

Title: _____

(Attach Acknowledgment of Authorized Representative of Principal)

Any claims under this bond may be addressed to:

_____ (name and address of Surety)

_____ (name and address of Surety's
agent for service of process in
California, if different from above)

_____ (telephone number of Surety's
agent in California)

(Attach Acknowledgment)

SURETY

By: _____
(Attorney-in-Fact)

APPROVED:

(Attorney for OWNER) Date

NOTICE:

No substitution or revision to this bond form will be accepted. Sureties must meet all requirements of Code of Civil Procedure Section 995.660(a). A certified copy of the Power of Attorney must be attached.

PAYMENT BOND

We, _____ as Principal,
and _____ as Surety, jointly and
severally, bind ourselves, our heirs, representatives, successors and assigns, as set forth herein, to the

OLIVENHAIN MUNICIPAL WATER DISTRICT

(herein called Owner) for payment of the penal sum of _____

_____ Dollars (\$ _____),

lawful money of the United States. Owner has awarded Principal a contract for the construction of

DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES

If Principal or any of his subcontractors fails to pay any of the persons named in Section 3181 of the California Civil Code, or amounts due under the Unemployment Insurance Code with respect to work or labor performed under the contract or during the two-year guarantee period, or for any amounts required to be deducted, withheld, and paid over to the Franchise Tax Board from the wages of employees of the contractor and his subcontractors pursuant to Section 13020 of the Unemployment Insurance Code, with respect to such work and labor, then Surety will pay the same in an amount not exceeding the sum specified above, and also will pay, in case suit is brought upon this bond, such reasonable attorney's fees as shall be fixed by the court.

This bond shall inure to the benefit of any of the persons named in Section 3181 of the California Civil Code, so as to give a right of action to them or their assigns in any suit brought upon this bond.

Surety agrees that no change, extension of time, alteration, or addition to the terms of the contract, or the work to be performed thereunder, or the plans and specifications shall in any wise affect its obligation on this bond, and it does hereby waive notice thereof.

Principal and Surety agree that should Owner become a party to any action on this bond that, each will also pay Owner's reasonable attorney's fees incurred therein in addition to the sum above set forth.

Executed in three original
counterparts on

_____, 20____

PRINCIPAL

By: _____

(Seal if Corporation)

Title: _____

(Attach Acknowledgment of Authorized Representative of Principal)

Any claims under this bond may be addressed to:

_____ (name and address of Surety)

_____ (name and address of Surety's
agent for service of process in
California, if different from above)

_____ (telephone number of Surety's
agent in California)

(Attach Acknowledgment)

SURETY

By: _____
(Attorney-in-Fact)

APPROVED:

(Attorney for OWNER) Date

NOTICE:

No substitution or revision to this bond form will be accepted. Sureties must meet all requirements of Code of Civil Procedure Section 995.660(a). A certified copy of the Power of Attorney must be attached.

**CONTRACTOR'S CERTIFICATE
REGARDING WORKERS' COMPENSATION**

Name of Contract: **DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4
UPGRADES**

Name of Owner: **OLIVENHAIN MUNICIPAL WATER DISTRICT**

Labor Code Section 3700:

"Every employer except the State shall secure the payment of compensation in one or more of the following ways:

- (a) By being insured against liability to pay compensation in one or more insurers duly authorized to write compensation insurance in this State.
- (b) By securing from the Director of Industrial Relations a certificate of consent to self-insure, which may be given upon furnishing proof satisfactory to the Director of Industrial Relations of ability to self-insure and to pay any compensation that may become due to his employees.
- (c) For all political subdivisions of the state, including each member of a pooling arrangement under a joint exercise of powers agreement (but not the state itself), by securing from the Director of Industrial Relations a certificate of consent to self-insure against workers' compensation claims, which certificate may be given upon furnishing proof satisfactory to the director of ability to administer workers' compensation claims that may become due to its employees. On or before March 31, 1979, a political subdivision of the state which, on December 31, 1978, was uninsured for its liability to pay compensation, shall file a properly completed and executed application for a certificate of consent to self-insure against workers' compensation claims. The certificate shall be issued and be subject to the provisions of Section 3702."

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.

Dated: _____, 20____

(Contractor)

By: _____
(Authorized Representative of Contractor)

(Seal if Corporation) Title: _____

(Labor Code Section 1861 provides that the above certificate must be signed and filed by the Contractor with the Owner prior to performing any work under this Contract.)

CERTIFICATE OF INSURANCE

Name of Contract: **DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES**

Name of Owner: **OLIVENHAIN MUNICIPAL WATER DISTRICT**

Type of Insurance: **WORKERS' COMPENSATION INSURANCE AND EMPLOYER'S LIABILITY INSURANCE**

THIS IS TO CERTIFY that the following policy has been issued by the below-stated company in conformance with the requirements of Articles 8-1 and 8-2 of the General Provisions and is in force at this time.

The Company will give at least 30 days' written notice by certified mail to the Owner and Engineer/Architect prior to any material change or cancellation of said policy.

<u>POLICY NUMBER</u>	<u>EXPIRATION DATE</u>	<u>TYPE OF INSURANCE</u>	<u>LIMITS OF LIABILITY</u>	
_____		A. WORKERS' COMPENSATION	Statutory Limits Under the Laws of the State of California	
_____		B. EMPLOYER'S LIABILITY	Each Employee	Each Accident
		Bodily Injury By Accident	\$	\$
		Bodily Injury By Disease	\$	\$

_____ Named Insured (Contractor)	_____ Insurance Company
_____ Street Number	_____ Street Number
_____ City and State	_____ City and State

By: _____
(Company Representative)
(SEE NOTICE ON PAGE 3 OF 3)

State of _____)
County of _____) ss.

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

On _____ before me, _____
Date Here Insert Name and Title of the Officer

Personally appeared _____
Name(s) of Signer(s)

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

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

WITNESS my hand and official seal

NOTARY PUBLIC

Insurance Company Agent for Service
of Process in California:

Name

Agency

Street Number

Street Number

City and State

City and State

Telephone Number

Telephone Number

This certificate or verification of insurance is not an insurance policy and does not amend, extend, or alter the coverage afforded by the policies listed herein. Notwithstanding any requirement, term, or condition of any contract or other document with respect to which this certificate or verification of insurance may be issued or may pertain, the insurance afforded by the policies described herein is subject to all the terms, exclusions, and conditions of such policies.

NOTICE:

No substitution or revision to the above certificate form will be accepted. If the insurance called for is provided by more than one insurance company, a separate certificate in the exact above form shall be provided for each insurance company.

Insurers must be authorized to do business and have an agent for service of process in California, have an "A" policyholder's rating and a financial rating of at least Class VI in accordance with the most current rating by A.M. Best Company.

(BLANK)

INSURANCE ENDORSEMENT

Name of Contract: **DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES**

Name of Owner: **OLIVENHAIN MUNICIPAL WATER DISTRICT**

Type of Insurance: **WORKERS' COMPENSATION INSURANCE AND EMPLOYER'S LIABILITY INSURANCE**

This endorsement forms a part of Policy No. _____.

ENDORSEMENT:

It is agreed that with respect to such insurance as is afforded by the policy, the Company waives any right of subrogation it may acquire against the Owner, the Engineer/Architect, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents by reason of any payment made on account of injury, including death resulting therefrom, sustained by any employee of the insured, arising out of the performance of the above-referenced contract.

This endorsement does not increase the Company's total limits of liability.

_____ Named Insured (Contractor)	_____ Insurance Company
_____ Street Number	_____ Street Number
_____ City and State	_____ City and State

By: _____
(Company Representative)

(SEE NOTICE ON PAGE 2 OF 2)

State of _____)
County of _____) ss.

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

On _____ before me, _____
Date Here Insert Name and Title of the Officer

Personally appeared _____
Name(s) of Signer(s)

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

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

WITNESS my hand and official seal

NOTARY PUBLIC

NOTICE:

No substitution or revision to the above endorsement form will be accepted. If the insurance called for is provided by more than one policy, a separate endorsement in the exact above form shall be provided for each policy.

Insurers must be authorized to do business and have an agent for service of process in California, have an "A" policyholder's rating and a financial rating of at least Class VI in accordance with the most current rating by A.M. Best Company.

CERTIFICATE OF INSURANCE

Name of Contract: **DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES**

Name of Owner: **OLIVENHAIN MUNICIPAL WATER DISTRICT**

Type of Insurance: **LIABILITY INSURANCE**

THIS IS TO CERTIFY that the following policies have been issued by the below-stated company in conformance with the requirements of Articles 8-1 and 8-3 of the General Provisions and are in force at this time. The policy shall be an occurrence policy with a deductible not to exceed \$5,000.

<u>POLICY NUMBER</u> <u>EXPIRATION DATE</u>	<u>TYPE OF INSURANCE</u>	<u>LIMITS OF LIABILITY</u> In Thousands (000)	
		<u>Occurrence</u>	<u>Aggregate</u>
_____	A. GENERAL LIABILITY		
	Bodily Injury, Personal Injury, and Property Damage Combined	\$	\$
_____	B. EXCESS GENERAL LIABILITY	\$	\$
_____	C. AUTOMOBILE LIABILITY		
	Bodily Injury and Property Damage Combined	\$	\$
_____	D. EXCESS AUTOMOBILE LIABILITY	\$	\$

The following types of coverage are included in said policies (indicate by "X" in space):

A. GENERAL LIABILITY

Comprehensive Form -----YES___ NO___

Premises-Operations-----YES___ NO___

Explosion and Collapse Hazard ----- YES___ NO___

Underground Hazard-----YES___ NO___

Products/Completed Operations Hazard-----YES___ NO___

Contractual Insurance -----YES___ NO___

Broad Form Property Damage Including Completed Operations-----YES___ NO___

Independent Contractors-----YES___ NO___

Personal Injury-----YES___ NO___

B. EXCESS GENERAL LIABILITY

Umbrella Form -----YES___ NO___

Other Than Umbrella Form-----YES___ NO___

If other than Umbrella Form, please explain below:

C. AUTOMOBILE LIABILITY

Comprehensive Form Including Loading and Unloading -----YES___ NO___

Owned -----YES___ NO___

Hired-----YES___ NO___

Non-Owned-----YES___ NO___

D. EXCESS AUTOMOBILE LIABILITY

Umbrella Form -----YES___ NO___

Other Than Umbrella Form-----YES___ NO___

If other than Umbrella Form, please explain below:

The Company will give at least 30 days' written notice by certified mail to the Owner and the Engineer/Architect prior to any material change or cancellation of said policies.

(SEE NOTICE ON PAGE 5 OF 5)

3 OF 5

County of _____)

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

On _____ before me, _____
Date Here Insert Name and Title of the Officer

Personally appeared _____
Name(s) of Signer(s)

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

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

WITNESS my hand and official seal

NOTARY PUBLIC

Insurance Company Agent for Service
of Process in California:

Name

Agency

Street Number

Street Number

City and State

City and State

Telephone Number

Telephone Number

NOTICE:

No substitution or revision to the above certificate form will be accepted. If the insurance called for is provided by more than one insurance company, a separate certificate in the exact above form shall be provided for each insurance company.

Insurers must be authorized to do business and have an agent for service of process in California, have an "A" policyholder's rating and a financial rating of at least Class VI in accordance with the most current rating by A.M. Best Company.

(BLANK)

INSURANCE ENDORSEMENT

Name of Contract: **DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES**

Name of Owner: **OLIVENHAIN MUNICIPAL WATER DISTRICT**

Type of Insurance: **LIABILITY INSURANCE**

This endorsement forms a part of Policy No. _____.

ENDORSEMENT:

The Owner, the Engineer/Architect, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents are included as additional insureds under said policies but only while acting in their capacity as such and only as respects operations of the named insured, his contractors, any subcontractor, any supplier, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable in the performance of the above-referenced contract. This insurance shall not apply if the loss or damage is ultimately determined to be the result of the sole and exclusive negligence (including any connected with the preparation or approval of maps, drawings, opinions, reports, surveys, designs, or specifications) of one or more of the aforesaid additional insureds. The insurance afforded to these additional insureds is primary insurance. If the additional insureds have other insurance which might be applicable to any loss, the amount of this insurance shall not be reduced or prorated by the existence of such other insurance.

The Contractual Liability Insurance afforded is sufficiently broad to insure all of the matters set forth in the article entitled "Indemnity" in the General Provisions of the above-referenced contract except those matters set forth in the third paragraph thereof.

This endorsement does not increase the Company's total limits of liability.

Named Insured (Contractor)

Insurance Company

Street Number

Street Number

City and State

City and State

By: _____
(Company Representative)

(SEE NOTICE ON PAGE 2 OF 2)

State of _____)

County of _____) ss.

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

On _____ before me, _____
Date Here Insert Name and Title of the Officer

Personally appeared _____
Name(s) of Signer(s)

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

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

WITNESS my hand and official seal

NOTARY PUBLIC

NOTICE:

No substitution or revision to the above endorsement form will be accepted. If the insurance called for is provided by more than one policy, a separate endorsement in the exact form shall be provided for each policy.

Insurers must be authorized to do business and have an agent for service of process in California, have an "A" policyholder's rating and a financial rating of at least Class VI in accordance with the most current rating by A.M. Best Company.

CERTIFICATE OF INSURANCE

Name of Contract: **DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES**

Name of Owner: **OLIVENHAIN MUNICIPAL WATER DISTRICT**

Type of Insurance: **BUILDERS' RISK "ALL RISK" INSURANCE**

THIS IS TO CERTIFY that the following policy has been issued by the below-stated company in conformance with the requirements of Articles 8-1 and 8-4 of the General Provisions and is in force at this time:

POLICY NUMBER	EXPIRATION DATE	LIMITS OF LIABILITY
		\$
		(Not Less Than Contract Amount)
		Deductible:
		\$
	(Not Sooner Than Contract Completion Date)	(Not More Than \$100,000)

This certificate or verification of insurance is not an insurance policy and does not amend, extend, or alter the coverage afforded by the policies listed herein. Notwithstanding any requirement, term, or condition of any contract or other document with respect to which this certificate or verification of insurance may be issued or may pertain, the insurance afforded by the policies described herein is subject to all the terms, exclusions, and conditions of such policies.

The Company will give at least 30 days' written notice by certified mail to the Owner and the Engineer/Architect prior to any material change or cancellation of said policy.

Named Insured (Contractor)

Insurance Company

Street Number

Street Number

City and State

City and State

By: _____
(Company Representative)

(SEE NOTICE ON PAGE 3 OF 3)

State of _____)
County of _____) ss.

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

On _____ before me, _____
Date Here Insert Name and Title of the Officer

Personally appeared _____
Name(s) of Signer(s)

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

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

WITNESS my hand and official seal

NOTARY PUBLIC

Insurance Company Agent for Service

OLIVENHAIN MWD

CERTIFICATE OF INSURANCE (BUILDERS' RISK "ALL RISK")

David C. McCollom Water Treatment Plant Stage 4 Upgrades

2 OF 3

of Process in California:

_____ Name	_____ Agency
_____ Street Number	_____ Street Number
_____ City and State	_____ City and State
_____ Telephone Number	_____ Telephone Number

NOTICE:

No substitution or revision to the above certificate form will be accepted. If the insurance called for is provided by more than one insurance company, a separate certificate in the exact above form shall be provided for each insurance company.

Insurers must be authorized to do business and have an agent for service of process in California, have an "A" policyholder's rating and a financial rating of at least Class VI in accordance with the most current rating by A.M. Best Company.

(BLANK)

INSURANCE ENDORSEMENT

Name of Contract: **DAVID C. MCCOLLOM WATER TREATMENT PLANT STAGE 4 UPGRADES**

Name of Owner: **OLIVENHAIN MUNICIPAL WATER DISTRICT**

Type of Insurance: **BUILDERS' RISK "ALL RISK" INSURANCE**

This endorsement forms a part of Policy No. _____.

ENDORSEMENT:

The Owner, the Engineer/Architect, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents are included as additional insureds under said policy but only while acting in their capacity as such with respect to the above-referenced contract.

The insurance afforded to these additional insureds is primary insurance. If the additional insureds have other insurance which might be applicable to any loss, the amount of this insurance shall not be reduced or prorated by the existence of such other insurance.

This endorsement does not increase the Company's total limits of liability.

Named Insured (Contractor)

Street Number

City and State

Insurance Company

Street Number

City and State

By: _____
 (Company Representative)

(SEE NOTICE ON PAGE 2 OF 2)

State of _____)
County of _____) ss.

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

On _____ before me, _____
Date Here Insert Name and Title of the Officer

Personally appeared _____
Name(s) of Signer(s)

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

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

WITNESS my hand and official seal

NOTARY PUBLIC

NOTICE:

No substitution or revision to the above endorsement form will be accepted. If the insurance called for is provided by more than one policy, a separate endorsement in the exact above form shall be provided for each policy.

Insurers must be authorized to do business and have an agent for service of process in California, have an "A" policyholder's rating and a financial rating of at least Class VI in accordance with the most current rating by A.M. Best Company.

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GENERAL PROVISIONS

SECTION 1 DEFINITIONS, TERMS, AND ABBREVIATIONS

1-1 DEFINITIONS

Whenever the following terms occur in the Contract Documents, the meaning shall be interpreted as follows:

ACCEPTANCE, FINAL ACCEPTANCE - The formal action by the Owner accepting the work as being complete.

ACCEPTED BID - The bid accepted by the Owner.

ATTORNEY FOR OWNER – Alfred E. Smith, Nossaman, LLP, 777 S. Figueroa Street, 34th Floor, Los Angeles, CA. 90017, (213) 612-7831

BIDDER - Any individual, partnership, corporation, joint venture, or other combination thereof submitting a bid for the work contemplated, acting directly or through an authorized representative.

CALENDAR DAY - Means all days of the week including Saturdays, Sundays and Holidays with the first day counted being the first day following the date specified.

CONTRACT - The written agreement executed between the Owner and the Contractor covering the performance of the work.

CONTRACTOR - The individual, partnership, corporation, joint venture, or other combination thereof who has entered into the contract with the Owner for the performance of the work. The term "Contractor" means the Contractor or his authorized representative.

CONTRACT DOCUMENTS - The Contract Documents set forth in the Agreement; also any and all supplemental agreements amending or extending the work contemplated. Supplemental agreements are written agreements covering alterations, amendments, or extensions to the contract and include contract change orders.

DAYS - Unless otherwise specified, days shall mean calendar days.

ENGINEER/ARCHITECT – The term "Engineer/Architect" means the Engineer/Architect or his authorized representative.

OWNER - The public entity identified as such in the Agreement. The term "Owner" means the Owner or his authorized representative.

OWNER'S REPRESENTATIVE - The person or firm authorized by the Owner to represent it during the performance of the work by the Contractor. The term "Owner's Representative" means the Engineer or the Construction Manager.

PLANS, DRAWINGS - The Plans (drawings), or reproductions thereof, which show the location, character, dimensions, and details of the work to be done.

SPECIAL PROVISIONS - Additions, deletions, and changes to the General Provisions and Standard Specifications.

SPECIFICATIONS - The directions, provisions, and requirements contained in the General Provisions and Standard Specifications as supplemented by the Special Provisions.

STANDARD SPECIFICATIONS - The Contract Documents identified or referenced as such.

SUBCONTRACTOR - An individual, partnership, corporation, joint venture, or other combination thereof who has a contract with the Contractor to perform any of the work at the site. Subcontractor also means an individual, partnership, corporation, joint venture, or other combination thereof who has a contract with another subcontractor to perform any of the work at the site.

STANDARD DRAWINGS, STANDARD PLANS - That portion of the Plans identified or referenced as such.

UTILITY - Public or private fixed works for the transportation of fluids, gases, power, signals, or communications.

WORK - Any and all obligations, duties, and responsibilities necessary to complete the construction assigned to, or undertaken by, the Contractor pursuant to the Contract Documents including all materials, equipment, and supplies incorporated or to be incorporated in the construction. Also, the completed construction or parts thereof required to be provided under the Contract Documents.

1-2 TERMS

Wherever the terms "required," "permitted," "ordered," "designated," "directed," "prescribed," or terms of like import are used, it shall be understood that the requirements, permission, order, designation, direction, or prescription of the Owner's Representative is intended. Similarly, the terms "acceptable," "satisfactory," "or equal," or terms of like import shall mean acceptable to or satisfactory to the Owner's Representative, unless otherwise expressly stated. The word "provide" shall be understood to mean furnish and install.

1-3 ABBREVIATIONS

Wherever abbreviations are used, they shall have the meanings as set forth in the Special Provisions.

SECTION 2 BID REQUIREMENTS AND CONDITIONS

2-1 CONTRACT DOCUMENTS

The Contract Documents are set forth in the Agreement form and the definition of "Contract Documents" is in Article 1-1 DEFINITIONS.

2-2 LICENSE AND BIDDER'S EXPERIENCE

No bid will be accepted from a bidder who is not licensed to conduct business in the state of California and licensed to perform the class of work defined by the Contract Documents. All bidders shall complete the Bidder's Experience form as part of their bid. Bidders failing to complete and submit the Bidder's Experience form with their bid may be treated as nonresponsive at the option of the Owner. Bidders unable to demonstrate five (5) years of successful prior experience performing the type and magnitude of work required by this contract may also be rejected as nonresponsive.

2-3 BID

Bids shall be made upon the Bid Form furnished by the Owner and a part of the Contract Documents. The Bid Form Checklist, Bid Form and Bid Bond must be submitted with the bid. All bids shall be properly executed and with all items filled in; the signatures of all persons signing shall be in longhand. Erasures, interlineations, or other corrections shall be authenticated by affixing in the margin immediately opposite the correction the initials of a person signing the bid. Written amounts shall govern in case of discrepancy between the amounts stated in writing and the amounts stated in figures. If the unit price and the total amount named by a bidder for any item are not in agreement, the unit price alone shall be considered as representing the bidder's intention, and the totals shall be corrected to conform thereto.

Bids shall not contain any recapitulation of the work to be done. Alternative bids will not be considered, except as called for. No oral, telegraphic, or telephonic bids or modifications will be considered.

Bids shall be accompanied by a "Bid Guarantee" in the form of cash, a cashier's check, a certified check, or bidder's bond executed by an admitted surety insurer, in an amount not less than 10% of the amount of bid, and made payable to or for the benefit of the Owner. Said cash, check, or bond shall be given as a guarantee that the bidder will enter into a contract and furnish the required bonds or substitutes and insurance certificates and endorsements if awarded the contract, and in case of refusal or failure to enter into said contract and furnish the required bonds or substitutes and insurance certificates and endorsements within 15 calendar days after notice of award by the Owner in writing, the cash or the check and the money represented by said check shall be forfeited to the Owner, or in the event that a bond is deposited, said security shall be forfeited. Forfeiture does not preclude the Owner from seeking all other remedies provided by law to recover losses sustained as a result of the Contractor's failure to enter into the contract or to furnish the required bonds or insurance certificates and endorsements.

Bids shall be sealed in an envelope marked and addressed as set forth in the Notice Inviting Sealed Bids. Bids shall be delivered to personnel of the Owner at the location designated in the Notice Inviting Sealed Bids on or before the day and hour set for the opening of bids.

2-4 WITHDRAWAL OF BID

A bidder may withdraw his bid by a signed written request any time prior to the day and hour for receiving bids designated in the Notice Inviting Sealed Bids. Thereafter the Bid may be withdrawn only as permitted in accordance with Public Contract Code Section 5100, et seq., regarding relief of Bidders.

The withdrawal of a bid does not prejudice the right of a bidder to file a new bid so long as the new bid is delivered as set forth in Article 2-3 BIDS prior to the closing time specified for all bids.

2-5 BIDDERS INTERESTED IN MORE THAN ONE BID

No person, partnership, or corporation shall be allowed to make or file, or be interested in more than one bid for the work, unless alternative bids are called for. A person, partnership, or corporation submitting a subbid to a bidder, or who has quoted prices on material to a bidder, is not thereby disqualified from submitting a subbid or quoting prices to other bidders.

2-6 INTERPRETATION OF PLANS AND OTHER CONTRACT DOCUMENTS

If any person or entity contemplating submitting a bid for the proposed contract is in doubt as to the true meaning of any part of the Plans, Specifications, or other Contract Documents, or finds discrepancies in, or omissions from the Plans and Specifications or other Contract Documents, he may submit to the Owner a written request for an interpretation or correction thereof. The person submitting the request will be responsible for its prompt delivery. An interpretation or correction of the Contract Documents will be made only by Addendum duly issued by the Owner and made available on the District website at www.olivenhain.com. The Owner and the Engineer/Architect will not be responsible for any other explanation or interpretation of the documents.

2-7 ADDENDA

Addenda issued before the time in which to submit bids expires shall be included in the bid and shall be made a part of the contract.

2-8 EXISTING CONDITIONS AND EXAMINATION OF CONTRACT DOCUMENTS

The bidder represents that he has carefully examined the Contract Documents and the site where the work is to be performed and that he has familiarized himself with all local conditions and federal, state and local laws, ordinances, rules, and regulations that may affect in any manner the performance of the work. The bidder further represents that he has studied all surveys and investigation reports about subsurface and latent physical conditions pertaining to the jobsite, that he has performed such additional surveys and investigations as he deems necessary to complete the work at his bid price, and that he has correlated the results of all such data with the requirements of the Contract Documents. The submittal of a bid shall be conclusive evidence that the bidder has investigated and is satisfied as to the conditions to be encountered, including locality, uncertainty of weather and all other contingencies, and as to the character, quality, quantities, and scope of the work.

The Plans and Specifications for the work show subsurface conditions or otherwise hidden conditions as they are supposed or believed by the Engineer/Architect to exist; but it is not

intended or to be inferred that the conditions as shown thereon constitute a representation that such conditions are actually existent. Except as otherwise specifically provided in the Contract Documents, the Owner, the Engineer/Architect, and their consultants shall not be liable for any loss sustained by the Contractor as a result of any variance of such conditions as shown on the Plans and the actual conditions revealed during the progress of the work or otherwise.

Where the Owner or the Engineer/Architect or their consultants have made investigations of subsurface conditions in areas where the work is to be performed, such investigations were made only for the purpose of study and design. The conditions indicated by such investigations apply only at the specific location of each boring or excavation at the time the borings or excavations were made. Where such investigations have been made, bidders or Contractors may inspect the records as to such investigations subject to and upon the conditions hereinafter set forth. The inspection of the records shall be made at the office of the Engineer/Architect.

The records of such investigations are not a part of the contract and are shown solely for the convenience of the bidder or Contractor. It is expressly understood and agreed that the Owner, the Engineer/Architect, and their consultants assume no responsibility whatsoever in respect to the sufficiency or accuracy of the investigations; the records thereof; or of the interpretations set forth therein or made by the Owner's consultants, the Engineer/Architect or his consultants in the use thereof by the Engineer/Architect, and there is no warranty or guarantee, either express or implied, that the conditions indicated by such investigations or records thereof are representative of those existing throughout such areas, or any part thereof, or that unlooked-for developments may not occur, or that materials other than, or in proportions, densities, or other characteristics different from, those indicated may not be encountered.

When a log of test borings showing a record of the data obtained by the investigation of subsurface conditions by the Owner, the Engineer/Architect, or their consultants is included with the Plans or other documents, it is expressly understood and agreed that said log of test borings does not constitute a part of the contract, represents only the opinion of the Owner or the Engineer/Architect or their consultants as to the character of the materials encountered by them in the test borings, is included in the Plans or other documents only for the convenience of bidders, and its use is subject to all of the conditions and limitations set forth in this article.

The availability or use of information described in this article is not to be construed in any way as a waiver of the provisions of the first paragraph in this article and a bidder or Contractor is cautioned to make such independent investigations and examination as he deems necessary to satisfy himself as to conditions to be encountered in the performance of the work.

No information derived from such inspection of records of investigations or compilation thereof made by the Owner, the Engineer/Architect, or their consultants will in any way relieve the bidder or Contractor from any risk or from properly fulfilling the terms of the contract nor entitle the Contractor to any additional compensation.

SECTION 3 AWARD AND EXECUTION OF CONTRACT

3-1 AWARD OF CONTRACT OR REJECTION OF BIDS

The award of the contract, if it be awarded, will be to the lowest responsible responsive bidder complying with the instructions contained in the Contract Documents. The Owner, however, reserves the right to select the schedules under which the bids are to be compared; to delete certain bid items from the Bid Schedule, to reject any and all bids, and to waive any irregularity in bids received. If, in the judgment of the Owner, a bid is unbalanced or if the bidder is not responsible, it shall be considered sufficient grounds for rejection of the entire bid.

The Owner shall have the period of time set forth in the Special Provisions after the opening of bids within which to accept or reject the bids. No bidder may withdraw his bid during said period. The Owner will return the bid guarantees, except any guarantees which have been forfeited, and except bidders' bonds, to the respective bidders whose bid they accompanied after the execution of the contract by the successful bidder or rejection of all bids or upon receipt of a written request therefor received after said period of time set forth in the Special Provisions.

Before award of the contract, any bidder shall furnish upon request proof of required insurance, a recent statement of his financial condition, and previous construction experience or such other evidence of his qualifications as may be requested by the Owner. If a bidder fails to furnish in a timely manner the information requested, it shall be considered sufficient grounds for rejection of such bidder's entire bid.

3-2 EXECUTION OF CONTRACT

The form of agreement, bonds, and other documents which the successful bidder, as Contractor, will be required to execute are included as a part of the Contract Documents.

The contract shall be signed by the successful bidder and returned to the Owner, together with the bonds or substitutes and insurance certificates and endorsements, within 15 calendar days or such additional time as may be allowed by the Owner from the date of the mailing of notice from the Owner to the bidder or from the date of personal delivery of notice from the Owner to the bidder that the agreement is ready for signature. The agreement, bonds or substitutes, insurance certificates and endorsements, and other documents to be executed by the Contractor shall be executed in original-quadruplicate, one each of which shall be filed with the Owner and one each with the Attorney for the Owner and the Engineer/Architect for the Owner.

3-3 BONDS

The successful bidder, simultaneously with execution of the Contract Documents, shall either furnish a Payment Bond and Performance Bond each in an amount equal to 100% of the contract amount, or equivalent cash or securities in lieu of these bonds in accordance with Code of Civil Procedure Section 995.710. The failure of Contractor to make a written request to Owner to use alternative securities meeting the requirements of Code of Civil Procedure Section 995.710 at the time the Contract Documents are signed shall be deemed a waiver of the right of Contractor to subsequently substitute these alternative securities. Alternative securities proposed by the Contractor shall be subject to review and approval by Owner. Contractor agrees to provide Owner with a deposit in a sum determined adequate by the Owner to cover all attorney's fees and all other fees, costs, and expenses incurred by the Owner in reviewing Contractor's request to use alternative securities in lieu of the required bonds and to prepare all agreements

determined necessary by Owner to adequately protect Owner's interest. Performance and Payment Bonds shall be furnished by surety companies meeting the requirements of Code of Civil Procedure Section 995.660(a) and shall be completed on the forms furnished as part of the Contract Documents. Surety companies, to be acceptable to Owner, must meet all requirements of Code of Civil Procedure Section 995.660(a).

If at any time a surety on any such bond fails to comply with Code of Civil Procedure Section 995.660(a), the Contractor shall, within 10 calendar days after notice from the Owner, substitute new bonds with surety companies meeting all requirements of Code of Civil Procedure Section 995.660(a). All premiums on these new bonds shall be paid solely by the Contractor. No further progress payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished new bonds to Owner meeting all requirements of Code of Civil Procedure Section 995.660(a).

The Performance Bond and the Payment Bond, or alternative securities meeting the requirements of Code of Civil Procedure Section 995.710 approved by the Owner, must remain in full effect throughout the period of the Work and for a period of two-year thereafter as required by Article 5-14 TWO-YEAR GUARANTEE.

3-4 INSURANCE REQUIREMENTS

The successful bidder will be required to furnish the Owner proof of full compliance with all insurance requirements as specified in SECTION 8 CONTRACTOR'S INSURANCE. The forms of Certificate of Insurance and Endorsement which the successful bidder, as Contractor, will be required to furnish are included as a part of the Contract Documents.

3-5 FAILURE TO EXECUTE CONTRACT

Failure by a bidder to whom the contract is awarded to execute the contract or to furnish the required bonds or insurance certificates and endorsements within the period of time required by Section 3-2 Execution of Contract shall be just cause for the annulment of the award and the forfeiture of the bid guarantee.

A bidder who is awarded the contract and fails to execute the contract or furnish the required bonds or substitutes, or insurance certificates and endorsements shall be liable to the Owner for all damages resulting therefrom including reasonable attorneys' fees. The bid guarantee forfeited shall not be a limitation thereon.

SECTION 4 SCOPE OF WORK

4-1 WORK TO BE DONE

The work to be done consists of furnishing all transportation, labor, materials, tools, equipment, services, permits, utilities and all other items which are necessary or appurtenant to construct and complete the entire project and construct the project designated in the Contract Documents, and to leave the grounds in a neat and presentable condition.

4-2 CHANGES IN THE WORK

The Owner may require changes in, additions to, or deductions from the work, including complete termination thereof. Adjustment, if any, in the amounts to be paid to the Contractor by reason of any such change, addition, or deduction shall be determined as set forth in SECTION 9 ESTIMATES AND PAYMENTS.

The Owner's Representative may order minor changes in the work not involving an increase or decrease in the contract amount, not involving a change in the time for completion, and not inconsistent with the purposes for which the work is being constructed. **If the Contractor believes that any order for minor changes in the work for which the contract amount or time for completion should be changed, he shall not proceed with the changes in the work so ordered and shall within seven calendar days of the receipt of such order notify the Owner's Representative in writing of his estimate of the changes in the contract amount and time for completion he believes to be appropriate.**

No payment for changes in the work will be made and no changes in the time for completion by reason of changes in the work will be made, unless the changes are covered by a written change order approved by the Owner in advance of the Contractor's proceeding with the changed work.

4-3 OBSTRUCTIONS

The Contractor shall remove and dispose of all structures, debris, or other obstructions of any character necessary to accommodate the work. Where such obstructions consist of improvements not required by law to be removed by the owner thereof, all such improvements shall be removed, maintained, and permanently replaced by the Contractor at his expense except as otherwise specifically provided in the Contract Documents.

4-4 UTILITIES

The Engineer/Architect has endeavored to determine the existence of utilities at the site of the work from the records of the owners of known utilities in the vicinity of the work. The positions of these utilities as derived from such records are shown on the Plans. The service connections to these utilities are not shown on the Plans.

The Contractor shall make his own investigations, including exploratory excavations, to determine the locations and type of existing service laterals or appurtenances when their presence can be inferred from the presence of other visible facilities, such as buildings, meter and junction boxes, on or adjacent to the site of the work. If the Contractor discovers utility facilities not identified in the Plans or Specifications or in a position different from that shown in the Plans and Specifications, he shall immediately notify in writing the Owner's Representative and the owner of the utility facility.

The Owner shall have the responsibility for the timely removal, relocation, protection, and temporary maintenance of existing main or trunkline utility facilities which are not indicated in the Plans and Specifications with reasonable accuracy.

In case it should be necessary to remove, relocate, protect, or temporarily maintain a utility because of interference with the work, the work on such utility shall be performed and paid for as follows:

When it is necessary to remove, relocate, protect, or temporarily maintain an existing main or trunkline utility facility not indicated in the Plans and Specifications with reasonable accuracy, the Owner will compensate the Contractor for the costs of locating, for the costs of repairing damage not due to the failure of the Contractor to exercise reasonable care, for the costs of removing, relocating, protecting, or temporarily maintaining such utility facilities, and for the costs for equipment on the site necessarily idled during such work. These costs, the work to be done by the Contractor in locating, removing, relocating, protecting, or temporarily maintaining such utility facilities shall be covered by a written change order conforming to the provisions of Article 4-2 CHANGES IN THE WORK and Article 9-1 PAYMENT FOR CHANGES IN THE WORK. The Owner may make changes in the alignment and grade of the work to obviate the necessity to remove, relocate, protect, or temporarily maintain such utility facilities or to reduce the costs of the work involved in removing, relocating, protecting, or temporarily maintaining such utility facilities. Changes in alignment and grade will be ordered in accordance with Article 4-2 CHANGES IN THE WORK.

When it is necessary to remove, relocate, protect, or temporarily maintain a utility (other than [1] existing main or trunkline utility facilities not indicated in the Plans and Specifications with reasonable accuracy, or [2] existing service laterals or appurtenances when their presence cannot be inferred from the presence of other visible facilities, such as buildings, meter and junction boxes, on or adjacent to the site of the work) the cost of which is not required to be borne by the owner thereof, the Contractor shall bear all expenses incidental to the work on the utility or damage thereto. The work on the utility shall be done in a manner satisfactory to the owner thereof; it being understood that the owner of the utility has the option of doing such work with his own forces, or permitting the work to be done by the Contractor. No representations are made that the obligations to remove, relocate, protect, or temporarily maintain any utility and to pay the cost thereof is or is not required to be borne by the owner of such utility, and it shall be the responsibility of the Contractor to investigate to find out whether or not said cost is required to be borne by the owner of the utility.

The right is reserved to governmental agencies and to owners of utilities to enter at any time upon any street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the work and for the purpose of maintaining and making repairs to their property.

4-5 PLANS AND SPECIFICATIONS FURNISHED BY THE OWNER

The Owner will provide to the Contractor PDF copies of Plans and Specifications necessary for the execution of the work. The Contractor shall keep one set of Plans and Specifications in good order with red line changes available to the Owner's Representative at the site of the work.

4-6 FINAL CLEANUP

Upon completion and before making application for acceptance of the work, the Contractor shall clean all rights-of-way, streets, borrow pits, and all other grounds occupied by him in connection

with the work of all rubbish, excess materials, temporary structures, and equipment, and all parts of the work and grounds occupied by him shall be left in a neat and presentable condition.

SECTION 5 QUALITY OF THE WORK

5-1 AUTHORITY OF THE OWNER'S REPRESENTATIVE

The Owner's Representative shall decide any and all questions which may arise as to the interpretation of the Plans and Specifications and shall have authority to disapprove or reject materials and equipment furnished and work performed which, in his opinion, is not in accordance with the Contract Documents. The Owner's Representative shall also have the authority to require the Contractor or any subcontractor to replace any workman or supervisor who, in his opinion, is not performing the work in a safe manner, fails to follow the instructions of the Owner's Representative, fails to perform work in accordance with the Contract Documents, fails to properly supervise the work, or demonstrates lack of competence to perform the particular work assigned to the workman or supervisor. The failure of the Contractor or any subcontractor to replace a worker or supervisor as directed by the Owner's Representative shall constitute a material breach of this agreement. Neither the Owner's Representative nor the Owner shall be liable to Contractor, any subcontractor, or any other person or entity for removing a workman or supervisor in accordance with the terms of this article.

5-2 SUPPLEMENTAL DRAWINGS

The Plans shall be supplemented by such drawings as are necessary to better define the work. All such drawings delivered to the Contractor by the Owner's Representative shall be deemed written instructions to the Contractor. If the Contractor believes that any supplemental drawings call for changes in the work for which the contract amount or time for completion should be changed, he shall not proceed with the changes in the work so called for and shall within seven calendar days of the receipt of the supplemental drawings notify the Owner's Representative in writing of his estimate of the changes in the contract amount and time for completion he believes to be appropriate.

No payment for changes in the work will be made and no change in the time for completion by reason of changes in the work will be made, unless the changes are covered by a written change order approved by the Owner in advance of the Contractor's proceeding with the changed work.

5-3 CONFORMITY WITH CONTRACT DOCUMENTS AND ALLOWABLE DEVIATIONS

The work shall conform to the lines, grades, dimensions, tolerances, and material and equipment requirements shown on the Plans or set forth in the Specifications. Although measurement, sampling, and testing may be considered evidence as to such conformity, the Owner's Representative shall be the sole judge as to whether the work or materials deviate from the Plans and Specifications, and his decision as to any allowable deviations therefrom shall be final.

If specific lines, grades, and dimensions are not shown on the Plans, those furnished by the Owner's Representative shall govern.

5-4 MANUFACTURER'S INSTRUCTIONS

All materials and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with the instructions of the applicable manufacturer, fabricator, supplier, or distributor, except as otherwise specifically provided in the Contract Documents.

5-5 COORDINATION OF PLANS AND SPECIFICATIONS

The Plans, Specifications, and other Contract Documents are essential parts of the contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for the complete work. In the event of an apparent difference between Plans and Specifications, reference shall be made to the Owner's Representative whose decision thereon shall be final.

Special Provisions shall govern over General Provisions and Standard Specifications.

5-6 INTERPRETATION OF PLANS AND SPECIFICATIONS

Figured dimensions on drawings shall govern, but work not dimensioned shall be as directed. Work not particularly shown or specified shall be the same as similar parts that are shown or specified. Large-scale details shall take precedence over smaller scale drawings as to shape and details of construction. Specifications shall govern as to materials and workmanship. Plans and Specifications are intended to be fully complementary and to agree. The Specifications calling for the higher quality material or workmanship shall prevail. Materials or work described in words which so applied have a well known technical or trade meaning shall be deemed to refer to such recognized standards. In the event of any discrepancy between any drawings and the figures thereon, the figures shall be taken as correct. In the event of any doubt or question arising respecting the true meaning of the Plans or Specifications, reference shall be made to the Owner's Representative whose decision thereon shall be final.

5-7 ERRORS OR DISCREPANCIES NOTED BY CONTRACTOR

It is the duty of the Contractor to promptly notify the Owner's Representative in writing of any design, materials, or specified method that the Contractor believes may prove defective or insufficient. If the Contractor believes that a defect or insufficiency exists in design, materials, or specified method and fails to promptly notify the Owner's Representative in writing of this belief, the Contractor waives any right to assert that defect or insufficiency in design, materials, or specified method at any later date in any legal or equitable proceeding against Owner, or in any subsequent mediation, arbitration, or settlement conference between the Owner and the Contractor. The Owner's Representative, on receipt of any such notice, will promptly investigate the circumstances and give appropriate instructions to the Contractor. Until such instructions are given, any work done by the Contractor after he comes to the belief that a defect or insufficiency exists in design, materials, or specified method which is directly or indirectly affected by such alleged defect or insufficiency in design, materials, or specified method will be at his own risk and he shall bear all cost arising therefrom.

If the Contractor, either before commencing work or in the course of the work, finds any discrepancy between the Plans and the Specifications or between either of them and the

physical conditions at the site of the work or finds any error or omission in any of the Plans or in any survey, he shall promptly notify the Owner's Representative of such discrepancy, error, or omission. If the Contractor observes that any Plans or Specifications are at variance with any applicable law, ordinance, regulation, order, or decree, he shall promptly notify the Owner's Representative in writing of such conflict. The Owner's Representative, on receipt of any such notice, will promptly investigate the circumstances and give appropriate instructions to the Contractor. Until such instructions are given, any work done by the Contractor after his discovery of such error, discrepancy, or conflict which is directly or indirectly affected by such error, discrepancy, or conflict will be at his own risk and he shall bear all cost arising therefrom.

5-8 SUPERVISION AND SUPERINTENDENCE

The Contractor shall supervise 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.

The Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction, but the Contractor shall not be solely responsible for the negligence of others in the design or selection of a specific means, method, technique, sequence, or procedure of construction which is indicated in and required by the Contract Documents except as otherwise provided in Article 5-7 ERRORS OR DISCREPANCIES NOTED BY CONTRACTOR.

The Contractor shall be responsible to see that the completed work complies with the Contract Documents.

The Contractor shall designate and keep on the work at all times during its progress a competent superintendent who shall not be replaced without written notice to the Owner's Representative. The superintendent will be the Contractor's representative at the site and shall have authority to act on behalf of the Contractor. All communications given to the superintendent shall be as binding as if given to the Contractor. During periods when the work is suspended, the Contractor shall make appropriate arrangements for any emergency work which may be required.

Whenever the superintendent is not present on any particular part of the work where the Owner's Representative may desire to inform the Contractor relative to interpretation of the Plans and Specifications or to the disapproval or rejection of materials or work performed, the Owner's Representative may so inform the foreman or other worker in charge of the particular part of the work in reference to which the information is given. Information so given shall be as binding as if given to the superintendent.

5-9 SHOP DRAWINGS

Shop drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data which are prepared by the Contractor or any subcontractor, manufacturer, supplier, or distributor and which illustrates some portion of the work.

The Contractor shall review, mark with his approval, and submit for review by the Owner's Representative shop drawings as called for in the Special Provisions and Standard

Specifications or requested by the Owner's Representative. Shop drawings shall be submitted by email as a PDF to the Owner's Representative and be accompanied by the Shop Drawing Submittal Form included at the end of the General Provisions. Shop drawings shall show the name of the project, the name of the Contractor, and, if any, the names of suppliers, manufacturers, and subcontractors. Shop drawings shall be submitted with promptness and in orderly sequence so as to cause no delay in prosecution of the work.

Shop drawings shall be complete in all respects. If the shop drawings show any deviations from the requirements of the Plans and Specifications because of standard shop practices or other reasons, the deviations and the reasons therefor shall be set forth in the Shop Drawing Submittal Form.

By submitting shop drawings, the Contractor represents that material, equipment, and other work shown thereon conforms to the Plans and Specifications, except for any deviations set forth in the Shop Drawing Submittal Form. A log shall be maintained by the Contractor showing the following information: sequential shop drawings number brief description, date submitted, date approved, any other data relevant to the shop drawings.

Within 30 calendar days after receipt of said shop drawings, the Owner's Representative will return via electronic mail (email), of the shop drawings to the Contractor with any comments noted thereon.

If so noted by the Owner's Representative, the Contractor shall correct the drawings and resubmit them in the same manner as specified for the original submittal. The Contractor in the Shop Drawing Submittal Form accompanying resubmitted shop drawings shall direct specific attention to revisions other than the corrections requested by the Owner's Representative on previous submittals.

The review by the Owner's Representative is only of general conformance with the design concept of the project and general compliance with the Plans and Specifications and shall not be construed as relieving the Contractor of the full responsibility for: providing materials, equipment, and work required by the contract; the proper fitting and construction of the work; the accuracy and completeness of the shop drawings; selecting fabrication processes and techniques of construction; and performing the work in a safe manner.

No portion of the work requiring a shop drawing submittal shall be commenced until the submittal has been reviewed by the Owner's Representative and returned to the Contractor with a notation indicating that resubmittal is not required.

If the Contractor believes that any shop drawing or communication relative thereto calls for changes in the work for which the contract amount or time for completion should be changed, he shall not proceed with the changes in the work so called for and shall within seven calendar days of the receipt of the shop drawings notify the Owner's Representative in writing of his estimates of the changes in the contract amount and time for completion he believes to be appropriate.

No payment for changes in the work will be made and no change in the time for completion by reason of changes in the work will be made, unless the changes are covered by a written change order approved by the Owner in advance of the Contractor's proceeding with the changed work.

5-10 QUALITY AND SAFETY OF MATERIALS AND EQUIPMENT

All equipment, materials, and supplies to be incorporated in the work shall be new, unless otherwise specified. All equipment, materials, and supplies shall be produced in a good and workmanlike manner. When the quality of a material, process, or article is not specifically set forth in the Plans and Specifications, the best available quality of the material, process, or article shall be provided.

Whenever any material, process, or article is indicated or specified by grade, patent or proprietary name, or by name of manufacturer, such Specification shall be deemed to be used for the purpose of facilitating description of the materials, process, or articles desired and shall be deemed to be followed by the words "or equal", and the Contractor may offer any material, process, or article which shall be substantially equal or better in every respect to that so indicated or specified; provided, however, that if the material, process, or article offered by the Contractor is not, in the opinion of the Owner's Representative, equal or better in every respect to that specified, then the Contractor must furnish the material, process, or article specified or one that in the opinion of the Owner's Representative is the substantial equal or better in every respect. In the event that the Contractor furnishes material, process, or article more expensive than that specified, the difference in cost of such material, process, or article so furnished shall be borne by the Contractor.

In accordance with Public Contract Code Section 3400, the Contractor shall submit data substantiating requests for substitution of "equal" items within 35 calendar days after award of the contract. This 35-day period of time is included in the number of days allowed for the completion of the work.

All materials, equipment, and supplies provided shall, without additional charge to Owner, fully conform with all applicable state and federal safety laws, rules, regulations, and orders, and it shall be Contractor's responsibility to provide only such materials, equipment, and supplies notwithstanding any omission in the Contract Documents therefor or that a particular material, equipment, or supply was specified.

All machinery and equipment provided by the Contractor for the work shall include locking mechanisms capable of locking any shut-down devices on the machinery and equipment before commencement of any repairs or other work. Any machinery or equipment provided by the Contractor, which does not have this locking ability, shall be altered at the expense of the Contractor to provide these locking mechanisms without compromising any safety features on the equipment or machinery prior to the commencement of any repairs or work on the equipment or machinery. The Contractor shall not commence any work or repairs on any machinery or equipment which has been shut down until the locking mechanism has been activated and the Contractor has tagged the applicable machinery or equipment with a tag stating "Danger Do Not Operate." This tag shall include the name of the employee who locked the equipment prior to the commencement of any work or repairs. The Contractor shall insure that all equipment and

machinery fully complies with Title 8 of California Administrative Code Sections 3202, 3314, 6003, 2320.4-2320.6, 2530.43, and 2530-86 at all times during performance of the work.

5-11 STANDARDS, CODES, SAMPLES, AND TESTS

Whenever reference is made to a standard, code, Specification, or test and the designation representing the date of adoption or latest revision thereof is omitted, it shall mean the latest revision of such standard, code, Specification, or test in effect on the day the Notice Inviting Sealed Bids is dated.

Tests shall be made in accordance with commonly recognized procedures of technical organizations and such special procedures as may be prescribed elsewhere in the Plans and Specifications. The Contractor shall furnish without charge such samples for testing as may be required by the Owner's Representative.

5-12 OBSERVATION OF WORK BY OWNER'S REPRESENTATIVE

The Owner's Representative shall at all times have access to the work during construction and shall be furnished with every reasonable facility for ascertaining full knowledge respecting the progress, workmanship, and character of materials and equipment used and employed in the work.

Whenever the Contractor varies the normal period during which work or any portion of it is carried on each day, he shall give timely notice to the Owner's Representative so that the Owner's Representative may, if he wishes, be present to observe the work in progress. If the Contractor fails to give such timely notice, any work done in the absence of the Owner's Representative will be subject to rejection.

The Contractor shall give timely notice to the Owner's Representative in advance of backfilling or otherwise covering any part of the work so that the Owner's Representative may, if he wishes, observe such part of the work before it is concealed.

The observation, if any, by the Owner's Representative of the work shall not relieve the Contractor of any of his obligations to fulfill the contract as prescribed. Defective work shall be made good, and materials and equipment furnished and work performed which is not in accordance with the Contract Documents may be rejected notwithstanding the fact that such materials, equipment, and work have been previously observed by the Owner's Representative or that payment therefor has been included in an estimate for payment.

5-13 REMOVAL OF DEFECTIVE AND UNAUTHORIZED WORK

Any work which does not conform the requirements of the Contract Documents or which is found unacceptable or deficient by the Owner or the Owner's Representative shall be remedied or removed and replaced by the Contractor at the Contractor's sole cost and expense, together with any other work which may be displaced in so doing, and no compensation will be allowed the Contractor for such removal, replacement, or remedial work. All materials found inadequate or deficient by the Owner or the Owner's Representative shall be immediately removed from the site.

Any work done beyond the lines and grades shown on the Plans or established by the Owner or any changes in, additions to, or deductions from the work done without written authority from the Owner will be considered as unauthorized and will not be paid for. Work so done will be ordered remedied, removed, or replaced by the Owner or the Owner's Representative at the Contractor's sole cost and expense.

Upon failure on the part of Contractor to comply promptly with any order of the Owner or Owner's Representative made under the provisions of this article the Owner or Owner's Representative shall have authority to cause all non-conforming materials, rejected work, or unauthorized work to be remedied, removed, or replaced at the Contractor's sole cost and expense and to deduct all fees and costs incurred by the Owner including staff time from any monies due or to become due the Contractor under this contract.

5-14 TWO-YEAR GUARANTEE

Besides guarantees required elsewhere, the Contractor shall and hereby does guarantee all work, materials, parts, equipment and supplies to be free from all defects due to faulty materials or workmanship for a period of two-years after the date of formal acceptance of the work by the Board of Directors of Owner except for any portion of the work that is utilized or placed into service by the Owner in accordance with the provisions of Article 6-6 USE OF COMPLETED PORTIONS. The guarantee period for portions of the work so utilized or placed into service shall be two-years commencing on the date of the written notification to the Contractor described in Article 6-6 USE OF COMPLETED PORTIONS. The Contractor shall repair or remove and replace any and all such work, together with any other work which may be displaced in so doing, that is found to be defective by Owner in workmanship and/or materials, equipment, parts or supplies within the two-year period, at the Contractor's sole cost and expense, ordinary wear and tear and unusual abuse or neglect excepted. In the event the Contractor fails to correct all defects identified by the Owner within seven (7) consecutive days after written notice of the defects from Owner, the Owner is hereby authorized to proceed to have the defects remedied and made good at the sole expense of the Contractor who hereby agrees to pay the cost and charges therefore immediately on demand. Such action by the Owner will not relieve the Contractor of the guarantees required by this article or elsewhere in the Contract Documents.

The Performance Bond and the Payment Bond shall continue in full force and effect for the guarantee period.

If, in the opinion of the Owner, defective work creates a dangerous condition or requires immediate correction or attention to prevent further loss to the Owner or to prevent interruption of operations of the Owner, the Owner may require the Contractor to correct the defects in a shorter period of time determined solely by Owner. If the Contractor does not correct the defects within the time specified by Owner, Owner may proceed to make such corrections or provide such attention; and all fees and costs of such correction or attention shall be charged against the Contractor. Such action by the Owner will not relieve the Contractor of the guarantees required by this article or elsewhere in the Contract Documents.

This article does not in any way limit the guarantee on any items for which a longer guaranty is specified or on any items for which a manufacturer or supplier gives a guarantee for a longer period. The Contractor agrees to act as a co-guarantor with such manufacturer or supplier and shall furnish the Owner all appropriate guarantee or warranty certificates upon completion of the project. No guarantee period whether provided for in this article or elsewhere in this contract shall in any way limit the liability of the Contractor or his subcontractors, materialmen, suppliers, sureties or insurers for the full statutory periods provided by California law.

SECTION 6 PROSECUTION AND PROGRESS

6-1 CONTRACTOR'S LIABILITY

The Contractor shall be solely liable and responsible to the Owner for all acts and omissions of the Contractor's directors, officers, agents, owners, and employees and for all acts and omissions of all subcontractors, materialmen and suppliers and their respective directors, officers, managers, members, agents, owners and employees performing any of the work or providing any materials or supplies included as part of the work. The Owner, the Engineer/Architect and the Owner's Representative shall not be liable in any way for any acts or omissions of the Contractor, any subcontractors, any materialmen, any suppliers, or any of their respective directors, officers, managers, members, agents, employees or owners. Nothing contained in the Contract Documents shall create any contractual relationship between any subcontractor materialman, or supplier and the Owner. The Contractor shall bind all subcontractors to all terms of the Contract Documents for all work being performed by those subcontractors.

The divisions and sections of the Specifications and the identifications of any Drawings shall not control the Contractor in dividing the work among subcontractors.

6-2 ASSIGNMENT

The performance of the contract may not be assigned, except upon the written consent of the Owner. Consent will not be given to any proposed assignment which would relieve the original Contractor or his sureties or insurers of their responsibilities under the contract, nor will the Owner consent to any assignment of a part of the work under the contract.

Upon obtaining a prior written consent of the Owner, the Contractor may assign moneys due or to become due him under the contract, to the extent permitted by law, but any assignment of moneys shall be subject to all proper setoffs in favor of the Owner and to all deductions provided for in the contract, and particularly all money withheld, whether assigned or not, shall be subject

to being used by the Owner for the completion of the work in the event that the Contractor should be in default therein.

No assignment of this contract will be approved unless it shall contain a provision that the funds to be paid to the assignee under the assignment are subject to a prior lien for services rendered or materials supplied for performance of the work called for under the contract in favor of all persons, firms, or corporations rendering such services or supplying such materials and that the Owner may withhold funds due until all work required by the Contract Documents is completed to the Owner's satisfaction.

In the event of bankruptcy of the Contractor, whether voluntary or involuntary, this Agreement may be automatically terminated at the election of the Owner. The election to terminate in accordance with this provision shall be deemed effective as of the date the Owner mails notice of termination in accordance with this section to the Contractor at the Contractor's last known address without any further action of any party. Upon termination in accordance with this provision, the Contractor shall be entitled to no further payments over and above the reasonable value of the actual Work completed as of the date the termination notice is mailed.

6-3 CONTRACTOR'S CONSTRUCTION SCHEDULE AND COST BREAKDOWN

Within fourteen (14) days after Notice to Proceed, the Contractor shall deliver to the Owner's Representative a construction progress schedule and cost breakdown in bar chart form showing the proposed dates of commencement and completion and cost of each of the various parts of the work and the anticipated amount of each monthly payment that will become due the Contractor in accordance therewith. The Owner shall be entitled to terminate this Contract if, in the Owner's opinion, the Contractor is failing to carry on the work diligently or in accordance with the approved construction schedule and breakdown. The Contractor has been advised and understands that time is of the essence with respect to completion of all phases of the work in accordance with the approved construction schedule.

6-4 TIME FOR COMPLETION AND FORFEITURE DUE TO DELAY

The Contractor shall complete all or any designated portion of the work called for under the contract within the time set forth in Supplement to the General Provisions Section 00810. Time is of the essence in this contract.

Failure of the Contractor to perform any covenant or condition contained in the Contract Documents within the time period specified shall constitute a material breach of this contract entitling the Owner to terminate the contract unless the Contractor applies for, and receives, an extension of time in accordance with the procedures set forth in this article and Article 6-5 EXTENSION OF TIME.

Failure of the Owner to insist upon the performance of any covenant or condition within the time period specified in the Contract Documents shall not constitute a waiver of the Contractor's duty to complete performance within the designated periods unless the waiver is in writing.

The Owner's agreement to waive a specific time provision or to extend the time for performance shall not constitute a waiver of any other time provisions contained in the Contract Documents.

Failure of the Contractor to complete performance promptly within the additional time authorized in the waiver or extension of time agreement shall constitute a material breach of this contract entitling the Owner to terminate.

In accordance with Government Code 53069.85, Contractor agrees to forfeit and pay Owner the amount per day set forth in the Special Provisions for each and every day of delay which shall be deducted from any payments due or to become due the Contractor.

The Contractor shall not be deemed in breach of this contract and no forfeiture due to delay shall be made because of any delays in the completion of the work due to unforeseeable causes beyond the control and without the fault or negligence of the Contractor provided the Contractor requests an extension of time in accordance with the procedures set forth in this article and Article 6-5 EXTENSION OF TIME. Unforeseeable causes of delay beyond the control of Contractor shall include acts of God, acts of a public enemy, acts of the government, acts of the Owner, or acts of another contractor in the performance of a contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and weather, or delays of subcontractors due to such causes, or delays caused by failure of the Owner or the owner of a utility to provide for removal or relocation of existing utility facilities. Delays caused by actions or neglect of Contractor or his agents, servants, employees, officers, subcontractors, directors, or of any party contracting to perform part or all of the work or to supply any equipment or materials shall not be excusable delays. Excusable delays (those beyond Contractor's control) shall not entitle the Contractor to any additional compensation. The sole remedy of the Contractor shall be to seek an extension of time.

6-5 EXTENSION OF TIME

The Contractor shall not be entitled to any increase in the contract price as a result of the Owner's approval of any extension of time except to the extent that the Owner approves an increase in the contract price on a properly executed Change Order.

The time specified for completion of all of the work or any part of the work may be extended only by a written change order executed by the Owner or other written form executed by the Owner.

Requests for an extension of time must be delivered to the Owner's Representative within ten consecutive calendar days following the date of the occurrence which caused the delay. The request must be submitted in writing and must state the cause of the delay, the date of the occurrence causing the delay, and the amount of additional time requested. Requests for extensions of time shall be supported by all evidence reasonably available or known to the Contractor which would support the extension of time requested. Requests for extensions of time failing to include the information specified in this article and requests for extensions of time which are not received within the time specified above shall result in the forfeiture of the Contractor's right to receive any extension of time requested.

If the Contractor is requesting an extension of time because of weather, he shall supply daily written reports to the Owner's Representative describing such weather and the work which could not be performed that day because of such weather or conditions resulting therefrom and which he otherwise would have performed.

The Owner's acceptance of the daily reports shall not be deemed an admission of the Contractor's right to receive an extension of time or a waiver of the Owner's right to strictly enforce the time provisions contained in the Contract Documents.

When the Contractor has submitted a request for an extension of time in accordance with the procedures of this article and Article 6-4 TIME FOR COMPLETION AND FORFEITURE DUE TO DELAY, the Owner will ascertain the facts and extent the delay and extend the time for completing the work if, in its judgment, the findings of fact justify such an extension, and its findings of facts thereon shall be final and conclusive. An extension of time may be granted by the Owner after the expiration of the time originally fixed in the contract or as previously extended, and the extension so granted shall be deemed to commence and be effective from the date of such expiration.

Any extension of time shall not release the sureties upon any bond required under the contract.

6-6 USE OF COMPLETED PORTIONS

When the work or any portion of it is sufficiently complete to be utilized or placed into service, the Owner shall have the right upon written notification to the Contractor to utilize such portions of the work and to place the operable portions into service and to operate same.

Upon said notice and commencement of utilization or operation by the Owner, the Contractor shall be relieved of the duty of maintaining the portions so utilized or placed into operation; provided, however, that nothing in this article shall be construed as relieving the Contractor of the full responsibility for completing the work in its entirety, for making good defective work and materials, for protecting the work from damage, and for being responsible for damage and for the work as set forth in the General Provisions and other Contract Documents nor shall such action by the Owner be deemed completion and acceptance, and such action shall not relieve the Contractor, his sureties, or insurers of the provisions of SECTION 8 CONTRACTOR'S INSURANCE, of Article 7-12 INDEMNITY, and of Article 5-14 TWO-YEAR GUARANTEE.

SECTION 7 LEGAL RELATIONS AND RESPONSIBILITIES

7-1 OBSERVING LAWS AND ORDINANCES

The Contractor shall keep himself fully informed of all existing and future laws, ordinances, and regulations which in any manner affect those engaged or employed to perform any of the work or providing any materials or supplies or which in any way affect the conduct of the work and of all statutes, laws, rules, regulations, orders, decisions, and decrees of any court or governmental agency having any jurisdiction or authority over all or any of the work or the conduct of the work, including all federal, state and local safety rules, regulations, and orders. This shall expressly include all ordinances, rules, regulations, and requirements applying to the work or the conduct of the work enacted by the Owner. If any discrepancy or inconsistency is discovered in the Plans, Specifications, or contract for the work the relation to any such law, rule, regulation, ordinance, order or decree, the Contractor shall forthwith report the same to the Owner's Representative in writing and cease operations on that part of the work until the Owner's Representative has given him appropriate instructions as provided for Article 5-7 ERRORS OR DISCREPANCIES NOTED BY CONTRACTOR.

The Contractor shall at all times observe and comply with and shall cause all of his directors, officers, agents, managers, members, owners, employees, subcontractors, materialmen and suppliers to observe and comply with all existing and future laws, ordinances, regulations, orders, and decrees, and shall hold harmless, indemnify, and defend the Owner, the Water Authority, the Engineer/Architect, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents from and against any and all liability, claims, causes of action, damages, losses, claim fees and costs, staff time, expenses, fees, and costs, including all costs of defense and attorneys' fees, arising from or based on the violation any such law, ordinance, regulation, order, or decree by the Contractor, any subcontractor, any materialman or supplier or any of their respective directors, officers, agents, managers, members, owners, or employees.

7-2 PERMITS AND LICENSES

The Contractor shall be solely liable and responsible for securing all permits and licenses necessary to perform all of the work, for paying all fees and charges necessary to secure any such permit, license, or approval, and for giving all notices which are appropriate or necessary to the proper and safe prosecution of the work. The Owner shall have no obligation to procure any permit, license, or approval necessary to perform all or any portion of the work. The Contractor shall also be solely liable and responsible for fully complying with all requirements of any permits, licenses or approvals pertaining to all or any of the work. The failure of Contractor to strictly comply with all requirements of any permits, licenses, or approvals applying to all or any of the work shall constitute a material breach of the contract.

7-3 INVENTIONS, PATENTS, AND COPYRIGHTS

The Contractor shall pay all royalties and assume all costs arising from the use of any invention, design, process, materials, equipment, product, or device which is the subject of patent rights or copyrights.

The Contractor shall hold harmless, indemnify, and defend the Owner, the Water Authority, the Engineer/Architect, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents from and against all claims, damages, losses, expenses, and other costs, including costs of defense and attorneys' fees, arising out of 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, materials, equipment, product or device, and shall defend all such claims in connection with any alleged infringement of such rights.

7-4 PUBLIC CONVENIENCE AND SAFETY

The Contractor shall conduct his operations at all times in a manner that creates the least possible obstruction and inconvenience to the public, and he shall have under construction no greater length or amount of work than he can prosecute properly with due regard to the rights of the public and all property owners in the area of the work. The Contractor shall be solely liable and responsible for ensuring that all of the work is conducted at all times in a safe manner that does not injure or damage any workers, members of the public or private or public property.

Convenient access to driveways, houses, and buildings along the line of work shall be maintained and temporary crossings shall be provided and maintained in good condition at all times during performance of the work. Not more than one crossing or intersecting street or road shall be closed at any one time.

The Contractor shall provide and maintain such fences, barriers, directional signs, lights, and flagmen as are necessary to give adequate warning to the public at all times of any conditions to be encountered as a result of the work and to give directions to the public. The Contractor shall ensure that all unsafe conditions created by the work are promptly remedied and that any unsafe conditions created by the work are protected by barriers, safeguards and warnings preventing vehicular, bicycle or walking access in any unsafe areas.

It shall also be the sole responsibility of the Contractor to ensure that the work is performed at all times in a manner that does not injure or harm any person or injure or damage any real or personal property of any person or entity.

The Contractor shall perform the work only the areas expressly identified in the Contract Documents. The Contractor must operate entirely within the limits of the project site. No equipment or materials may be parked, stockpiled, or stored outside the project site or designated Contractor staging areas. The Contractor shall not enter onto, occupy, or disturb any privately owned land or any public or private habitat not scheduled for removal in the approved plans with any men, tools, materials, dirt, or equipment except with the prior express written consent of the Owner and all owners of any privately-owned land. The Contractor has been advised, and understands, that any request to enter onto, occupy, or disturb any privately-owned land or habitat must be submitted to the general manager of the Owner for written approval prior to entering onto, occupying, or disturbing any privately-owned land or public or private habitat for any purpose. The violation of this section by Contractor shall constitute a material breach of this contract.

The Contractor and any subcontractors, materialmen, or suppliers shall not, at any time, conduct any of the work in any manner that creates any public or private nuisance or trespass on the land of any private party or public agency. It shall be the sole responsibility of Contractor to conduct the work at all times in a manner that avoids creating any nuisance or trespass on any real or personal property owned by any private party or public agency.

The Contractor hereby agrees to indemnify, defend, and hold harmless the Owner, Engineer/Architect, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents from and against any and all liability, claims, causes of action, actions, damages, losses, fees, costs, or expenses, of whatever type or nature, including all costs of defense, attorneys' fees, and claim fees or costs, arising out of or resulting from performance of any of the work by the Contractor, its subcontractors, materialmen, or suppliers, or their respective directors, officers, agents, managers, members, owners, or employees which results in any injury or damage to persons or property including wrongful death regardless of whether or not such claim, cause of action, damage, loss or expense is caused in whole or in part by the negligence, active or passive, of Owner, the Engineer/Architect, or the Owner's Representative excepting only those claims and causes of action caused by the sole active negligence or intentional misconduct of the Owner, the Engineer/Architect, or the Owner's

Representative. From and after the date of submission of any claim or demand to Owner, the indemnified parties shall recover from the Contractor all attorneys fees, expert fees and costs, claim costs, and staff time involved in handling the claim or any subsequent action on the claim at the standard hourly rates for staff handling the claim or action.

7-5 RESPONSIBILITY FOR LOSS, DAMAGE, OR INJURIES

The Contractor shall be solely responsible for all liability, claims, causes of action, demands, losses, costs, fees, expenses, and damages, of whatever type or nature, from any cause arising out of or resulting from or in connection with the performance of any of the work, excepting only those claims and causes of action caused solely and exclusively by the active negligence or intentional misconduct of the Owner, the Engineer/Architect, the Owner's Representative, or their consultants, directors, officers, employees, and agents. This exclusive responsibility shall extend to all liability, claims, causes of action, demands, losses, costs, fees, and expenses, of whatever type or nature, after completion of the work as well as during the progress of the work.

In the event any hazardous or toxic materials, including but not limited to asbestos, are utilized in construction or hazardous or toxic materials are otherwise encountered during construction, the Contractor shall take all appropriate precautions to protect persons and property and shall comply with all applicable regulations for the installation and handling of such hazardous or toxic materials. The Contractor is solely responsible for protection of all persons and property that could be affected by any construction or work and for the proper handling and disposal of all such hazardous or toxic materials.

Contractor has been advised that the Owner has Material Safety Sheets (hereinafter "MSS") available for review on any hazardous chemical they may be exposed to while working in or around Owner facilities. It shall be the sole responsibility of Contractor to request and inspect these MSS forms prior to commencement of any work and to alert all employees and agents of Contractor of potential hazardous waste exposure from Owner facilities. It shall be the sole responsibility of Contractor to provide the Owner's Representative with completed MSS forms for all hazardous or toxic substances that the Contractor utilizes as part of the work prior to the use of any hazardous or toxic substances and to provide these MSS forms to the Contractor's agents and employees prior to their exposure to any hazardous or toxic substance utilized by the Contractor. Further, Contractor shall comply with all provisions contained in General Industry Safety Orders Section 5194 of Title 8 of the California Administrative Code (the California Hazardous Communication Regulation) at all times during performance of the work.

7-6 CONTRACTOR'S RESPONSIBILITY FOR THE WORK

Until formal acceptance of the work by action of the Board of Directors of Owner, the Contractor shall be solely liable and responsible for all aspects of the work and all equipment materials and supplies to be provided as part of the work (including materials for which he has received partial payment or materials which have been furnished by the Owner) and shall bear the sole risk of injury, loss, or damage to any of the work, or any materials, supplies, or equipment being used or provided in conjunction with the work from any act of nature or the elements and from all other causes, whether arising from the execution or from the non-execution of the work.

The Contractor, at the Contractor's sole cost and expense, shall rebuild, repair, restore, and make good all injuries, losses, or damages whatsoever to any portion of the work or to any materials, equipment, or supplies from any cause before completion and formal acceptance of the work by formal action of the Board of Directors of Owner and shall solely bear the expense thereof. Where the Owner or the Owner's Representative determines it is necessary to protect the work or materials from any damage or injury, the Contractor shall at his sole expense provide suitable drainage and erect any additional structures and take all additional protective actions determined necessary or appropriate by either the Owner or the Owner's Representative to protect the work or materials from further damage or injury. The suspension of the work or the granting of an extension of time from any cause whatsoever shall not relieve the Contractor of his sole responsibility for the work, materials, or equipment as specified herein.

In an emergency affecting the safety of life or property, including any adjoining property, the Contractor, without special instructions or authorizations, shall promptly act to prevent such threatened loss or injury. The Contractor shall also promptly implement any and all directions given by the Owner or the Owner's Representative to protect the safety of life or property during any emergency as determined by Owner.

Notwithstanding the foregoing provisions of this section, the Contractor shall not be responsible for the cost of repairing or restoring damage to the work where the damage has been determined to have been caused solely by an Act of God in excess of 5% of the contract and amount provided that the work damaged is built in accordance with accepted and applicable building standards and in strict compliance with the Plans and Specifications. For the purpose of this paragraph, "Acts of God" shall include only earthquakes in excess of a magnitude of 3.5 on the Richter Scale and tidal waves. No other actions of the elements, nature, or man shall be treated as Acts of God under this paragraph.

7-7 PRESERVATION OF PROPERTY

The Contractor shall be solely liable and responsible for avoiding injury or damage or interfering with the construction or operation of any and all existing improvements or facilities, all utility facilities, all personal and real property whether owned by any public agency or private party, and any and all trees, shrubbery, landscaping and habitat that are not to be removed. The Contractor shall be solely liable and responsible for any and all damage and injury to any real or personal property of any person or entity both during and after performance of the work.

All trees, shrubbery, and landscaping that are not to be removed, and all lines, fences, signs, survey markers and monuments, buildings and structures, conduits, pipelines both under or above ground, all sewer and water pipelines or facilities, all highway or street facilities, and any and all other improvements, facilities, habitat, trees, or landscaping within or adjacent to the work not to be removed in the approved plans shall be protected by the Contractor from all injury or damage and the Contractor shall provide and install suitable safeguards to protect all such objects from any injury or damage. If any of the foregoing objects are injured or damaged either during or after performance of the work, they shall be promptly replaced or restored to a condition as good as when the Contractor commenced work or as good as required by the Plans and Specifications if any such objects or are part of the work being performed, at the Contractors sole cost and expense. The Owner, the Engineer/Architect and the Owners Representative and

their respective Directors, officers, agents and employees shall have no liability whatsoever for any injury or damage caused in whole or in part by the actions or omissions of the Contractor, any subcontractor, any materialmen or supplier, or any of their respective directors, officers, agents, employees, managers, or members except where the injury or damage is caused by the sole and exclusive active negligence or intentional misconduct of the Owner, the Engineer/Architect, the Owners Representative, or their consultants, directors, officers, employees, and agents. The Contractor shall also be solely liable and responsible for any and all damage or injury to any landscaping or habitat caused in whole or in part by the actions or omissions of the Contractor, any subcontractor, any materialmen or supplier, or their respective directors, officers, agents, employees, managers, owners, or members.

The fact that any pipeline or other underground facility is not shown on the Plans, shall not relieve the Contractor of his responsibility under this section.

In addition to any requirements imposed by law, the Contractor shall shore up, brace, underpin, and protect all foundations, structures, or improvements adjacent to or adjoining the site of the work which are in any way affected by the excavations or by any of the work. Whenever any notice is required to be given by the Owner or the Contractor at any adjacent or adjoining landowner or other party before commencement of any work, this notice shall be given by the Contractor.

7-8 REGIONAL NOTIFICATION CENTER CONTACT

The Contractor, except in an emergency, shall contact the appropriate regional notification center prior to commencing any excavation work. Notify the center at least two working days in advance or up to a maximum of 14 calendar days in advance of any excavation work. The Contractor shall delineate the proposed excavation site with white paint on paved surfaces or with markings such as flags or stakes in unpaved areas. The Contractor shall provide the regional notification center with all job site location information. The regional notification center will assign to the Contractor a Dig Alert Number which validates the Contractor's excavation permit and will notify all of its members having subsurface installations in the area. No excavation shall be commenced and carried out by the Contractor until all existing subsurface installations have been field marked and the Owner has been given the Dig Alert Number by the Contractor.

Emergency shall be defined as a sudden, unexpected occurrence, involving a clear and imminent danger, demanding immediate action to prevent or mitigate loss of, or damage to, life, health, property, or essential public services. Emergency includes such occurrences as fire, flood, earthquake, or other soil or geologic movements, as well as such occurrences as riot, accident, or sabotage (Government Code Section 4216).

Subsurface installation means any underground pipeline, conduit, duct, wire, or other structure operated or maintained in or across a public street or public right-of-way (Government Code Section 4216).

7-9 EXCAVATION PLANS FOR WORKER PROTECTION REQUIRED BY LABOR CODE SECTION 6705

If the total amount of the contract is in excess of \$25,000, the Contractor shall submit to the Owner for acceptance, in advance of excavation, a detailed Plans 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. The Plans shall be prepared by a registered civil or structural engineer. As a part of the Plans, a note shall be included stating that the registered civil or structural engineer certifies that the Plans complies with all CAL-OSHA Construction Safety Orders and regulations, or that the registered civil or structural engineer certifies that the Plans is not less effective than the shoring, bracing, sloping, or other provisions of the Safety Orders and regulations.

The Owner or the Engineer/Architect or their consultants may have made investigations of subsurface conditions in areas where the work is to be performed. If so, these investigations are identified in the Special Provisions and the records of such investigations are available for inspection at the office of the Engineer/Architect. The detailed Plans showing the design of shoring, etc., which the Contractor is required to submit to the Owner for acceptance in advance of excavation will not be accepted by the Owner if the Plans are based on subsurface conditions which are more favorable than those revealed by the investigations made by the Owner or the Engineer/Architect or their consultants; nor will the Plans be accepted if it is based on soils-related design criteria which is less restrictive than the criteria set forth in the report on the aforesaid investigations of subsurface conditions.

The detailed Plans showing the design of shoring, etc., shall include surcharge loads for nearby embankments and structures, for spoil banks, and for construction equipment and other construction loadings.

The Plans shall indicate for all trench conditions the minimum horizontal distances from the side of the trench at its top to the near side of the surcharge loads.

Nothing contained in this article shall be construed as relieving the Contractor of the full responsibility for providing shoring, bracing, sloping, or other provisions which are adequate for worker protection.

7-10 SAFETY

In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for conditions of the jobsite, including safety of all persons and property during performance of the work, and the Contractor shall fully comply with all state, federal and other laws, rules, regulations, and orders relating to safety of the public and workers.

The right of the Engineer/Architect or the Owner's Representative to conduct construction review or observation of the Contractor's performance will not include review or observation of the adequacy of the Contractor's safety measures in, on, or near the construction site.

7-11 PERSONAL LIABILITY

No director, officer, employee, or agent of the Owner, the Engineer/Architect, the Owner's Representative, or their consultants shall be personally responsible for any liability arising under or by virtue of the contract.

7-12 DEFENSE AND INDEMNITY

The Contractor hereby agrees to indemnify, defend, and hold harmless the Owner, the Engineer/Architect, and the Owner's Representative and their respective directors, officers, agents, employees and consultants from and against any and all liability, claims, demands, causes of action, actions, damages, losses, fees, costs, or expenses, of whatever type or nature, including all costs of defense and attorneys' fees, caused in whole or in part, or claimed to be caused in whole or in part, by any act or omission of the Contractor, any subcontractor, any supplier or materialman or any of their respective directors, officers, agents, employees, managers, members, or owners except only those claims and causes of action caused by the sole active negligence or intentional misconduct of the Owner, the Engineer/Architect or the Owner's Representative or their respective agents or employees. This indemnification shall extend to all claims, demands, causes of action, actions, or liability occurring after completion of the project as well as during the progress of the Work.

The Contractor further agrees to indemnify, defend, and hold harmless the Owner, the Engineer/Architect, and Owner's Representative and their respective directors, officers, agents, employees, and consultants from and against any and all liability, claims, causes of action, actions, losses, fees, costs, expenses, or damages, of whatever type or nature, including all costs of defense and attorneys' fees, as a result of the failure of or claimed failure of the Contractor to strictly comply with any of the Contractor's obligations under this contract. This indemnity shall expressly include claims by the Owner for any injury, damages, losses, costs, fees or expenses arising from or related to the failure of the Contractor or any of his subcontractors, materialmen, or suppliers to strictly comply with all terms of this contract or as a result of any improper workmanship or defective supplies or materials.

The Contractor's indemnity obligations as contained in this section shall remain in full force and effect and shall apply whether or not the claim, cause of action, damage, cost, fee, or expense is covered by any applicable insurance policy and regardless of any position that may be taken by any insurance company regarding a defense or coverage for any claim or cause of action asserted. From and after the date any claim or demand is submitted to Owner covered by these indemnity provisions, the indemnified parties shall be entitled to recover from Contractor all fees and costs incurred in investigating the claim, all staff time involved in handling the claim or any subsequent action on the claim at staff's ordinary hourly rates, all expert fees and costs, all attorneys' fees, and all court costs. The Contractor shall also be solely liable and responsible for paying any and all damages, fees or costs awarded to the claimant as a result of any settlement or final judgment of any cause of action or action covered by these indemnity provisions. This indemnity shall expressly include all wrongful death actions as well as any actions asserting any damage or injury to any persons or real or personal property.

From and after submission of any claim or demand to any of the indemnified parties, the indemnified party shall be entitled to appoint their own independent counsel to represent them and the Contractor shall pay all fees, costs, and expenses of whatever type or nature (including all staff time) incurred by each of the indemnified parties within thirty (30) consecutive days of receipt of a demand for reimbursement of these costs, fees, or expenses by each of the indemnified parties. A breach of this indemnity provision by Contractor shall constitute a material breach of the contract.

7-13 HOURS OF LABOR

The Contractor shall forfeit as a penalty to the Owner \$25 for each worker employed in the execution of the contract by the Contractor or any subcontractor under him for each calendar day during which such 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 the provisions of the Labor Code and, in particular, Section 1810 to Section 1815 thereof, inclusive, except that work performed by employees of Contractors in excess of 8 hours per day and 40 hours during any one week shall be permitted upon compensation for all hours worked in excess of 8 hours per day at not less than one and one-half times the basic rate of pay as provided in said Section 1815.

7-14 PREVAILING WAGE

The Contractor shall comply with Labor Code Section 1775. In accordance with said Section 1775, the Contractor shall forfeit as a penalty to the Owner \$50 for each calendar day or portion thereof for each worker paid less than the stipulated prevailing rates for such work or craft in which such worker is employed for any work done under the contract by him or her or by any subcontractor under him or her in violation of the provisions of the Labor Code and in particular, Labor Code Sections 1770 to 1780, inclusive. In addition to said penalty and pursuant to said Section 1775, the difference between such stipulated prevailing wage rates and the amount paid to each worker for each calendar day or portion thereof for which each worker was paid less than the stipulated prevailing wage rate shall be paid to each worker by the Contractor. Pursuant to Labor Code Section 1775, to the extent there is insufficient money due a contractor to cover all penalties forfeited and amounts due, the Division of Labor Standards Enforcement shall be notified of the violation and the Division of Labor Standards Enforcement shall be entitled to maintain an action in any court of competent jurisdiction to recover the penalties and the amounts due pursuant to Labor Code Section 1775.

Section 1776 of the Labor Code requires each contractor and its subcontractors to keep accurate payroll records showing the name, address, social security number, work classification, straight time, and overtime hours worked each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed by him or her in connection with the work required by these Contract Documents. These payroll records shall be made available for inspection or furnished to all employees, any representative of the Owner, the Division of Labor Standards Enforcement, and the Division of Apprenticeship Standards of the Department of Industrial Relations. Contractor shall provide a certified copy of these payroll records to any of the aforementioned parties within 10 calendar days after receipt of a written request for these records. Contractor understands that it is the responsibility of the Contractor to ensure that these payroll records are maintained by Contractor and all subcontractors performing the work in accordance with Labor Code Section 1776(h). The payroll records shall be on forms provided by the Division of Labor Standard Enforcement or provide the same information as the information required by this form.

Pursuant to Labor Code Section 1777.1, whenever any contractor or subcontractor performing a public works project is found by the Labor Commissioner or the Owner to be in violation of Labor Code Section 1770 et seq., except Section 1775, the contractor or subcontractor or any

firm, corporation, partnership, or association of which the contractor or any subcontractor has a substantial interest, shall be ineligible to bid on or to receive any public works contract for a period of not less than one-year or more than three years. The period of debarment shall run from the date the determination of the violation is made by the Labor Commissioner.

The Owner shall be entitled to withhold wages and penalties due as a result of any violation of the Labor Code from Payments due the Contractor in accordance with Labor Code Section 1726. These withheld amounts shall be paid to the Labor Commissioner for disbursement in accordance with Labor Code Section 1730. The Contractor's right to recover these wages and penalties shall be limited as provided in the Labor Code.

7-15 TRAVEL AND SUBSISTENCE PAYMENTS

Each worker needed to execute the work must be paid travel and subsistence payments as defined in the applicable collective bargaining agreements filed in accordance with Labor Code Section 1773.8.

7-16 APPRENTICES

Attention is directed to the provisions in Sections 1777.5, 1777.6, and 1777.7 of the Labor Code concerning the employment of apprentices by the Contractor or any subcontractor under him.

The Contractor and any subcontractor under him shall comply with the requirements of Sections 1777.5 and 1777.6 of the Labor Code in the employment of apprentices.

Information relative to apprenticeship standards, wage schedules, and other requirements may be obtained from the Director of Industrial Relations, ex officio the Administrator of Apprenticeship, San Francisco, California, or from the Division of Apprenticeship Standards and its branch offices.

Willful violations of Section 1777.5 will result in the Contractor, and the business entity under which the Contractor is doing business, being denied the right to bid on, or to receive, any public works contract for a period of up to one year for the first violation and for a period of up to three years for the second and subsequent violations commencing from the date the determination of noncompliance by the Administrator of Apprenticeship Council. In addition, if the Contractor violates Section 1777.5, he will forfeit as a civil penalty the sum of \$50 for each calendar day of non-compliance which shall be withheld from progress payments by Owner upon notice from the Department of Industrial Relations. (Labor Code Section 1777.7.)

7-17 WARRANTY OF TITLE

No materials, supplies, or equipment for the work under this contract shall be purchased subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest therein or any part thereof is retained by the seller or supplier. The Contractor warrants clear and good title to all materials, supplies, and equipment installed and incorporated in the work and agrees upon completion of all work to deliver the premises together with all improvements and appurtenances constructed or placed thereon by him to the Owner free from any claims, liens, encumbrances, or charges and further agrees that neither he nor any person,

firm, or corporation furnishing any material or labor for any work covered by the contract shall have any right to a lien upon the premises or any improvement or appurtenance thereon, provided that this shall not preclude the Contractor from installing metering devices or other equipment of utility companies or of municipalities, the title of which is commonly retained by the utility company or the municipality. Nothing contained in this article, however, shall defeat or impair the right of such persons furnishing materials or labor under any bond given by the Contractor for their protection or any right under any law permitting such persons to look to funds due the Contractor in the hands of the Owner. The provisions of this article shall be inserted in all subcontracts and material contracts, and notices of its provision shall be given to all persons furnishing materials for the work when no formal contract is entered into for such materials.

7-18 PROPERTY RIGHTS IN MATERIALS

Nothing in the contract shall be construed as vesting in the Contractor any right of property in the materials used after they have been attached or affixed to the work or the soil. All such materials shall become the property of the Owner upon being so attached or affixed. Soil, stone, gravel, and other materials found at the site of the work and which conform to the Plans and Specifications for incorporation into the work may be used in the work. No other use shall be made of such materials except as may be otherwise described in the Plans and Specifications.

7-19 MUTUAL RESPONSIBILITY OF CONTRACTORS

Nothing in the contract shall be interpreted as granting to the Contractor exclusive occupancy of the site of the project. The Contractor must ascertain to his own satisfaction the scope of the project and the nature of any other contracts that have been or may be awarded by the Owner in the construction of the project, to the end that the Contractor may perform this contract in the light of such other contracts, if any.

The Contractor shall not cause any unnecessary hindrance or delay to any other contractor working on the project. If the performance of any contract for the project is likely to be interfered with by the simultaneous performance of some other contract or contracts, the Owner's Representative shall decide which contractor shall cease work temporarily and which contractor shall continue or whether the work under the contracts can be coordinated so that the contractors

may proceed simultaneously. On all questions concerning conflicting interest of contractors performing related work, the decision of the Owner's Representative shall be binding upon all contractors concerned and the Owner, the Engineer/Architect, the Owner's Representative, and their consultants shall not be responsible for any damages suffered or extra costs incurred by the Contractor resulting directly or indirectly from the award or performance or attempted performance of any other contract or contracts on the project or caused by a decision or omission of the Owner's Representative respecting the order of precedence in the performance of the contracts.

If through acts of neglect on the part of the Contractor, any other contractor or any subcontractor shall suffer loss or damage on the work, the Contractor agrees to settle with such other contractor or subcontractor by agreement or arbitration, if such other contractor or subcontractor will so settle. If such other contractor or subcontractor shall assert any claim against the Owner,

the Engineer/Architect, the Owner's Representative, or their consultants or any of their directors, officers, employees, or agents on account of any damage alleged to have been so sustained, the Owner shall notify the Contractor who shall hold harmless, indemnify, and defend the Owner, the the Engineer/Architect, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents against any such claim, including all attorneys' fees and any other costs incurred by the indemnified parties relative to any such claim.

7-20 TERMINATION FOR BREACH

If the Contractor refuses or fails to prosecute the work or any separable part thereof with such diligence as will ensure its completion within the time specified herein, or any extension thereof, or fails to complete such work within such time, or if the Contractor should be adjudged a bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency, or if he files a petition to take advantage of any debtor's act, or if he or any of his subcontractors should violate any of the provisions of the contract, or if he should persistently or repeatedly refuse or should fail, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials to complete the work in the time specified, or if he should fail to make prompt payment to subcontractors or for material or labor, or if he should persistently disregard laws, ordinances, or instructions given by the Owner or Owner's Representative, the Owner may, without prejudice to any other right or remedy, serve written notice upon the Contractor and his surety of his intention to terminate the contract, said notice to contain the reasons for such intention to terminate the contract, and unless within ten days after the service of such notice such violations shall cease and satisfactory arrangements for the corrections thereof be made, the contract shall upon the expiration of said ten days cease and terminate. In such case, the Contractor shall not be entitled to receive any further payment until the work is finished.

In the event of any such termination, the Owner shall immediately serve written notice thereof upon the surety and the Contractor, and the surety shall have the right to take over and perform the contract; provided, however, that if the surety within 15 calendar days after the serving upon it of a notice of termination does not give the Owner written notice of its intention to take over and perform the contract or does not commence performance thereof within 30 calendar days from the date of serving said notice, the Owner may take over the work and prosecute the same to completion by contract or by any other method it may deem advisable for the account and at the expense of the Contractor, and his surety shall be liable to the Owner for any excess cost or other damage occasioned the Owner thereby, and in such event the Owner may, without liability for so

doing, take possession of and utilize in completing the work such materials, appliances, plants, and other property belonging to the Contractor that may be on the site of the work and be necessary therefor. For any portion of such work that the Owner elects to complete by furnishing its own employees, materials, tools, and equipment, the Owner shall be compensated for such in accordance with the schedule of compensation for force account work in Article 9-1 PAYMENT FOR CHANGES IN THE WORK.

If the unpaid balance of the contract price exceeds the direct and indirect costs of completing the work, including, but not limited to, all costs to Owner arising from professional services and

attorneys' fees and all costs generated to insure or bond the work of substituted contractors or subcontractors utilized to complete the work, such excess shall be paid to Contractor. If such costs exceed the unpaid balance, Contractor shall pay the difference to Owner promptly upon demand; on failure of Contractor to pay, the surety shall pay on demand by Owner. Any portion of such difference not paid by Contractor or surety within 30 calendar days following the mailing of a demand for such costs by Owner shall earn interest at the rate of 10% per annum or the maximum rate authorized by California law, whichever is lower.

The foregoing provisions are in addition to and not in limitation of any other rights or remedies available to the Owner.

7-21 NOTICE AND SERVICE THEREOF

Any notice required or given under the contract shall be in writing, be dated, and signed by the party giving such notice or his duly authorized representative, and be served as follows:

If to the Owner, by personal delivery or by deposit in the United States mail.

If to the Contractor, by personal delivery to the Contractor or to his authorized representative at the site of the project or by deposit in the United States mail.

If to the surety or any other person, by personal delivery to said surety or other person or by deposit in the United States mail.

All mailed notices shall be in sealed envelopes, shall be sent by certified mail with postage prepaid, and shall be addressed to the addresses in the Contract Documents or such substitute addresses which a party designates in writing and serves as set forth herein.

7-22 PARTIAL INVALIDITY

If any provision of this contract is held by a court of competent jurisdiction to be invalid, void, or unenforceable, the remaining provisions shall nevertheless continue in full force without being impaired or invalidated in any way.

7-23 ATTORNEYS' FEES

In the event any arbitration proceeding, administrative proceeding or litigation in law or in equity, including an action for declaratory relief, is brought to invalidate, enforce, or interpret any term or provision of this contract, the prevailing party shall recover all attorneys' fees, all expert fees and costs, and all costs of the proceeding which shall be determined by the Court or the presiding officer at the proceeding authorized to make a determination of the issues or in a separate action brought for that purpose, in addition to any other relief provided by California law.

If any party to this agreement becomes a party to any litigation, administrative proceeding or arbitration concerning the invalidation, enforcement or interpretation of the provisions of this agreement or the performance of this agreement by reason of any act or omission of another party or authorized representative of another party to this agreement and not by any act or omission of a party that becomes a party to that proceeding or any act or omission of its

authorized representatives, the party that causes another party to become involved in the proceeding shall be liable to that party for all expert fees and costs, all attorneys' fees, and all costs of the proceeding. The award of these expert fees and costs, attorneys' fees, and costs shall be determined as provided above.

From and after any date of submission of any demand or claim to Owner or any of the other indemnified parties covered by any indemnity provisions of this contract, the indemnified party shall be entitled to appoint their own independent counsel to represent them and the Contractor shall pay all fees and costs incurred by the indemnified parties to investigate and evaluate the claim or cause of action, for all staff time at the hourly rates of each staff member handling the claim or cause of action, all attorneys' fees, all expert fees and costs, and all court costs when and as these fees and costs are incurred by each of the indemnified parties. The Contractor agrees to pay all of these fees, costs, and expenses to each of the indemnified parties not later than thirty (30) days following a demand for reimbursement of these fees, costs, and expenses by each of the indemnified parties. Amounts not paid by the Contractor within this thirty (30) day period shall earn interest at the rate of one percent (1%) per month until paid by Contractor in full.

In the event opposing parties have each prevailed on one or more cause of action actually contested or admitted by pleadings or pre-hearing documents on file, the presiding officer may offset such fees and costs between prevailing parties after considering the necessity of the proceeding and the importance of the issue or issues upon which a party has prevailed. However, the court or presiding officer shall have no authority to relieve the Contractor of the Contractor's obligation to pay all damages, fees, costs, and expenses of each of the indemnified parties as provided in the indemnity provisions of this contract.

The term "prevail" as used in this section shall include any action at law, in equity, or pursuant to arbitration in which either party has been successful including, but not limited to, demurrers, motions to strike, judgments on the pleadings, summary judgments or summary adjudications of issues, any other motion of whatever type or nature, or any trial proceeding or motion.

7-24 LANDS AND RIGHTS-OF-WAY

The lands and rights-of-way for the facility to be constructed will be provided by the Owner. The Contractor shall make his own arrangements and pay all expenses for additional area required by him outside the limits of the Owner's lands and rights-of-way.

Work in public right-of-way shall be done in accordance with the requirements of the permit issued by the public agency in whose right-of-way the work is located in addition to conforming to the Plans and Specifications. If a permit is not required, the work shall conform to the standards of the public agency involved in addition to conforming to the Plans and Specifications.

7-25 NO WAIVER OF RIGHTS OR REMEDIES

No action or failure to act by the Owner, Engineer/Architect, or Owner's Representative shall constitute a waiver of any right or duty afforded any of them under the Contract Documents, nor shall any such action or failure to act constitute an approval of or acquiescence in a breach of this contract by Contractor. No oral waiver of any rights or remedies granted to the Owner,

Engineer/Architect, or Owner's Representative shall be effective for any purpose. To be effective, the waiver must be in writing and executed by an authorized representative of Owner, the Engineer/Architect, or the Owner's Representative. Contractor has been informed, and understands, that the Engineer/Architect and Owner's Representative have no authority whatsoever to waive any rights or remedies granted to the Owner by this contract or to alter any term or provision of the Contracts Documents or the approved Plans and Specifications. Any such purported waiver shall be void and unenforceable.

7-26 TAXES

The Contractor shall pay all sales, consumer, use, and other taxes.

NOTICE OF TAXABLE POSSESSORY INTEREST - The terms of this document may result in the creation of a possessory interest. If such a possessory interest is vested in a private party to this document, the private party may be subjected to the payment of personal property taxes levied on such interest.

7-27 ASSIGNMENT OF ANTI-TRUST ACTIONS

In entering into a public works contract or 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.

In submitting a bid to a public purchasing body, the bidder offers and agrees that if the bid is accepted, it will assign to the purchasing 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, materials, or services by the bidder for sale to the purchasing body pursuant to the bid. Such assignment shall be made and become effective at the time the purchasing body tenders final payment to the bidder.

Contractor shall insure that a comparable provision is included in all subcontracts at all tier levels which are executed pursuant to this Agreement.

7-28 PAYROLL RECORDS

It shall be the responsibility of the Contractor to maintain an accurate payroll record showing the name, address, social security number, work classification, straight time and overtime hours worked each day and week, and the actual per diem wages paid to each employee in accordance with Labor Code Section 1776, and to ensure that each subcontractor also complies with all provisions of Labor Code Section 1776 and this contract provision.

All payroll records shall be certified as accurate by the applicable contractor or subcontractor or its agent having authority over such matters.

The Contractor shall ensure that all payroll records are available for inspection at the Contractor's principal office during normal business hours and shall notify the Owner, in writing, of the place where all payroll records are located from time to time.

The Contractor shall furnish a copy of all payroll records, upon request, to employees or their authorized agents, to the Owner, to the Division of Labor Standards Enforcement, and to the Division of Apprenticeship Standards of the Department of Industrial Relations. The Contractor shall also furnish a copy of payroll records to the general public upon request provided the public request is made through the Owner, the Division of Apprenticeship Standards, or the Division of Labor Standards Enforcement of the Department of Industrial Relations. In no event shall members of the general public be given access to payroll records at the Contractor's principal office.

Records made available to the general public in accordance with the prior paragraph shall be marked or obliterated in such a manner that the name and address of the Contractor and/or subcontractor and the name, address, and telephone number of all employees does not appear on the modified record.

The Contractor shall file a certified copy of any requested payroll records with the entity that requested such records within ten days of the date a written request for payroll records has been received.

Failure of the Contractor to comply with any provisions of this article or Labor Code Section 1776 within ten days of the date of a written request for compliance is received shall result in a forfeiture of up to \$50 per calendar day or portion thereof, for each worker, until strict compliance is obtained. Upon notification by the Division of Apprenticeship Standards or the Division of Labor Standards Enforcement of the Department of Industrial Relations, the Owner shall withhold penalties under this article or Labor Code Section 1776 from the Contractor's payments then due.

7-29 MODIFICATION

This contract may not be altered in whole or in part except by modification in writing and properly executed by all parties hereto or by change as provided herein.

7-30 JURISDICTION AND VENUE

In the event any legal or equitable proceeding is commenced to invalidate, enforce, or interpret any of the terms or provisions of this contract, the parties expressly agree that jurisdiction and venue shall lie only in the Superior Court located in the North County Judicial District, County of San Diego, State of California. The Contractor acknowledges and agrees that this contract has been executed and requires performance solely within the jurisdiction and venue of the North County Judicial District and that the contract requires work solely within the jurisdiction and venue of the North County Judicial District.

7-31 HAZARDOUS WASTE

It shall be the responsibility of the Contractor to pay all fees and costs associated with removal and cleanup of any hazardous waste used at or brought to the job site by the Contractor, any subcontractor, or any agent, representative, or employee of the Contractor or any subcontractor.

The Contractor shall identify and remove all such hazardous waste in accordance with all federal, state, and local rules and regulations and shall promptly notify the Owner's Representative of any such hazardous waste. If hazardous waste is discovered during performance of the work which has not been brought to, or used at, the job site by the Contractor, any subcontractor, or any agent, representative, or employee of the Contractor or any subcontractor, the Contractor shall identify and remove this hazardous waste in accordance with all federal, state, and local rules and regulations and in accordance with directions of the Owner and the Contractor shall be entitled to request an increase in compensation due for these removal and cleanup costs in accordance with Article 9-1 PAYMENT FOR CHANGES IN THE WORK.

7-32 EXCAVATIONS BELOW FOUR (4) FEET

If any work required by this contract includes digging trenches or other excavations that extend deeper than four feet below the surface, the Contractor shall promptly, and before the following conditions are disturbed, notify the Owner in writing of any:

Material that the Contractor believes may be material that is hazardous waste, as defined in Section 25117 of the Health and Safety Code, that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with the provisions of existing law.

Subsurface or latent physical conditions at the site differing from those indicated.

Unknown physical conditions at the site of any unusual nature, different materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract.

Nothing in this article is intended to relieve the Contractor of his responsibility to carefully examine the Contract Documents and the site where the work is to be performed in accordance with Article 2-8 EXISTING CONDITIONS AND EXAMINATION OF CONTRACT DOCUMENTS; to familiarize himself with all local conditions and federal, state, and local laws, ordinances, rules, and regulations that may affect the performance of any work; to study all surveys and investigation reports about subsurface and latent physical conditions pertaining to the job site; to perform such additional surveys and investigations as the Contractor deems necessary to complete the work at his bid price; and to correlate the results of all such data with the requirements of the Contract Documents.

If the Owner determines that hazardous waste exists and that conditions exist which Contractor could not discover through the investigations required by the preceding paragraph, the Owner shall notify the Contractor and the Contractor may request a change order in accordance with Article 9-1 PAYMENT FOR CHANGES IN THE WORK. Nothing in this article shall relieve the Contractor of the obligation to pay all fees and costs associated with removal and cleanup of any hazardous waste used at, or brought to, the job site by the Contractor as specified in Article

7-31 HAZARDOUS WASTE. Nor shall this article relieve the Contractor of responsibility for site conditions discoverable by any investigation required by the preceding paragraph.

In the event that a dispute arises between the Owner and the Contractor involving hazardous waste and whether site conditions differ materially from those the Contractor could or should have discovered by the investigations required by this contract, the Contractor shall not be excused from the scheduled completion date provided in the Contract Documents and shall proceed with all work in the manner and in the time required by the Contract Documents.

7-33 ARBITRATION

All public works claims between the Contractor and Owner relating to this contract where the total claims of both parties are equal to or less than \$375,000 shall be submitted to mediation first and then to arbitration in accordance with Public Contract Code Section 20104, et seq. A copy of Public Contract Code Section 20104, et seq stating these arbitration requirements is attached following the General Provisions. When a total payment of the Contractor and the Owner exceed a total of \$375,000, this section shall not apply and neither the Owner nor the Contractor shall have any obligation to arbitrate the claim.

SECTION 8 CONTRACTOR'S INSURANCE

8-1 GENERAL

The Contractor shall not commence or continue to perform any work unless he, at his own expense, has in full force and effect all required insurance. The Contractor shall not permit any subcontractor to perform work on this project unless the Workers' Compensation Insurance requirements have been complied with by such subcontractor.

The types of insurance the Contractor shall obtain and maintain are Workers' Compensation Insurance and Employer's Liability Insurance, Liability Insurance, Builders' Risk "All Risk" Insurance, all as set forth herein.

Workers' Compensation Insurance and Employer's Liability Insurance and Liability Insurance shall be maintained in effect for the full guarantee period.

Insurers must be authorized to do business and have an agent for service of process in California, have an "A" policyholder's rating and a financial rating of at least Class VI in accordance with the most current rating by A.M. Best Company.

As evidence of specified insurance coverage, the Contractor shall provide certificates of insurance and endorsements on the forms provided as a part of the Contract Documents. No alteration or substitution of said forms will be allowed.

8-2 WORKERS' COMPENSATION INSURANCE AND EMPLOYER'S LIABILITY INSURANCE

Upon execution of the Agreement, the Contractor shall provide a Certificate(s) of Insurance certifying that he has obtained for the period of the contract full Workers' Compensation

Insurance coverage for no less than the statutory limits and Employer's Liability Insurance coverage in limits not less than the amounts set forth in the Special Provisions, for all persons whom he employs or may employ in carrying out the work under the contract. At the same time, the Contractor shall provide the Insurance Endorsement(s) on the forms provided as part of the Contract Documents. This insurance shall be in strict accordance with the requirements of the most current and applicable state Workers' Compensation Insurance laws.

8-3 LIABILITY INSURANCE

Upon execution of the Agreement, the Contractor shall provide a Certificate(s) of Insurance showing that he has Liability Insurance coverage in limits not less than the amounts set forth in the Special Provisions. At the same time, the Contractor shall provide the Insurance Endorsement(s) on the forms provided as part of the Contract Documents.

All liability insurance shall include occurrence coverage with a deductible amount not exceeding the amount specified on the liability certificate form.

Included in such insurance shall be a "Cross Liability" or "Severability of Interest" clause.

The Liability Insurance coverage shall include each of the following types of insurance:

A. General Liability

- (1) Comprehensive Form.
- (2) Premises-Operations.
- (3) Explosion and Collapse Hazard.
- (4) Underground Hazard.
- (5) Products/Completed Operations Hazard.
- (6) Contractual Insurance.
- (7) Broad Form Property Damage Including Completed Operations.
- (8) Independent Contractors.
- (9) Personal Injury.

B. Automobile Liability

- (1) Comprehensive Form Including Loading and Unloading.
- (2) Owned.
- (3) Hired.
- (4) Non-Owned.

The Liability Insurance shall include as additional insureds: the Owner, the Engineer/Architect, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents. The insurance afforded to these additional insureds shall be primary insurance. If the additional insureds have other insurance which might be applicable to any loss, the amount of the insurance provided under this article on LIABILITY INSURANCE shall not be reduced or prorated by the existence of such other insurance.

8-4 BUILDERS' RISK "ALL RISK" INSURANCE

Upon execution of the Agreement, the Contractor shall provide a Certificate(s) of Insurance showing that he has obtained for the period of the contract Builders' Risk "All Risk" completed value insurance coverage (including any damage attributable directly or indirectly to surface water, runoff, rainfall or flood but excluding earthquake and tidal wave) upon the entire project which is the subject of the contract and including completed work and work in progress. At the same time, the Contractor shall provide the Insurance Endorsement(s) on the forms provided as a part of the Contract Documents. Such insurance shall include as additional insureds: the Owner, the Engineer/Architect, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents.

Such insurance may have a deductible clause but not to exceed \$25,000.

8-5 CONTRACTOR'S LIABILITY NOT LIMITED BY INSURANCE

Nothing contained in these insurance requirements is to be construed as limiting the liability of the Contractor or the right of the Owner to secure damages in excess of any insurance which may be provided.

SECTION 9 ESTIMATES AND PAYMENTS

9-1 PAYMENT FOR CHANGES IN THE WORK

The Contractor shall not be entitled to any increase in the contract price due to any change in the work unless the Contractor submits a written request within seven calendar days from the date of the event which causes the Contractor to request a change in the price.

Changes in, additions to, or deductions from the work, including increases or decreases in the quantity of any item or portion of the work, shall be set forth in a written change order executed by the Owner and by the Contractor which shall specify:

The changes, additions, and deductions to be made.

The increase or decrease in compensation due the Contractor, if any.

Adjustment in the time of completion, if any.

Adjustment in the compensation due the Contractor shall be determined by one or more of the following methods in the order of precedence listed below:

Unit price contained in the contract.

Mutually agreeable lump sum or unit prices. If requested by the Owner's Representative, the Contractor shall furnish an itemized breakdown of the quantities and prices used in computing proposed lump sum and unit prices.

Force account whereby the Contractor is compensated for furnishing labor, materials, tools, and equipment as follows:

Cost of labor plus 15% for workers directly engaged in the performance of the work. Cost of labor shall include actual wages paid including employer payments to or on behalf of the workers for health and welfare, pension, vacation, and similar purposes plus payments imposed on payroll amounts by state and federal laws plus subsistence and travel allowance payments to workers.

Cost of material plus 15%. Cost of material shall include sales tax, freight, and delivery charges. The Owner reserves the right to furnish such materials as he deems advisable and the Contractor shall not be paid the 15% markup on such materials.

For tools and equipment actually engaged in the performance of the work, rental rates plus 15%. The rental rates shall be those prevailing in the area where the work is performed. No rental charge shall be made for the use of tools or equipment having a replacement value of \$500 or less.

Subcontractor invoices to the Contractor plus 5%. Subcontractor invoices shall be based on the above-described cost of labor plus 15%, cost of material plus 15%, and tool and equipment rental rates plus 15%.

No payment shall be made for any item not set forth above, including without limitation, Contractor's overhead, general administrative expense, supervision, or damages claimed for delay in prosecuting the remainder of the work.

For force account work, the Contractor shall submit to the Owner's Representative for his verification, daily work sheets showing an itemized breakdown of labor, materials, tools, and equipment used in performing the work. No payment will be made for work not verified by the Owner's Representative.

9-2 PROGRESS PAYMENTS

The Contractor shall, on or before the third day of each calendar month after actual construction work is started, prepare the Progress Estimate and Payment Form included at the end of the General Provisions. The Contractor and the Owner's Representative shall review each work item and agree on the total value of work performed during the previous month. In the event the Contractor and the Owner's Representative cannot agree on the estimated total value of work during the previous month, the estimated total value of work performed as determined by the Owner's Representative during the previous month shall be used. No progress payment will be processed by the Owner until all information required by the Progress Estimate and Payment

Form has been completed and the Contractor has signed the form. By signing the Progress Estimate and Payment Form, the Contractor expressly waives and releases any claims the Contractor may have, of whatever type or nature, for the period specified which is not shown as a retention amount or a disputed claim on the Release Form included at the end of the General Provisions. The Contractor shall submit to the Owner at CIP_AccountsPayable@olivenhain.com within seven days from signing the Progress Estimate and Payment Form a completed and signed Release Form that corresponds to the same pay estimate work period. The Owner shall have no obligation to pay the Contractor for any work done until the Release Form has been executed by the Contractor and submitted to the Owner for the corresponding pay period in accordance with Article 9-6 REQUIRED RELEASES.

Properly submitted Progress Estimate and Payment Form with corresponding Release Form shall be paid by the Owner within thirty days after receipt. Properly submitted forms not paid within this thirty-day period shall earn interest at the legal rate set forth in subdivision (a) of Section 685.010 of the Code of Civil Procedure. The Contractor and Owner agree that the thirty-day period for payment shall not commence until the Contractor has executed and submitted the Release Form to the Owner for the corresponding pay period.

In preparing any progress payment with the Contractor, the Owner's Representative will use the cost breakdown in by Article 6-3 CONTRACTOR'S CONSTRUCTION SCHEDULE AND COST BREAKDOWN. No allowance shall be made for materials delivered but not installed. In evaluating any progress payment, the Owner's Representative may take into consideration any facts and conditions deemed proper by him or her in his or her sole discretion including, but not limited to, the ratio of the difficulty or cost of the work done to the probable difficulty or cost of the work remaining to be done under the contract, the value of the work actually completed, and the estimated cost to complete all of the work in accordance with the contract price. In the event of any dispute between the Owner and the Contractor on the amount that should be paid for any progress payment, the determination of the Owner or the Owner's Representative shall control and be binding on the Contractor. No dispute between the Contractor and the Owner concerning the amount to be paid for any progress payment shall relieve the Contractor of its continuing obligation to complete all contract work within the time required by the Contract Documents, and to complete the work for the contract price and shall not relieve the Contractor of any other obligations contained in the Contract Documents. Owner shall retain five percent (5%) of each progress payment approved by the Owner's Representative as part security for the fulfillment of the contract by Contractor, unless Contractor has substituted adequate equivalent securities as required by Article 9-5 WITHHELD CONTRACT FUNDS. The total amount retained will equal 5% of the contract price. In the event of a dispute between the Owner and Contractor, the Owner shall have the right to withhold an amount up to 150% of the disputed amount in accordance with Public Contract Code Section 7107(c). As part of any progress payment the Owner shall have the express right to deduct and withhold from any payments due the Contractor any amounts the Owner or the Owner's Representative determines are necessary or appropriate to cover all fees, costs, expenses, and damages incurred or estimated by the Owner as a result of any breach of this contract by the Contractor and to cover any and all damages suffered or estimated by the Owner as a result of the breach of any term or provision of the contract by the Contractor. Amounts the Owner may withhold also expressly include any and all liquidated damages authorized by the terms of this contract.

9-3 FINAL ESTIMATE AND PAYMENT

Contractor shall not make any request for the final payment until all work required by the Plans and Specifications of the Contract Documents has been completed to the satisfaction of the Owner's Representative. Upon receipt of a request from Contractor for final payment, the Owner's Representative will make a final inspection of the work done and advise the Contractor of additional work required before final payment will be processed. All prior progress estimates and payments shall be subject to correction in the final estimate and payment.

The final payment shall not be due and payable until 60 calendar days after the date of filing a Notice of Completion of the accepted work. The date of completion shall be determined in accordance with Public Contract Code Section 7107. In the event of a dispute between the Owner and the Contractor, Owner shall be entitled to withhold an amount up to 150% of the disputed amount.

It is mutually agreed between the parties to the contract that no certificate given or payment made under this contract shall constitute evidence of performance of the contract and no payment by Owner shall be construed as an acceptance of any defective work or improper materials.

Contractor shall not be entitled to payment of the final amount due until Contractor has executed a Release Form in accordance with Article 9-6 REQUIRED RELEASES. Contractor hereby expressly agrees that payment of the final amount due under the contract shall release the Owner, the Engineer/Architect, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents, from any and all claims relating to the work for which Contractor is being paid. It is the declared intention of the parties that this provision comply with Public Contract Code Section 7100 and that this section shall be construed as in compliance with Public Contract Code Section 7100 to the maximum feasible extent.

9-4 OWNER'S RIGHT TO WITHHOLD CERTAIN AMOUNTS AND MAKE APPLICATION THEREOF

In addition to the amounts which the Owner may retain under Sections 9-2 and 9-3 of this contract, the Owner may withhold a sufficient amount or amounts from any payment otherwise due to the Contractor (including any final payment) as may be necessary or appropriate in Owner's sole and exclusive judgment to cover each of the following:

Payments which are or may be past due and payable for properly filed claims against the Contractor or any subcontractors for any labor, materials, or equipment furnished in or about the performance of the work on the project under this contract including any amounts asserted as attorneys' fees, costs, or interest by the claimant.

All fees, costs, and expenses estimated by the Owner for correcting any work determined to be defective by the Owner.

Any amounts determined appropriate or necessary by the Owner to cover the Owner's estimate of any damages paid or payable as a result of any claim or cause of action on the contract caused, or claimed to be caused by any action or omission of Contractor,

any subcontractor, supplier or materialmen or their respective directors, officers, agents, employees, members, managers or consultants and all fees, costs, and expenses, including all attorneys' fees, expert fees and costs, staff time at each staff members' normal hourly rates and all court costs estimated by the Owner in responding to the claim or cause of action.

Any amounts determined necessary or appropriate by Owner to cover all of the indemnity obligations of Contractor under this contract.

Any amounts claimed by the Owner as forfeiture due to delay and any and all other amounts, fees, costs, or expenses estimated by the Owner as offsets.

The Owner has the express authority to withhold any amount or amounts determined appropriate by Owner from time to time from any payments otherwise due Contractor to cover all or any of the preceding items in the Owner's sole and exclusive judgment. The Owner may also apply all or any portion of any such withheld amount or amounts to the payment of any claims in such amounts and at such times as are determined appropriate by Owner, in Owner's discretion. In withholding any sums permitted by this section or in paying any claims, the Owner shall be deemed the agent of the Contractor and any payments made by the Owner on any claim shall be considered as a payment made under the contract by the Owner to the Contractor. The Owner shall not be liable to the Contractor for Owner's withholding of any and all amounts permitted by this section or Owner's payment of any claims as permitted by this section. Such withholdings and payments may be made by Owner at any time without prior judicial determination of the merits of any claims or causes of action. The Owner will render to the Contractor a proper account of any funds withheld or disbursed as permitted by this section.

9-5 WITHHELD CONTRACT FUNDS

Pursuant to Public Contract Code Section 22300, the Contractor may substitute equivalent securities for retention amounts which this Contract requires. However, the Owner reserves the right to solely determine the adequacy of the securities being proposed by the Contractor and the value of those securities. The Owner shall also be entitled to charge an administrative fee, as determined by Owner in its sole discretion, for substituting equivalent securities for retention amounts.

The Contractor agrees that the Owner's decision with respect to the administration of the provisions of Section 22300 shall be final and binding and not subject to subsequent litigation or arbitration of any kind as to acceptance of any securities being proposed, the value of these securities, the costs of administration and the determination of whether or not the administration should be accomplished by an independent agency or by the Owner. The Owner shall be entitled, at any time, to request the deposit of additional securities of a value designated by the Owner, in Owner's sole discretion, to satisfy this requirement. If the Owner does not receive satisfactory securities within 12 calendar days of the date of the written request, Owner shall be entitled to withhold amounts due Contractor until securities of satisfactory value to Owner have been received.

9-6 REQUIRED RELEASES

In accordance with Public Contract Code Section 7100, the Contractor shall not be entitled to any payment specified in this Contract which is undisputed until such time as the Contractor has executed the Release Form(s) included at the end of the General Provisions releasing the Owner from all claims relating to work for which the Contractor is being paid. The Release Form contains space for the Contractor to claim any disputed amount and to designate the retention amount for each pay period associated with the release. Contractor hereby expressly agrees that failure on his part to designate any disputed amount or to designate the correct retention amount for each release period on the Release Form shall constitute an express waiver of the right of the Contractor to claim any disputed amount or any retention amount at any later date. The Owner shall have no obligation to pay the Contractor for any work done until the Release Form at the end of the General Provisions has been executed by the Contractor and submitted to the Owner.

9-7 AB 626

State of California Assembly Bill 626 (AB 626) establishes, for contracts entered into on or after January 1, 2017, a claims resolution process that must be applied to any and all claims by contractors in connection with a public works project. AB 626 also creates a process whereby a subcontractor, who may lack legal standing to assert a claim against a public entity, may make a claim through the contractor.

A claim is defined as a separate demand by the contractor for one or more of the following: (i) a time extension for relief from damages or penalties for delay, (ii) payment of money or damages arising from work done pursuant to the contract for a public work, or (iii) payment of an amount disputed by the public entity, as specified.

AB 626 requires a public entity, upon receipt of a claim sent by registered or certified mail, to conduct a reasonable review, within 45 days, provide a written statement identifying the disputed and undisputed portions of the claim. The 45-day period may be extended by mutual agreement or, until after the next meeting of the governing body of the public entity, if the governing body must approve the disputed and undisputed portions of the claim. The Bill also requires any payment due on the undisputed portion of the claim to be processed within 60 days.

If the claimant disputes the public entity's written response or if the public entity fails to respond to a claim within the time prescribed, the claimant must demand, in writing, a meet and confer for settlement of the issues in dispute. The public entity must then schedule a meet and confer conference within 30 days for settlement of the dispute. AB 626 requires any disputed portion of the claim that remains in dispute after the meet and confer conference to be subject to nonbinding mediation, as specified. The public entity can also require arbitration of disputes under private arbitration or the Public Works Contract Arbitration Program, if the mediation does not resolve the dispute.

If the public entity fails to respond to a claim from a contractor within the time periods prescribed in AB 626, the claim is deemed rejected in its entirety and alternate dispute resolution processes may be pursued. AB 626 provides that unpaid claim amounts which are not paid in a timely manner shall accrue interest at 7% per annum.

SECTION 10 AUTHORITY AND STATUS OF OWNERS REPRESENTATIVES

10-1 STATUS OF OWNERS REPRESENTATIVES

The Contractor has been informed, and understands, that the Engineer/Architect and the Owner's Representative are not agents or employees of Owner. They are independent contractors retained by Owner to assist in preparation of the design plans for the work and in supervising the work to be performed by the Contractor. Owner does not direct the Engineer/Architect or the Owner's Representative in the performance of their respective duties and obligations. Owner shall not be liable for any errors or omissions of the Engineer/Architect, the Owners Representative or their respective directors, officers, agents or employees.

10-2 AUTHORITY OF OWNER'S REPRESENTATIVES

Contractor has been informed, and understands, that the Engineer/Architect and the Owner's Representative have no authority to alter any of the terms or provisions of the Contract Documents

or to alter any of the requirements contained in the plans and specifications approved by Owner. In the event that Contractor desires to modify any term or provision of the Contract Documents or to modify any of the requirements of the approved plans and specifications, a written request must be submitted with the requested changes to the Owner through the Owner's Representative. Only the general manager of Owner has the authority to alter or modify any of the terms or provisions of the Contract Documents. No modification or change to the Contract Documents shall be effective for any purpose unless the change or modification has been expressly approved, in writing, by the general manager of Owner. Any requested changes by the Contractor to the approved plans and specifications must be submitted to the Owner's Engineer for review and approval through the Owner's Representative. No changes to the approved plans or specifications shall be effective for any purpose unless the Owner's Engineer has expressly approved of the change, in writing. The Contractor is expressly prohibited from entering onto private property, disturbing any habitat, or using private property to stockpile, store, or spread any men, tools, equipment, materials, or dirt without the express prior written consent of the general manager of Owner. The violation of this section by Contractor or any of its subcontractors, materialmen, or suppliers or their respective directors, officers, managers, members, agents, consultants or employees shall constitute a material breach of this Agreement.

SECTION 11 FORMS

11-1 SHOP DRAWING SUBMITTAL FORM

The Contractor shall complete the Shop Drawing Submittal Form included at the end of the General Provisions when submitting Shop Drawings as called for in the Special Provisions and Standard Specifications or requested by the Owner's Representative. Duplication of this form is permissible to comply with the requirements of the Contract Documents. No substitution or revision to this form will be accepted and approved by the Owner.

11-2 PROGRESS ESTIMATE AND PAYMENT FORM

OLIVENHAIN MWD

David C. McCollom Water Treatment Plant Stage 4 Upgrades

GENERAL PROVISIONS

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The Contractor will use the Progress Estimate and Payment Form included at the end of the General Provisions when preparing the monthly progress payment for review. No progress payment will be processed to pay the Contractor until the progress estimate and payment form and the release form included at the end of these general provisions have been fully completed and submitted by the Contractor to the Owner's Representative and approved by the Owner.

11-3 RELEASE FORM(S)

The Contractor shall complete the Conditional and/or Final Release Forms (as appropriate) included at the end of the General Provisions and submit to the Owner for the corresponding pay period in accordance with Article 9-6, REQUIRED RELEASES. Duplication of this form is permissible to comply with the requirements of the Contract Documents. No substitution or revision to this form will be accepted. No payment request to the Contractor will be processed until the Release Form has been fully completed and submitted by the Contractor.

END OF SECTION

SHOP DRAWING SUBMITTAL FORM

TO: OWNER'S REPRESENTATIVE
c/o Olivenhain Municipal Water District
1966 Olivenhain Road
Encinitas, CA 92024

From: (Contractor)
(Address)

Contractor Job Number _____

Owner: **OLIVENHAIN MUNICIPAL WATER DISTRICT**

OMWD PN: _____

Project: **David C. McCollom Water Treatment Plant Stage 4 Upgrades**

OWNER'S REP ACCT NO. _____

SUBMITTAL NO.: _____

RESUBMITTAL: ☐ Yes ☐ No

SPECIFICATION SECTION: _____

DESCRIPTION: _____

This Shop Drawing Submittal has been prepared by the Contractor or any subcontractor, manufacturer, supplier, or distributor and illustrates some portion of the work. The Contractor warrants one of the following conditions:

☐ The Contractor has approved this submittal and represents that the material, equipment, and other work shown conforms to the Plans and Specifications.

☐ The Contractor has approved this submittal but represents that this is a deviation from the requirements of the Plans and Specifications and has set forth the reasons for the deviation below.

DEVIATION/REVISIONS:

By: _____

Title: _____

(BLANK)

OLIVENHAIN MWD

David C. McCollom Water Treatment Plant Stage 4 Upgrades

GENERAL PROVISIONS

1 OF 1

BLANK

PROGRESS ESTIMATE AND PAYMENT FORM

Owner: **OLIVENHAIN MUNICIPAL WATER DISTRICT** OMWD _____

Project: **David C. McCollom Water Treatment Plant Stage 4 Upgrades** Contract End Date _____

Contractor: _____ Revised Contract End Date _____

PAY ESTIMATE NO. _____

PERIOD WORK PERFORMED: _____ Contract Job No. _____

Date Created _____

Work Item	Description of Work Item	Total Cost of Work Item	Percent Complete	Value of Work

Total Project Cost of Work Items			
Estimated Total Value of Work Performed			
Less Five Percent (5%) of Such Estimated Total Value			
Total Amount Due for Work Performed			
Less All Previous Payments			
AMOUNT DUE AND PAYABLE TO THE CONTRACTOR			

Prepared by Owner's Representative _____ ☐ CM reviewed as-builts and schedule update

Accepted by CONTRACTOR _____ Approved by OWNER _____

By: _____ By: _____

Date: _____ Date: _____

Distribution: ☐ Owner ☐ Contractor ☐ Engineer ☐ Finance

(BLANK)

**CONDITIONAL WAIVER AND RELEASE ON
PROGRESS PAYMENT**
(CA CIVIL CODE §8132) (1)

NOTICE: THIS DOCUMENT WAIVES THE CLAIMANT'S LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS EFFECTIVE ON RECEIPT OF PAYMENT. A PERSON SHOULD NOT RELY ON THIS DOCUMENT UNLESS SATISFIED THAT THE CLAIMANT HAS RECEIVED PAYMENT.

Identifying Information:

Name of Claimant: _____

Name of Customer: **Olivenhain Municipal Water District**

Job Location: **David C. McCollom Water Treatment Plant Stage 4 Upgrades**

Owner: **Olivenhain Municipal Water District**

Through Date: _____

Conditional Waiver and Release

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for labor and service provided, and equipment and material delivered, to the customer on this job through the Through Date of this document. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. This document is effective only on the claimant's receipt of payment from the financial institution on which the following check is drawn:

Maker of Check: **Olivenhain Municipal Water District**

Amount of Check: _____

Check Payable to: _____

This document does not affect any of the following:

- (1) Retentions.
- (2) Extras for which the claimant has not received payment.
- (3) The following progress payments for which the claimant has previously given a conditional waiver and release but has not received payment:
Date(s) of waiver and release: _____
Amount(s) of unpaid progress payment(s): \$ _____
- (4) Contract rights, including:
(A) a right based on rescission, abandonment, or breach of contract, and
(B) the right to recover compensation for work not compensated by the payment.

SIGNATURE

Claimant's Signature: _____

Claimant's Title: _____

Date of Signature: _____

BLANK

**CONDITIONAL WAIVER AND RELEASE ON
FINAL PAYMENT**
(CA CIVIL CODE §8136) (3)

NOTICE: THIS DOCUMENT WAIVES THE CLAIMANT'S LIEN, STOP PAYMENT NOTICE, AND PAYMENT BOND RIGHTS EFFECTIVE ON RECEIPT OF PAYMENT. A PERSON SHOULD NOT RELY ON THIS DOCUMENT UNLESS SATISFIED THAT THE CLAIMANT HAS RECEIVED PAYMENT.

Identifying Information:

Name of Claimant: _____

Name of Customer: **Olivenhain Municipal Water District**

Job Location: **David C. McCollom Water Treatment Plant Stage 4 Upgrades**

Owner: _____

Conditional Waiver and Release

This document waives and releases lien, stop payment notice, and payment bond rights the claimant has for labor and service provided, and equipment and material delivered, to the customer on this job. Rights based upon labor or service provided, or equipment or material delivered, pursuant to a written change order that has been fully executed by the parties prior to the date that this document is signed by the claimant, are waived and released by this document, unless listed as an Exception below. This document is effective only on the claimant's receipt of payment from the financial institution on which the following check is drawn:

Maker of Check: **Olivenhain Municipal Water District**

Amount of Check: _____

Check Payable To: _____

Exceptions

This document does not affect any of the following:

Disputed claims for extras in the amount of: \$ _____

SIGNATURE

Claimant's Signature: _____

Claimant's Title: _____

Date of Signature: _____

(BLANK)

PROPOSED CHANGE ORDER

Owner: **OLIVENHAIN MUNICIPAL WATER DISTRICT**

Project: **David C. McCollom Water Treatment Plant
Stage 4 Upgrades**

Contractor: _____

PROPOSED CHANGE ORDER NO. _____

Date: _____

*A change to the contract documents for the above referenced project is being considered. Please provide cost and schedule impact(s) for the following described work:

DESCRIPTION OF CHANGE / PCO's

Cost Impact

Schedule Impact

\$ _____

_____ Day(s)

TOTAL

\$ _____

Calendar Day(s)

NOTE: Attention is called to the sections in the General Provisions on Scope of Work and Estimates and Payments.

THIS PROPOSED CHANGE ORDER IS NOT EFFECTIVE UNTIL A CONTRACT CHANGE ORDER HAS BEEN APPROVED BY OWNER.

This PCO was initiated by _____ On _____

Submitted _____ On _____
Contractor

(BLANK)

Article 1.5

RESOLUTION OF CONSTRUCTION CLAIMS

Section	Section
20104. Application of article; provisions included in plans and specifications.	20104.6. Payment on undisputed portion of claim; interest on arbitration awards or judgments
20104.2. Claims; requirements; tort claims excluded.	20104.8. Repealed.
20104.4. Civil action procedures; mediation and arbitration; trial de novo; witnesses.	

Article 1.5 was added by Stats. 1994, c. 726 (A.B. 3069), § 22, eff. Sept. 22, 1994.

Former Article 1.5, Resolution of Construction Claims, consisting of §§20104 to 20104.8, added by Stats. 1990, c. 1414 (A.B. 4165), § 2, was repealed by Stats. 1990, c. 1414 (A.B. 4165), § 2, operative Jan. 1, 1994.

§ 20104. Application of article; provisions included in plans and specifications

(a) (1) This article applies to all public works claims of three hundred seventy-five thousand dollars (\$375,000) or less which arise between a contractor and local agency.

(2) This article shall not apply to any claims resulting from a contract between a contractor and a public agency when the public agency has elected to resolve any disputes pursuant to Article 7.1 (commencing with Section 10240) of Chapter 1 of Part 2.

(b) (1) “Public work” has the same meaning as in Sections 3100 and 3106 of the Civil Code, except that “public work” does not include any work or improvement contracted for by the state or the Regents of the University of California.

(2) “Claim” means a separate demand by the contractor for (A) a time extension, (B) payment of money or damages arising from work done by, or on behalf of, the contractor pursuant to the contract for a public work and payment of which is not otherwise expressly provided for or the claimant is not otherwise entitled to, or (C) an amount the payment of which is disputed by the local agency.

(c) The provisions of this article or a summary thereof shall be set forth in the plans or specifications for any work which may give rise to a claim under this article.

(d) This article applies only to contracts entered into on or after January 1, 1991.

(Added by Stats. 1994, c. 726 (A.B. 3069), § 22, eff. Sept. 22, 1994.)

Historical and Statutory Notes

1990 Legislation

Former § 20104 was renumbered Public Contract Code § 20103.5 and amended by Stats. 1990, c. 1414 (A.B. 4165), § 1.

Former § 20104, added by Stats. 1990, c. 1414 (A.B. 4165), § 2, relating to application of article regarding resolution

of construction claims, was repealed by Stats. 1990, c. 1414 (A.B. 4165), § 2, operative Jan. 1, 1994. See, now, this section.

Derivation: Former § 20104, added by Stats. 1990, c. 1414, § 2.

§ 20104.2 Claims; requirements; tort claims excluded

For any claim subject to this article, the following requirements apply:

(a) The claim shall be in writing and include the documents necessary to substantiate the claim. Claims must be filed on or before the date of final payment. Nothing in this subdivision is intended to extend the time limit or supersede notice requirements otherwise provided by contract for the filing of claims.

(b) (1) For claims of less than fifty thousand dollars (\$50,000), the local agency shall respond in writing to any written claim within 45 days of receipt of the claim, or may request, in writing, within 80 days of receipt of the claim, any additional documentation supporting the claim or relating to defenses to the claim the local agency may have against the claimant.

(2) If additional information is thereafter required, it shall be requested and provided pursuant to this subdivision, upon mutual agreement of the local agency and the claimant.

(3) The local agency's written response to the claim, as further documented, shall be submitted to the claimant within 15 days after receipt of the further documentation or within a period of time no greater than that taken by the claimant in producing the additional information, whichever is greater.

(c) (1) For claims of over fifty thousand dollars (\$50,000) and less than or equal to three hundred seventy-five thousand dollars (\$375,000), the local agency shall respond in writing to all written claims within 60 days of receipt of the claim, or may request, in writing, within 30 days of receipt of the claim, any additional documentation supporting the claim or relating to defenses to the claim the local agency may have against the claimant.

(2) If additional information is thereafter required, it shall be requested and provided pursuant to this subdivision, upon mutual agreement of the local agency and the claimant.

(3) The local agency's written response to the claim, as further documented, shall be submitted to the claimant within 30 days after receipt of the further documentation, or within a period of time no greater than that taken by the claimant in producing the additional information or requested documentation, whichever is greater.

(d) If the claimant disputes the local agency's written response, or the local agency fails to respond within the time prescribed, the claimant may so notify the local agency, in writing, either within 15 days of receipt of the local agency's response or within 15 days of the local agency's failure to respond within the time prescribed, respectively, and demand an informal conference to meet and confer for settlement of the issues in dispute. Upon a demand, the local agency shall schedule a meet and confer conference within 30 days for settlement of the dispute.

(e) Following the meet and confer conference, if the claim or any portion remains in dispute, the claimant may file a claim as provided in Chapter 1 (commencing with Section 900) and Chapter 2 (commencing with Section 910) of Part 3 of Division 3.6 of Title 1 of the Government Code. For purposes of those provisions, the running of the period of time within which a claim must be filed shall be tolled from the time the claimant submits his or her written claim pursuant to subdivision (a) until the time that claim is denied as a result of the meet and confer process, including any period of time utilized by the meet and confer process.

(f) This article does not apply to tort claims and nothing in this article is intended nor shall be construed to change the time periods for filing tort claims or actions specified by Chapter 1 (commencing with Section 900) and Chapter 2 (commencing with Section 910) of Part 3 of Division 3.6 of Title 1 of Government Code.

(Added by Stats. 1994, c. 726 (A.B. 3069), § 22, eff. Sept. 22, 1994.)

Historical and Statutory Notes

1990 Legislation

Former § 20104.2, added by Stats. 1990, c. 1414 (A.B. 4165), § 2, amended by Stats. 1991, c. 1029 (A.B. 1086), § 1, relating to requirements for claims filed under the article,

was repealed by Stats. 1990, c. 1414 (A.B. 4165), § 2, operative Jan. 1, 1994. See, now, this section.

Derivation: Former § 20104.2, added by Stats. 1990, c. 1414, § 2, amended by Stats. 1991, c. 1029, § 1.

Library Reference

California Practice Guide: Alternative Dispute Resolution, Knight, Fannin & Disco, see Guide's Table of Statutes for chapter paragraph number references to paragraphs discussing this section.

Civil Procedure Before Trial, Well & Brown, Guide's Table of Statutes for chapter paragraph number references to paragraphs discussing this section.

§ 20104.4 Civil action procedures, mediation and arbitration; trial de novo; witnesses

The following procedures are established for all civil actions filed to resolve claims subject to the article:

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

(b) (1) If the matter remains in dispute, the case shall be submitted to judicial arbitration pursuant to Chapter 2.5 (commencing with Section 1141.10) of Title 3 of Part 3 of the Code of Civil Procedure, notwithstanding Section 1141.11 of that code. The Civil Discovery Act of 1986 (Article 3 (commencing with Section 2016) of Chapter 3 of Title 3 of Part 4 of the Code of Civil Procedure) shall apply to any proceeding brought under this subdivision consistent with the rules pertaining to judicial arbitration.

(2) Notwithstanding any other provision of law, upon stipulation of the parties, arbitrators appointed for purposes of this article shall be experienced in construction law, and, upon stipulation of the parties, mediators and arbitrators shall be paid necessary and reasonable hourly rates of pay not to exceed their customary rate, and such fees and expenses shall be paid equally by the parties, except in the case of arbitration where the arbitrator, for good cause, determines a different division. In no event shall these fees or expenses be paid by state or county funds.

(3) In addition to Chapter 2.5 (commencing with Section 1141.10) of Title 3 of Part 3 of the Code of Civil Procedure, any party who after receiving an arbitration award requests a trial de novo but does not obtain more favorable judgment shall, in addition to payment of costs and fees under that chapter, pay the attorney's fees of the other party arising out of the trial de novo.

(c) The court may, upon request by any party, order any witnesses to participate in the mediation or arbitration process.

(Added by Stats. 1994, c. 726 (A.B. 3069), § 22, eff. Sept. 22, 1994.)

Historical and Statutory Notes

1990 Legislation

Former § 20104.4, added by Stats. 1990, c. 1414 (A.B. 4165), § 2, amended by Stats. 1991, c. 1029 (A.B. 1086), § 2, relating to procedures for civil actions filed to resolve construction claims, was repealed by Stats. 1990, c. 1414

(A.B. 4165), § 2, operative Jan. 1, 1994. See, now, this section.

Derivation: §20104.4, added by Stats. 1990, c. 1414, § 2, amended by Stats. 1991, c. 1029, § 2.

Library Reference

California Practice Guide: Alternative Dispute Resolution,
Knight, Fannin & Disco, see Guide's Table of Statutes

for chapter paragraph number references to paragraphs
discussing this section.

§ 20104.6 Payment on undisputed portion of claim; interest on arbitration awards or judgments

(a) No local agency shall fail to pay money as to any portion of a claim which is undisputed except as otherwise provided in the contract.

(b) In any suit filed under Section 20104.4, the local agency shall pay interest at the legal rate on any arbitration award or judgment. The interest shall begin to accrue on the date the suit is filed in a court of law.

(Added by Stats. 1994, c. 726 (A.B. 3069), § 22, eff. Sept. 22, 1994.)

Historical and Statutory Notes

1990 Legislation

Former § 20104.6, added by Stats. 1990, c. 1414 (A.B. 4165),
§ 2, relating to payment of undisputed portion of claims, was
repealed by Stats. 1990, c. 1414 (A.B. 4165), § 2, operative Jan.
1, 1994. See, now, this section.

Derivation: Former § 20104.6, added by Stats. 1990, c.
1414, § 2.

§ 20104.8 Repealed by Stats. 1990, c. 1414 (A.B. 4165), § 2, operative Jan. 1, 1994

Historical and Statutory Notes

The repealed section, added by Stats. 1990, c. 1414 (A.B.
4165), § 2, related to application of the article to specified

contracts and provided for repeal of the article on Jan 1, 1994.

(Blank)

SECTION 00810 –SUPPLEMENT TO THE GENERAL PROVISIONS

1.01 DEFINITIONS

Whenever the following terms occur in the Contract Documents, the meaning shall be interpreted as follows:

ATTORNEY FOR Owner – Alfred E. Smith, Nossaman LLP, 777 South Figueroa Street, 34th Floor, Los Angeles, CA 90017, (213) 612-7831

BOARD OF DIRECTORS – Board of Directors of the Olivenhain Municipal Water District.

CITY – City of Encinitas, 505 South Vulcan Ave. Encinitas, CA 92024

CONTRACT TIME – The number of consecutive days stated in the contract documents commencing from the date of the notice of award, for completion of the Work.

DATE OF AWARD OF CONTRACT – The date of the District Resolution (formal action of the Board of Directors of the District) awarding the Contract.

DISTRICT – Olivenhain Municipal Water District (OMWD), 1966 Olivenhain Road, Encinitas, California 92024, (760) 753-6466.

DISTRICT’S REPRESENTATIVE – The Owner’s Representative.

DRAWINGS or PLANS – Construction drawings entitled, “David C. McCollom Water Treatment Plant - Stage 4 Upgrades,” and referenced Standard Drawings or Regional Standard Drawings.

ENGINEER – Hazen and Sawyer, 11260 El Camino Real Suite 102, San Diego California 92130, Tel: (858) 764-5520.

OWNER – Olivenhain Municipal Water District (OMWD), 1966 Olivenhain Road, Encinitas, California 92024, Tel: (760) 753-6466; Fax: (760) 753-1578.

OWNER’S REPRESENTATIVE – The person or engineering/architectural firm authorized by the District to represent it during the performance of the work and until final acceptance. The Owner’s Representative is referred to throughout the Contract Documents as if singular in number and masculine in gender. The Owner’s Representative means the Owner’s Representative and his assistants.

PUBLIC WORKS SPECIFICATIONS – Standard Specifications for Public Works Construction Current Edition by APWA/AGC, the “GREENBOOK”, Current Edition.

REGIONAL STANDARD DRAWINGS – Standard Drawings for Agencies in the San Diego Region as recommended by the Regional Standards Committee and published by the San Diego County Department of Public Works, Current Edition.

SUPPLEMENTAL TO THE GENERAL PROVISIONS – Section 00810 of the specifications.

SPECIFICATIONS – Division 1 to 16 of the technical specifications contained in these Contract Documents, and those technical specifications contained in the Drawings.

STANDARD DRAWINGS – Drawings A-1.1 through G-15 of the Olivenhain Municipal Water District, Standard Specifications and Drawings for the Construction of Water, Recycled Water, and Sewer Facilities, dated December 2017, with revisions.

STANDARD SPECIFICATIONS – Divisions 1 through 15 of the Olivenhain Municipal Water District, Standard Specifications and Drawings for the Construction of Water, Recycled Water, and Sewer Facilities, dated February 2017, with revisions.

STATE STANDARD SPECIFICATIONS – State of California, Department of Transportation, Standard Specifications, Current Edition, Caltrans.

STATE STANDARD PLANS – State of California, Department of Transportation, Standard Plans, Current Edition, Caltrans.

WATER AUTHORITY – San Diego County Water Authority

Whenever the following terms appear in the State Standard Specifications or Public Works Specifications, the meaning shall be interpreted as follows:

AGENCY, BOARD or DEPARTMENT – The Owner.

ENGINEER – The Owner's Representative.

1.02 TERMS

- A. Command type sentences used in the Contract Documents refer to and are directed to the Contractor.

1.03 ABBREVIATIONS

- A. Interpret abbreviations used on the Drawings and in the Specifications as explained on the Drawings.

1.04 MARKING AND ADDRESSING BID ENVELOPE

- A. Bids shall be sealed in an envelope marked and addressed as set forth in the Notice Inviting Sealed Bids.

1.05 AWARD OF CONTRACT OR REJECTION OF BIDS

- A. Within a period of 60 calendar days after the opening of bids, the District will accept or reject the bids.

1.06 CONTRACTOR'S LICENSING REQUIREMENTS

- A. The District has determined the license classification necessary to bid and perform the subject contract. In no case shall this contract be awarded to a specialty contractor whose classification constitutes less than a majority of the portion of the work of this contract, all

work to be performed outside of the contractor's license specialty, except work specifically authorized by District, shall be performed by a licensed subcontractor in compliance with the Subletting and Subcontractor Fair Practices Act commencing with Section 4100 et seq., of the Public Contract Code. See Business and Professions Code Section 7059.

- B. The Contractor's license classification required for this project is a California State Contractor's License A – General Engineering.
- C. It is the District's intent that "plans", as used in Public Contract Code Section 3300, is defined as the construction Contract Documents, which include both the Drawings and the Specifications

1.07 TIME FOR COMPLETION AND FORFEITURE DUE TO DELAY

- A. The work shall be completed within **FIVE HUNDRED THIRTY (530) CONSECUTIVE CALENDAR DAYS** from and after the date of the Notice to Proceed.
- B. As specified in Section 01014, the plant shall be shut down for a period of 60 days. Forfeiture for each day completion is delayed beyond the shutdown period allowed or any construction activity extending the allowable shut down period beyond the allowable 60 days period will be at the rate of \$10,000.00 per day, in the Owner's sole discretion.
- C. The Contractor will not be permitted to begin work until the agreement, bonds or substitutes, insurance certificates and endorsements are acceptable to the District and Attorney for District. This period of time is set forth in Paragraph 3-2 Execution of Contract in the General Provisions. Time is of the essence in this contract.
- D. The Contractor shall complete all work in its entirety as specified in the Contract Documents within these time periods. Time of completion shall also include time for all submittals and coordination required to satisfy the requirements of these Contract Documents.
- E. The Contractor agrees that the work shall be prosecuted regularly, diligently, and uninterruptedly and at such rate of progress as will ensure full completion thereof within the Time for completion stated above including minimizing Construction Highline and customer interruption of water service. It is expressly understood and agreed, by and between Contractor and District that the Time for completion is reasonable for the completion of the WORK, taking into consideration the average climatic range, usual industrial conditions prevailing in this locality, and lead time required to procure equipment.
- F. The Contractor shall provide proof of delays caused from equipment or material procurement outside of his/her control for approval by the Owner. Approved delays shall be remedied by additional time to the contract and shall not include additional compensation.
- G. The Contractor shall provide submittals to the Owner for long-lead items seven (7) working days after issuance of the Notice to Proceed. Delays to the contract time for completion as a result of the Contractors failure to provide submittals for long-lead items within this time period will not be considered by the Owner for requests for additional time.

1.08 LIQUIDATED DAMAGES

- A. Pursuant to Government Code 53069.85, forfeiture for each day project completion is delayed beyond the time allowed shall be at the rate of \$2,500.00 per day, except as noted below.

1.09 PERMITS

- A. The Contractor shall obtain and pay for all required permits and provide copies of all permits to the District's Representative prior to starting work, including the San Diego County Air Pollution Control District's permits for construction and operation of diesel generators, if used. The Contractor shall comply with the ordinances, directives, and regulations of the respective agencies with jurisdiction over the area of the work. All work not specifically covered in the required permits shall conform to the requirements of these Specifications. The cost of all permits and plan check review shall be borne by the Contractor and included in the Contractor's bid.
- B. The Contractor shall be responsible for developing haul routes for the importing or exporting of materials or equipment for the project and obtaining and paying for all required permits from the affected agencies of jurisdiction, i.e., City of Encinitas and/or City of Carlsbad. The Contractor shall provide copies of all required permits to the District's Representative prior to starting work. The Contractor shall comply with the ordinances, directives, and regulations of the respective agencies with jurisdiction over the area of the work. All costs for transport fees, dump fees, plan or haul route reviews, permits, and related incidentals shall be borne by the Contractor and included in the Contractor's bid.

1.10 USE OF ASBESTOS PRODUCTS NOT PERMITTED

The intent of the Contract Documents is to provide asbestos-free components throughout the project in accordance with the recent Environment Protection Agency stated policy seeking a ban on the use of all products containing asbestos. Where the Contract Documents or the referenced specifications, standards, codes, or tests refer to products containing asbestos, the Contractor shall provide acceptable alternatives under those documents, or in the absence of such referenced alternatives, he shall submit a proposed substitute to the District's Representative for review and acceptance.

1.11 ABATEMENT OF AIR POLLUTION

- A. Comply with all applicable Federal, State, County, and City laws and regulations concerning the prevention and control of air pollution.
- B. Conduct construction activities and equipment in a manner so as to minimize atmospheric emissions or discharges of air contaminants. Equipment or vehicles that show excessive emissions of exhaust gases shall not be operated on the site.

1.12 NOISE CONTROL REQUIREMENTS

- A. The Contractor shall comply with all local sound control and noise level rules, regulations and ordinances which apply to any work performed pursuant to the Contract.
- B. The Contractor shall familiarize themselves with the City or County Zoning Performance Standards applicable to night work and day work.
- C. Each internal combustion engine, used for any purpose on the job or related to the job, shall be equipped with a muffler of a type recommended by the manufacturer. No internal combustion engine shall be operated on the project without said muffler.
- D. Each vehicle equipped with a back-up alarm shall use a white noise back-up alarm Brigade BBS-97 or equal at all times.
- E. Noise level requirements shall apply to all equipment on the job or related to the job, including but not limited to trucks and transient equipment that may or may not be owned by the Contractor. The use of loud sound signals shall be avoided in favor of light warnings except those required by safety for the protection of personnel.
- F. All work shall be coordinated with OMWD Staff as to insure minimal disruption to daily operations on the OMWD Campus.

1.13 AMOUNT OF LIABILITY INSURANCE

A. Employer's Liability Insurance:

- 1. Bodily injury coverage by accident shall be for not less than \$1,000,000 for each employee and \$1,000,000 for each accident.

B. General Liability:

- 2. Bodily injury, personal injury, and property damage coverage shall be in a combined single limit of not less than \$1,000,000 for each occurrence and \$2,000,000 aggregate.

C. Automobile Liability:

- 1. Bodily injury and property damage coverage shall be in a combined single limit of not less than \$1,000,000 for each occurrence and \$2,000,000 aggregate.

D. Builder's Risk Insurance:

- 1. Builder's Risk Insurance shall be provided for the full contract amount.

E. Earthquake and Tidal Wave Insurance:

- 1. Earthquake and Tidal Wave Insurance is not required for this project.

F. Additional Insured:

1. In addition to the additional insureds required for Liability insurance in the General Provisions, 8-3 LIABILITY INSURANCE, and 8-4 BUILDER'S RISK "ALL RISK" INSURANCE, the District and each of its directors, officers, employees, and agents and its Design Engineer shall be named as additional insureds for all Liability insurance and Builders' Risk Insurance provided herein.

1.14 USE OF THE STANDARD DRAWINGS

- A. Where the Drawings or Specifications make reference to the Standard Drawings, construct the item in accordance with the details and materials as specified in the Contract Documents. For items not included in the Standard Drawings that are part of the Contract Documents, construct the item in accordance with the Olivenhain Municipal Water District, Standard Specifications and Drawings for the Construction of Water, Recycled Water, and Sewer Facilities dated June 2008 with revisions. These District Standard Drawings and Standard Specifications are available for purchase at the office of the District.

1.15 CONSTRUCTION SCHEDULE AND BID BREAKDOWN

- A. The Contractor shall conform to the requirements of Article 6-3 Contractor's CONSTRUCTION SCHEDULE AND COST BREAKDOWN of the General Provisions within 15 days after the date of award of contract. Submit to the District's Representative a construction progress schedule and bid breakdown in bar chart form. Divide each lump sum bid item into its major elements of work and show separately labor, materials and equipment costs. The District's Representative will use this cost breakdown as a basis for the monthly progress estimate and payment. The schedule shall specifically include and identify the construction sequence requirements defined on the plans.

1.16 STORM DRAIN PROTECTION

- A. The Contractor shall comply with all local ordinances, County of San Diego Ordinance No. 9424, National Pollutant Discharge Elimination Permit Number CAS 0108758 and State Water Resources Control Board NPDES Permit No. CAS000002. The Contractor shall install and maintain Best Management Practices (BMPs) to the Maximum Extent Practicable (MEP) to prevent or reduce pollutant discharges to local storm drain/storm water conveyance systems and/or receiving waters from construction activities. The Contractor shall manage the Work to prevent or reduce pollutant discharges to local storm drain/storm water conveyance systems and/or receiving waters. BMPs to be implemented are detailed in the County of San Diego "Stormwater Standards Manual" and shall be applied in the following areas, if applicable to the project:

- (1) Erosion control on slopes;

- (2) Erosion control on flat areas; or BMPs to desilt runoff from flat areas;
- (3) Runoff velocity reduction;
- (4) Sediment control;
- (5) Offsite sediment tracking control;
- (6) Materials management;
- (7) Waste management;
- (8) Vehicle and equipment management;
- (9) Water conservation;
- (10) Structure construction and painting;
- (11) Paving operations;
- (12) Dewatering operations;
- (13) Planned construction operations;
- (14) Downstream erosion control;
- (15) Prevention of non-stormwater discharges;
- (16) Management of run-on discharges;
- (17) Protection of ground water; and

BMPs shall include post-construction BMPs for permanent control of erosion from slopes. These BMPs can include structures to convey runoff safely from the tops of slopes, vegetation or alternative stabilization of all disturbed slopes and/or the use of natural drainage systems to the MEP.

1.17 PROTECTION OF EXISTING UTILITIES

- A. The Contractor shall coordinate their efforts with the District and shall take every precaution to protect all existing utilities and structures at the project site. The Contractor shall be responsible for all Underground Service Alert notification and mark outs prior to the beginning of work.

1.18 COORDINATION WITH DISTRICT OPERATIONS

- A. The Contractor shall coordinate all work with the District sufficiently ahead of time so as to not interfere with the District's operations. The Contractor shall submit a detailed sequence of work to the District for all work. This proposed sequence of work shall be reviewed and approved with the District prior to construction for consistency with the Construction

Sequence and Constraints as described in these Contract Documents and the District's required operation. .

- B. The District will occupy the site and existing adjacent buildings during the entire construction period.
- C. The jobsite is located within a secured facility. Access to the site shall be provided by the District to allow work to commence in accordance with the contract documents. Contractor shall abide by the District's terms of site access at all times including but not limited to abiding by approved working hours, restrictions to access, and maintaining designated laydown areas. The Contractor shall follow the District's safety protocols or the Contractor's safety protocols (whichever is more restrictive) at all times while on District Property.
- D. District Driveway Access/Entrance Gates shall be accessible at all times, unless specifically approved in writing and coordinated with the District not less than 5 business days in advance.

1.19 PRE-CONSTRUCTION CONFERENCE AND PROGRESS MEETINGS

- A. A Pre-Construction Conference shall be scheduled prior to start of project. The District, the Contractor, and the District's Construction Manager shall be present. The Contractor's detailed sequence of work and a list of labor, material and equipment rates for additional work shall be established and maintained throughout the project. Contractor shall identify all personnel assigned to the project and a complete set of approved submittal data for use by inspection personnel. Contractor shall have a designated representative for this project.
- B. The Contractor shall also attend project progress meetings as described in Specification Section 01014, Construction Sequence and Constraints.

1.20 HOURS OF WORK

Hours of work shall be 8:00 A.M. to 4:30 P.M. unless otherwise specified in writing and agreed to by the District. See Section 01014 for further requirements. **Absolutely no equipment shall be started or warmed up prior to 8:00 AM or after 4:30 PM.** Overtime and shift work may be established as short-term procedure by Contractor with written notice to and written permission from District. No work other than overtime and shift work approved by District shall be done between the hours of 4:30 P.M. and 8:00 A.M., nor on weekends, or District recognized holidays, except such work as is necessary for the proper care and protection of the work already performed, except in case of emergency, or as otherwise specified by the District, and as specified herein. Special consideration may be given outside of these established working ours to minimize impact to District Staff and normal business operations. Any special work hours or dates must be arranged and approved by the District in advance of the planned work in writing. The District reserves the right to require any work that interferes with normal scheduled business to be rescheduled. The District recognized holidays are as follows:

- New Year's Day
- Martin Luther King, Jr. Day
- Presidents' Day
- Memorial Day
- Independence Day
- Labor Day
- Veterans Day
- Thanksgiving Day And The Following Friday
- Christmas Day

In the event that a national holiday falls on a Saturday, the previous Friday shall be Considered a holiday. If a national holiday falls on a Sunday, the following Monday shall be considered a holiday.

1.21 CONSTRUCTION SURVEYS

A. LAND MONUMENTS

The Contractor shall notify the District and the District's Representative of any existing Federal, State, City, County, and private land monuments encountered. All monuments shall be preserved, or if necessary to be destroyed during performance of the Work, shall be replaced by a licensed surveyor under contract to the Contractor. Appropriate record of survey drawings shall be filed with the City of Encinitas and County of San Diego for all replaced monuments. When government monuments are encountered, the Contractor shall notify the District's Representative at least two (2) weeks in advance of the proposed construction and provide for surveying of the existing monument before it is disturbed or destroyed.

A. CONSTRUCTION TESTING

1. The District shall furnish compaction testing for all bedding, backfill, and soil compaction testing.
2. The District shall furnish all materials testing and special inspections called for in the Contract Documents, including, but not limited to concrete and asphalt pavement.
3. When any work is determined to be unsatisfactory, faulty or defective, or does not conform to the requirements of the Contract Documents, the costs incurred by the District for additional tests or inspections shall be reimbursed by the Contractor. Said costs shall be paid by the District and deducted from progress payments to the Contractor.
4. Contractor shall provide at least 72-hour written notice of its readiness for all special inspection and testing.
5. When tests or inspections cannot be performed after such notice, the Contractor shall reimburse the District for laboratory personnel and travel expenses incurred due to the Contractor's negligence.

1.22 CONSTRUCTION WATER

OLIVENHAIN MWD

David C. McCollom Water Treatment Plant Stage 4 Upgrades

SPECIAL PROVISION

9 OF 15

- A. The Contractor shall obtain and pay for a construction water meter from the District and shall be responsible for all highlines and other temporary equipment and facilities necessary to provide adequate construction water to the project site. The meter requires a security deposit and will be refunded to the Contractor, less any damage or loss charges, at completion of the project. The Contractor shall coordinate the locations of water supply with the District. The following conditions must also be met:
1. Excess water must be available in the pipeline at the connection point.
 2. The Contractor shall submit a construction water service connection plan a minimum of two weeks prior to the need for water. This plan shall indicate all piping, valves, and other materials necessary to connect to District owned piping at designated blow-off, air vacuum, and air release structures located within the project site. Do not install piping, meter, or valves until the District's Representative has approved the water service plan.
 3. Accurately measure all water use and submit meter readings to the District's Representative when the meter is installed, at the end of each month and when the meter is removed.
 4. Securely lock the installed valve in the closed position at the end of each workday and during all times of inactivity. Avoid wasting water and prevent unauthorized use. Do not use water from the District on any other project.
 5. Coordinate all use of water, flushing of pipelines and filling of pipelines with the District's representative. All requests for use of water and for increases or decreases in quantity shall be made in writing to the District's Representative two working days in advance.

1.23 POWER AND LIGHTING

- A. The Contractor shall provide all power required for construction operations, and shall provide and maintain all temporary power facilities required to perform the work in a safe and satisfactory manner. All electrical facilities shall conform to the requirements of the requirements of Title 8, Industrial Relations, Subchapter 5, Electrical Safety Orders, of the California Code of Regulation; and Subpart K of the OSHA Safety and Health Standards for Construction.
- B. The Contractor shall provide adequate light for work conducted at night or under low light conditions to provide adequate facilities for inspection and safe working conditions and to insure proper work.
- C. Temporary connections for electricity shall be subject to approval of the District's Representative and the power company representative. Remove temporary electrical connections in like manner prior to final acceptance of the work.

1.24 CONTRACTOR STAGING AND LAYDOWN AREA

- A. A staging area, as indicated on the Contract Drawings, will be provided where the Contractor may set up a field office and store equipment and materials. The Contractor shall make his own arrangements for, and bear all costs of required utilities. Upon completion of work, the Contractor's staging area shall be removed and the area cleaned and restored to its original condition.
- B. Throughout all phases of construction, including suspension of work, and until final acceptance of the project, the Contractor shall keep the work site clean and free from rubbish and debris. The Contractor shall also abate dust nuisance by cleaning or sweeping and sprinkling with water or other means as necessary, in accordance with the San Diego Air Pollution Control District's regulations. The use of water resulting in mud on public streets and/or private property will not be permitted as a substitute for cleaning, sweeping, or other methods. Every day, and as required by the District's Representative, the Contractor shall furnish and operate a motorized, self-loaded sweeper with water spray nozzles to keep paved areas affected by the work acceptably clean and dust free.
- C. The Contractor shall keep the premises free at all times from accumulations of waste materials and rubbish. Contractor shall provide adequate trash receptacles about the site, and shall promptly empty the containers when filled. Wastes shall not be buried or burned on the site or disposed of into storm drains, sanitary sewers, streams, or waterways. All wastes shall be removed from the site and disposed of in a manner complying with local ordinances and antipollution laws. Volatile wastes shall be properly stored in covered metal containers and removed daily. Construction materials shall be neatly stacked by the Contractor when not in use. The Contractor shall promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.

1.25 SANITATION AND DRINKING WATER

- A. The Contractor shall provide toilet and wash-up facilities for his work force at the site of work. They shall comply with applicable laws, ordinances, and regulations pertaining to the public health and sanitation of dwellings and camps. The facilities shall be stored within the staging areas overnight and on weekends. The Contractor shall maintain the sanitary facilities in an acceptable condition from the beginning of work to completion and shall remove the facilities and disinfect the premises.
- B. The Contractor shall provide safe drinking water at all times at the jobsite.

1.26 SAFETY

- A. District and its inspectors, consultants, agents and other representatives are in no way responsible for safety and are there only to observe the work compliance with plans and specifications.

- B. As an informational submittal, Contractor shall prepare and submit a general company Health and Safety Plan (HSP), modified or supplemented to include job-specific considerations.
- C. The Contractor acknowledges responsibility for jobsite and acknowledges that the District, Engineer and their agents, employees, consultants and representatives will not have any such responsibility. To the fullest extent permitted by law the Contractor shall indemnify, defend and hold harmless the District, Engineer, their present companies, subsidiaries, agents, and employees from and against all claims, damages, losses and expenses, including but not limited to attorney fees and claim costs, arising out of or resulting from performance of work by the Contractor, its subcontractors, or their agents and employees, which results in damage, loss or expense is caused in whole or in part by the negligence, active or passive, of District, Engineer, their parent and subsidiary companies, as well as their agents and employees, excepting only the sole negligence of District, Engineer, their parent or subsidiary companies and their agents and employees.

1.27 INDEMNIFICATION

- A. Contractor hereby releases and agrees to indemnify, defend, hold harmless the District, the City, Engineer, their parent and subsidiary companies, agents, employees, consultants and representatives for any and all damage to persons or property or wrongful death regardless of whether or not such claim, damage, loss or expense is caused in whole or in part by the negligence, active or passive, of District, Engineer, their parent and subsidiary companies, as well as their agents and employees, excepting only the sole negligence of District, Engineer, their parent or subsidiary companies and their agents and employees to the fullest extent permitted by law. Such indemnification shall extend to all claims, demands, actions, or liability for injuries, death or damages occurring after completion of the project, as well as during the work's progress. Contractor further agrees that it shall accomplish the above at its own cost, expense and risk exclusive of and regardless of any applicable insurance policy or position taken by any insurance company regarding coverage.
- B. Contractor shall defend, indemnify and hold the District, the City, Engineer, its employees, officers, or agents, harmless against any and all claims by any parties arising from, or related to, any and all damages, including legal costs and attorney's fees, resulting from interference with, interruption of, damage to, or any and all injuries which result from damage caused to subsurface installation, which is unforeseen and despite Engineer's/Architect's effort during the design process was not located, excepting only the gross negligence or willful misconduct of Engineer in providing its services.

1.28 MEASUREMENT AND PAYMENT

A. General:

- 1. The measurement and payment provisions of these Contract Documents shall govern over those of referenced standards, if any.

2. The price set forth in the Bid Form for the work shall include all costs and expenses incidental to completing the work, and payment of the price bid will be payment in full under this contract, except as provided by Article 9-1 PAYMENT FOR CHANGES IN THE WORK of the General Provisions.
3. As a condition precedent to approval of the Contractor's monthly payment application by the District's Representative, the Contractor shall attend all progress or issue resolution meetings scheduled by the District's Representative. In addition, the Contractor shall submit a monthly construction schedule properly updated and accurately showing the work completed to date and the work yet to be performed in the remaining Contract time. The Contractor agrees failure to comply with the foregoing to the satisfaction of the District's Representative shall delay the monthly progress payment to the Contractor without penalty to the District.

B. Lump Sum Work Items Listed in the Bid Schedule:

1. The lump sum prices include full compensation for furnishing the labor, materials, tools, and equipment and doing all the work involved to complete the work included in lump sum work items listed in the Bid Schedule and defined by the Contract Documents.
2. The application for payment for a lump sum payment item will be for that specific work item based on the percentage completed. The percentage complete will be based on the value of partially completed work relative to the value of the item when entirely completed and ready for service. The application for payment will be in accordance with Article 9-2 PROGRESS PAYMENTS of the General Provisions.

C. Work Items Not Listed in the Bid Schedule:

1. The General Provisions and items in the Special Provisions which are not listed in the Bid Schedule of the Bid Form are, in general, applicable to more than one listed work item, and no separate work item is provided therefor. Include the cost of work not listed but necessary to complete the project designated in the Contract Documents in the various listed work items of the Bid Form.
2. The bids for the work are intended to establish a total cost for the work in its entirety. Should the Contractor feel that the cost for the work has not been established by specific items in the Bid Form, he shall include the cost for that work in some related bid item so that his bid for the project does reflect his total cost for completing the work in its entirety.

1.29 NOTICE OF COMPLETION

- A. Contractor shall apply for acceptance of the work encompassed in the Bid Schedules. Upon substantial completion of the work encompassed in the Bid Schedule, the District, at the District's sole discretion, will issue a Notice of Substantial Completion for this work.
- B. Upon completion of all work in the Bid Schedules in accordance with the Contract documents, Contractor shall apply for acceptance of the work. Upon acceptance of the work encompassed in the Bid Schedules, the District, at the District's sole discretion, will

prepare a Notice of Completion for consideration and approval by the District Board of Directors.

1.30 GUARANTEE

- A. For all work encompassed in the Bid Schedule a two-year guarantee shall be furnished by the Contractor as required in the General Provisions, Article 5-14, except that any guarantee included for materials or equipment beyond the period specified herein shall be solely the responsibility of the guarantor and not the Contractor. This guarantee period shall commence with the District's issuance of a Notice of Substantial Completion or Notice of Completion for the Bid Schedule, whichever is first. Plant establishment shall not be subject to the one-year guarantee and shall be completed in accordance with the Contract Drawings.

1.31 LABOR COMPLIANCE PROGRAM AND CONTRACTOR REGISTRATION WITH STATE OF CALIFORNIA

- A. In accordance with requirements defined by the California State Legislature via Senate Bill 854, all contractors and subcontractors involved with public works project shall be registered with the State Department of Industrial Relations. Registration is completed through an on-line application process and the payment of a fee to the State. The registration process requires contractors and subcontractors to provide workers' compensation coverage to its employees, hold a valid Contractors State Board License, have no delinquent unpaid wage or penalty assessments, and not be subject federal or state debarment. The registration form is located on the State Department of Industrial Relations website:

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

- B. Prior to start of construction, the Contractor shall submit to the District evidence of completing this registration for the prime firm and all subcontracting firms. Failure to submit the requested documentation shall be cause for delay of the project and subject to forfeiture due to delay in accordance with paragraph 1.07 of the Supplement to General Provisions.

1.32 SITE RESTORATION

- A. Contractor shall return all disturbed areas to pre-construction conditions including, but not limited to topographic elevations, grade and material of existing surface, slopes, curb and gutter, sidewalks, driveways, striping, seal coatings, landscaping, sod grass, fences, irrigation lines and facilities, railroad ties, District facilities, and structures.

1.33 ALFA LAVAL CENTRIFUGE EQUIPMENT

The District has pre-negotiated a quote with Alfa Laval for the new Centrifuge equipped with Diverter Gate , New Diverter Gate for existing Centrifuge, and associated electrical panels with Alfa Laval. The equipment details and quote are included in Appendix A. The District has not and will not be pre-purchasing the above equipment and/or material. Instead, Contractor is responsible for contracting with and submitting payment directly to the equipment supplier.

END OF SECTION

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PART II

TECHNICAL SPECIFICATIONS

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PART II - TECHNICAL SPECIFICATIONS

Division	Spec Number	Title
Division 1 - General Requirements	01010	Summary of Work
	01014	Construction Sequence and Constraints
	01045	Cutting and Patching
	01046	Control of Work
	01136	General Equipment Requirements
	01170	Special Provisions
	01200	Measurement and Payment
	01300	Submittals
	01311	Construction Scheduling
	01350	Anchorage and Bracing of Nonstructural Components
	01370	Schedule of Values
	01445	Pipeline Testing and Cleaning
	01450	Special Inspections
	01500	Temporary Facilities
	01562	Dust Control
	01600	Products Delivery Requirements
	01610	Material and Equipment
	01630	Substitutions and Product Options
	01660	Product Storage and Protection Requirements
	01665	Equipment Testing and Startup
	01700	Contract Closeout
	01710	Cleaning
	01715	Equipment Operation and Maintenance Training
	01720	Project Record Documents

Division	Spec Number	Title
	01730	Operation and Maintenance Manuals
	01740	Warranties and Bonds
Division 2 - Site Work	02050	Demolition and Renovation
	02222	Protecting Existing Underground Utilities
Division 3 - Concrete	03250	Concrete Joints and Joint Accessories
	03300	Cast-in-Place Concrete
	03600	Grout
	03732	Concrete Repairs
Division 4 - Masonry (NOT USED)		
Division 5 - Metals	05010	Metal Materials
	05035	Galvanizing
	05050	Metal Fastening
	05120	Structural Steel
	05500	Metal Fabrications
	05520	Guards and Railings
	05531	Gratings, Checkered Floor Plates and Access Doors
Division 6 - Woods and Plastics (NOT USED)		
Division 7 - Thermal and Moisture Protection	07900	Joint Fillers, Sealants and Caulking
Division 8 - Doors and Windows (NOT USED)		
Division 9 - Finishes	09900	Painting and Coating
	09902	Field Painting
Division 10 – Specialties (NOT USED)		
Division 11 – Equipment and General Provisions	11200	Stainless Steel Storage Tank
	11224	Inline Static Mixer
	11240	Polymer Dosing Skid
	11315	Progressive Cavity Pumps
	11345	Vertical Crosslinked Polyethylene Storage Tank
	11363	Dewatering Centrifuge
Division 12 - Furnishings (NOT USED)		
Division 13 - Instrumentation and Controls	13401	Process Instrumentation and Controls
	13446	Electrical Operators for Valves and Gates
Division 14 - Conveying Systems (NOT USED)		
Division 15 - Mechanical	15050	General Piping Requirements
	15051	Process Piping – General Requirements
	15052	Piping Testing – General Requirements
	15062	Stainless Steel Pipe and Fittings
	15100	Plant/Process Valves
	15120	Piping Specialties

Division	Spec Number	Title
	15140	Pipe Supports
	15144	Pressure Testing of Piping
	15207	Centrifuge Diverter Gate
	15290	Polyvinyl Chloride (PVC) Pipe and Fittings
Division 16 - Electrical	16000	Common Work Results for Electrical
	16002	Electrical and Instrumentation Demolition and Modifications
	16060	Grounding and Bonding for Electrical Systems
	16080	Commissioning of Electrical Systems
	16120	Low Voltage Conductors and Cables
	16130	Raceway and Boxes
	16190	Miscellaneous Electrical Equipment
	16220	Low Voltage Motors
	16260	Low Voltage Variable Frequency Motor Controllers

Appendix

Appendix A - Alfa Laval Equipment Details and Quote (Bid Item #4)

Project Plans

David. C. McCollom Water Treatment Plant Stage Four Process Upgrades Plans
(43 sheets, bound separately)

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.01 LOCATION OF WORK

- A. The work of this Contract is located at the Olivenhain Municipal Water District's David C. McCollom Water Treatment Plant (DCMWTP) located at 19090 Via Ambiente Road, Escondido, California 92029.

1.02 SCOPE OF WORK

- A. The Work shall include upgrading of Stage 4 at DCMWTP. The Work is described in more detail in Section 1.02B.
- B. The Work includes, but is not necessarily limited to, the following:
 - 1. Demolition
 - Centrifuge platform system with guardrails, electrical panel and breakers.
 - Centrifuge feed pump system with instruments and valves
 - Centrate pump system with instruments and valves
 - Centrate tank system with instruments and valves
 - Polymer tank system with instruments and valves
 - Polymer skid system with equipment pad
 - 2. Centrifuge
 - Furnish/install centrifuge and diverter gate
 - Furnish/install diverter gate on existing centrifuge
 - Furnish/install flush water pipe
 - Include fittings, valves, rotameters and panel
 - 3. Centrifuge electrical panels
 - Furnish/install split centrifuge panels
 - Relocate fiber optic patch panel and provide new connections as described in notes on Electrical Drawings
 - 4. Centrifuge feed pump
 - Relocate centrate feed pump for use as centrifuge feed pump
 - Furnish/install Thickened Solids pipe
 - Include fittings, valves, flow meters and static mixers
 - 5. Centrate feed pump
 - Furnish/install centrate feed pump
 - Include fittings, pipe from tank to pump
 - Include fittings and pipe from pump to flowmeter

- Reuse existing flow meter
 - Furnish/install valves
- 6. Centrate tank
 - Furnish/install tank, 316SS
 - Furnish/install pipe, valves and saddle tap
- 7. Polymer dosing
 - Furnish/install polymer drum handling system
 - Furnish/install polymer skid
 - Include piping with valves and fittings
 - Modify polymer junction box for new skid
 - Furnish/install polymer day tank, double-wall
- 8. Structural
 - Include additional unistrut framing to support valves
 - Include polymer day tank support frame
 - Furnish/install removeable guardrail at centrifuge
 - Place polymer skid concrete equipment pad to support second skid
 - Place centrate feed pump concrete equipment pad
 - Include strengthening of centrifuge platform with members
 - Shorten discharge bin rail
 - Furnish/install diamond steel plate over exposed concrete
 - Relocate flared portion to new end point
 - Furnish/install bin rail and diamond steel plate for new centrifuge discharge bin
 - Furnish/install 6,000lb load rating winches on concrete pad
- 9. Electrical and Controls
 - Furnish/install centrate feed pump VFD
 - Furnish/install centrifuge feed pump VFD
 - Furnish/install instruments:
 - Centrifuge feed pump
 - Pressure indicators and pressure switches
 - Centrate feed pump
 - Pressure indicators and pressure switches
 - Centrate tank instruments:
 - Level indicator transmitter, level switches and TSS analyzer
 - Polymer day tank instruments:
 - Level indicator transmitter, level switches and pressure indicators
 - Furnish/install conduit and conductors per cable and conduit schedule
 - PVC-coated RGS indoors
 - RGS outdoors
 - Allow for integration and programming

10. Furnishing, installing, and testing all electrical and instrumentation wiring and interconnections and appurtenances.
 11. Furnishing, installing, and testing all control air piping to valves and appurtenances.
 12. All structural, mechanical, electrical, and instrumentation work, as shown on the Drawings and specified herein.
 13. All other work as required or shown elsewhere in the Contract Specifications or Drawings and all supplemental work (whether or not mentioned specifically in the Contract Documents) to fulfill the contract obligation in accordance with the Contract Documents.
 14. Startup and Testing – CONTRACTOR shall assume primary responsibility for all startup and testing activities but shall perform said tasks in close coordination and with the Control System Integrator (CSI).
CONTRACTOR shall be responsible for coordinating and defining said activities with the CSI as part of this bid. CONTRACTOR shall provide skilled labor as necessary to compliment and support the activities of the CSI, and to adjust, repair, or replace any equipment and appurtenances, as may be needed for a complete and fully operational system. The CSI will be required to certify the installation and successful operation of all new and replacement items within this contract. CONTRACTOR shall pay for site utilities (e.g., water and electricity) during installation, startup, and field testing of the plant upgrades.
- C. The Work to be executed as part of this Contract is not necessarily limited to the description of this Section. Accordingly, the CONTRACTOR shall become thoroughly familiarized with all of the Contract Documents in order to fully understand the extent of the Work.

1.03 CONTRACTOR'S USE OF PREMISES

- A. CONTRACTOR shall limit the use of the premises for his Work and for storage to allow for:
 1. Work by other contractors.
 2. Owner occupancy.
- B. CONTRACTOR shall assume full responsibility for security of all his and his subcontractors materials and equipment stored on the site.
- C. Coordinate use of premises with OWNER and other contractors.
- D. If directed by the OWNER or ENGINEER, move any stored items which interfere with operations of OWNER or other contractors.

- E. Obtain and pay for use of additional storage or work areas if needed to perform the Work.
- F. The CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the construction limits as specified, to areas permitted by law, ordinance, permits or the requirements of the contract documents and shall not unreasonably encumber the premise with construction equipment or other material or equipment.
- G. During the progress of the work, the CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the work. At the completion of the work in a specific area, the CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises, as well as all tools, appliances, construction equipment and machinery and surplus materials, and shall leave the site clean and ready for occupancy by the OWNER. The CONTRACTOR shall restore to their original condition those portions of the site not designated for alteration by the contract documents.
- H. The CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall the CONTRACTOR subject any part of the work or adjacent property to stresses or pressures that will endanger it.

1.04 OWNER OCCUPANCY

- A. OWNER will occupy premises during performance of the work for the conduct of his/her normal operations. Coordinate all construction operations with OWNER to minimize conflict and to facilitate OWNER usage.
 - 1. OWNER must keep water treatment plant in service at all times with the exception of a 60 consecutive day window as defined in Section 01014 Construction Sequence and Constraints.
 - 2. Temporary shutdowns shall not be permitted without the advance notice to the OWNER per 1.04A. All shutdowns shall be subject to OWNER approval.

1.05 WORK SEQUENCE

- A. Perform Work in sequence as defined in Section 01014 to accommodate OWNER's operations during the construction period and to ensure completion of the Work in the Contract Time. Completion dates of the various stages shall be in accordance with the approved construction schedule submitted by the CONTRACTOR.

1.06 OWNER-FURNISHED PRODUCTS

- A. All products shall be furnished through the CONTRACTOR.

END OF SECTION

SECTION 01014

CONSTRUCTION SEQUENCE AND CONSTRAINTS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

- A. The water treatment plant must provide continuous treatment capacity during the construction period except as directed by the OWNER and meet its water quality permit requirements under all operating conditions.
- B. In general, no Work which affects or could affect plant operations or plant performance shall be performed without a specific detailed plan by the CONTRACTOR approved in advance by the ENGINEER and the OWNER. All requests for plant system diversions, shutdowns, modifications, etc. shall be in writing to the OWNER's on-site representative with a copy to the ENGINEER.
- C. The construction progress schedule required under Section 01170 shall reflect the conditions presented in this section.

1.02 RELATED WORK DESCRIBED ELSEWHERE

- A. Liquidated damages are included in Section 00810.
- B. Project Summary of Work is included in Section 01010.
- C. Site Conditions is included in Section 01011.
- D. Control of Work is included in Section 01046.
- E. Construction Schedule is included in Section 01311.

1.03 DEFINITIONS AND TERMS

- A. Plant Operational Constraints: The constraints to performance of the Work required because of plant operations which must be maintained at all times are identified in this section. Cumulative plant operational constraints which substantially delay the CONTRACTOR beyond the constraints identified in this section shall be treated as excusable delays. These constraints shall be included in the CONTRACTOR's progress schedule.
- B. Construction Scheduling Constraints: The constraints to performance of the Work required because of special sequencing with other parts of the Work, calendar time constraints and special testing, commissioning and work procedures are identified in this Section. These constraints are in addition to the standard procedural constraints such as shop drawings, testing, commissioning, training, etc and the above plant operational constraints. These constraints shall be included in the CONTRACTOR's progress schedule.

- C. Special Conditions: Certain special conditions, if any, related to performance of the Work are identified in this section. If they affect the scheduling of the Work, they shall be included in the CONTRACTOR's progress schedule.

1.04 NOTIFICATION REQUIREMENT

- A. The CONTRACTOR shall give a minimum of ten (10) calendar days advance notice to the ENGINEER of each component proposed for shutdown or disruption for 24 hours or less and fifteen (15) calendar days if the shutdown or disruption is longer than 24 hours, all of which shall be subject to OWNER approval and limitations.

1.05 TIE-IN PREPARATIONS

- A. Where new systems are to be tied-into existing systems, which are required to be shutdown to make the tie-in, the new system shall be fully prepared in anticipation of the tie-in to minimize downtime of the existing system. The new equipment shall be fully tested to the maximum extent possible prior to the tie-in. Measurements shall be taken to ensure that the new equipment and/or piping are of the correct size, length and alignment to complete the tie-in. The CONTRACTOR shall supply a list of all materials and equipment needed to accomplish the tie-in and shall review the proposed tie-in with the ENGINEER and OWNER.
- B. Once initiated, work shall continue until the tie-in is completed. CONTRACTOR shall ensure that all materials, labor and equipment required to complete the Work are available at the site of the tie-in prior to the initiation of Work and verified by the Owner's Representative.

1.06 SUBMITTAL REQUIREMENTS

- A. The CONTRACTOR shall submit to the OWNER and ENGINEER for approval a detailed Schedule for Construction prior to initiation of site construction. The Schedule shall comply with aspects of the work described herein.
- B. The CONTRACTOR shall update the schedule as required by Section 01311.
- C. For all work which will require a temporary shutdown of operations or water service disruptions, the CONTRACTOR shall submit a proposed work plan which indicates the manpower, tools, equipment, construction procedure, and proposed time period to be used according to 1.04 A.
- D. CONTRACTOR shall submit shop drawings to show details of all temporary services, temporary piping restraints, bypasses and tie-ins to existing systems.
- E. The CONTRACTOR shall submit a detailed work plan to the OWNER and ENGINEER for approval prior to the 60 day plant shutdown.

1.07 PLANT OPERATIONAL CONSTRAINTS

- A. Several areas of construction under this contract must be coordinated with the Plant Operating Personnel and accomplished in a logical order to maintain the process flow through the plant and to allow construction to be completed within the time allowed by Contract Documents. The CONTRACTOR shall coordinate activities with the other contractors, subcontractors and equipment suppliers, as required, to allow orderly and timely completion of all the work.
- B. The CONTRACTOR shall coordinate all daily Work through the Owner's Representative. Only the OWNER is allowed to execute the necessary procedures to isolate and remove units from service. The CONTRACTOR shall notify the Owner's Representative in writing according to 1.04A, with the exception of any process areas that are provided with longer notice periods as defined in the specifications. The plant shall remain in service at all times during the construction period except as directed by the OWNER.
- C. If it is required that the OWNER operate a valve, gate, or similar item for isolation of a unit from service or to provide the CONTRACTOR with shutoff service, and if shutoff is not achieved, the OWNER shall be afforded seven (7) calendar days to make repairs necessary to provide shutoff service.
- D. Various interconnections within the plant will depend on the closure of various valves and gates. Many of these valves and gates are aged and may not seal properly. Any corrective measure or temporary facilities necessary to attain the shut-off needed to perform the work shall be completed at no additional cost to the OWNER and without interrupting the plant operation.
- E. Vehicle and pedestrian access must be maintained to plant processes and chemical tanks at all times. When pedestrian or vehicle access through construction areas must be disrupted, provide alternate acceptable access to be approved by OWNER/ENGINEER for all routine deliveries to the plant such as chemical deliveries, the plant operators or other contractors.
- F. Coordinate the activities in the interface or common areas with these other contractors and the plant operators. Submit to the ENGINEER a description and schedule as to how the common areas will be utilized, recognizing the required coordination with other contractors and the plant operators.
- G. Various interconnections within the plant may require temporary partial power shutdown. Make every effort necessary to minimize the shutdown time. The CONTRACTOR shall coordinate with the ENGINEER and/or District authorities prior to attempting any such power shutdown. The CONTRACTOR shall give the ENGINEER advance notice according to 1.04A.
- H. The OWNER's facilities, including but not limited to, lunch room, locker rooms, restrooms, offices, office equipment, and parking lots shall not be used by the CONTRACTOR.
- I. During start-up and testing of CONTRACTOR supplied equipment and appurtenances, make available the staff, equipment and manufacturer's representatives required to make any necessary adjustments and training.

- J. CONTRACTOR parking and construction trailers shall be located within the designated staging area.
- K. CONTRACTOR shall be subject to and comply with all of the OWNER's security procedures, including, but not limited to: restricted access to the water treatment plant site, use of security badges and sign-in procedures, limited access to existing water treatment plant facilities. Security measures may vary over the course of the project and CONTRACTOR shall comply with all reasonable procedure modifications.
- L. Safe access shall be provided for the OWNER operations at all times.
- M. The CONTRACTOR shall coordinate his activities with the other contractor's on site to allow orderly and timely completion of all the work.

1.08 CONSTRUCTION SCHEDULING CONSTRAINTS

- A. The CONTRACTOR shall consider the following constraints in the development of the overall plan of construction. This is not meant to be all inclusive, but to provide the CONTRACTOR with a general overview of some of the constraints involved with the proposed construction. This list is not intended to release the CONTRACTOR from the responsibility to coordinate the work in any manner to ensure project completion within the time allowed. The following areas are not necessarily listed in their required sequence of construction, nor do they list all items that the CONTRACTOR will need to coordinate with the ongoing plant operations.
- B. The plant will undergo a yearly shutdown that typically last two weeks and is a construction constraint.
- C. Normal working hours shall be 7:00 a.m. until 4:30 p.m., Monday through Friday, as specified in the General and Supplementary Conditions of the Contract. No work shall be performed on weekends or holidays or without an OWNER's representative present. Work outside these times may be performed provided the CONTRACTOR notifies the OWNER, in writing, a minimum of seven (7) days in advance of planned work activities outside these times. Notification shall include time when work will be done, names of all workers present at site during non-normal work hours and for how long a period the extra hours will be needed. In the event the OWNER approves work outside of normal working hours, the CONTRACTOR shall reimburse the OWNER for the cost of the OWNER's representatives during these periods.
- D. Connections to Existing Equipment – Any outages required for connections to existing equipment shall be scheduled with the OWNER with a notice according to 1.04A. The duration of any outage shall be minimized and shall not exceed forty-eight (48) hours. A maximum of five (5) outages shall occur in a month outside of the 60 day shutdown.
- E. Primary Power Outages – Any required shutdowns to the primary power supply shall be scheduled with the OWNER with advance notice according to 1.04A. The

duration of any shutdown shall be minimized and shall not exceed four (4) hours. Full primary power shall be restored for a minimum of five (5) days between shutdowns.

- F. Noise – The CONTRACTOR shall be aware that excessive noise shall not be permitted.
- G. Final Paving – Final wear course of the asphalt paving shall not be installed until the last portion of the project when heavy equipment is no longer utilized .
- H. Construction Units
 - 1. Refer to Section 01010, Summary of Work, for a list of treatment units, structures, and buildings that are to be constructed with minimal interruption of the operation of the existing treatment facilities.

I. Location of Existing Utilities

Prior to commencing underground work or work requiring excavation, the CONTRACTOR shall locate and expose the existing underground electrical conduits, including other existing utilities, process piping, chemical lines, potable and non-potable water lines, etc., located in the areas of the proposed improvements. The CONTRACTOR is advised of the following specific locations:

- 1. Abandoned underground utilities may exist throughout the plant. The location and extent of abandoned pipe shown on the drawings is approximate and taken from record drawings. The CONTRACTOR shall demolish parts of the abandoned pipe that interfere with construction of new pipelines, paving or structures.

I. Construction Constraints and Maintenance of Flow

Constructability and maintenance of flow will be important during construction of the proposed facilities. The CONTRACTOR shall have the leeway to develop construction means and methods as necessary to complete the work defined in this contract document (subject to the ENGINEER's and OWNER's review).

- 1. Several major constraints shall be considered when preparing the construction sequence for this project. These constraints are listed below.
 - a. All equipment Operational Readiness Tests (ORT) and individual system Functional Acceptance Tests (FAT) will be completed in 530 calendar days from Construction NTP.
- 2. The CONTRACTOR may use the sequence presented herein or any other sequence they deem necessary to complete the project within the construction constraints defined below (subject to review by OWNER and ENGINEER). If the CONTRACTOR accepts the sequence presented herein, it becomes "the" plan and the ENGINEER and/or OWNER will have no responsibility for any real or alleged problems resulting from use of the schedule presented herein.
- 3. Modifications to Stage 4:

Sequence of construction for the mechanical equipment will prioritize maintaining the operation of the plant, and will be in synergy with the electrical, I&C and structural construction requirements. Preparatory work, including demolition, will be performed to the maximum extent possible before the plant is temporarily shut down for mechanical connections. The new centrifuge is expected to have the longest lead item (42 weeks) and all the other mechanical equipment can be installed and either fully or partly tested before then. A possible sequence of construction is presented below:

- a. Shutdowns will be minimized when possible and work will be done concurrently where applicable. Equipment requiring one day (or less) of plant shutdown:
 - Replacement of the existing plug valves for the centrifuge feed pumps. This work can be completed anytime during the construction period.
 - New centrifuge feed pump (with VFD) and the discharge line connection to the new centrifuge. This work will need completion before the installation of the new centrifuge.
 - Centrate pumps installation and testing with the existing centrate tank. Pumps are duty/standby and they will be replaced one at the time, while one of the existing centrate pump remains operational. Once one of the new centrate pumps is replaced, it will become the operating pump while the second pump is replaced. VFDs will be installed prior to the pumps installation and the new pumps will be able to operate at same flows as current. CSI will modify PLC logic concurrently with new centrate pump installation. This work will need completion before the installation of the new centrate tank.
- b. Equipment requiring more than one day shutdown:
 - Installation of the new centrate tank: The steel tank will be prefabricated however shutdown will be required for tank installation, installations of the feed, discharge, and drain line and for relocation of the instruments from existing tank to the new tank. Once this tank is installed, the centrate system will be ready for testing the operation with two centrifuges. This work will need completion before the installation of the new centrifuge.
 - Shutdown period for the new centrate tank shall be used in parallel for modifications to the polymer system. First priority is the replacement of the polymer day tank and relocation of the instruments from the existing tank to the new tank. The existing polymer skid will require relocation to allow for the addition of the new polymer dosing skid. The existing polymer skid shall be relocated to a temporary location (using flexible hoses) until the concrete pad supporting the two polymer skids

is modified. Connecting lines from the new polymer skid to the new centrifuge will be installed prior to this shutdown and will be ready once the new polymer skid is installed. This work will need completion before the installation of the new centrifuge.

- A separate shutdown period is anticipated for 30 days for the installation of the centrifuge, which will likely be the last equipment to arrive at the site. Prior to this shutdown, the new centrifuge feed pump and the new polymer dosing skid will be installed. Modifications to the centrifuge platform will also be completed prior to the new centrifuge installation.
4. Testing/Commissioning – Following completion of the approved installation of all equipment and systems, including, but not limited to, all equipment, piping, valves, instruments, wiring, and appurtenances CONTRACTOR and CSI subcontractor shall allow for up to 30 days to conduct debugging of the control system prior to the initiation of functional testing of pumps and equipment. Testing, start-up and commissioning of the Stage 4 Upgrades shall be complete prior to 530 calendar days after the construction NTP.

1.09 CONSTRUCTION SCHEDULE

- A. The CONTRACTOR shall submit, for review and approval, a schedule with a planned sequence of construction prior to the start of construction, per the requirements of Section 01311. The planned sequence shall ensure that all construction sequence and constraint requirements are met

1.10 COORDINATION MEETINGS

- A. At the minimum, bi-weekly progress meetings shall be scheduled and administered by the CONTRACTOR. It shall be the CONTRACTOR's responsibility to prepare agenda, distribute written notice of the meetings and make physical arrangements for meetings. The CONTRACTOR will record the meeting minutes and distribute copies of minutes within two (2) days after each meeting.
- B. The following General Construction Coordination Meeting will be attended, as a minimum, by the OWNER's representatives, the CONTRACTOR, the Centrifuge supplier (Alfa Laval), and the ENGINEER's representatives.
1. The first meeting shall be held within one month of the Notice of Award and will be considered the construction kickoff meeting. The CONTRACTOR shall summarize their understanding of the portions of the project, discuss any proposed substitutions or alternatives, schedule testing and delivery milestone dates.
 2. The second meeting will be conducted approximately one month prior to the extended plant shutdown. The purpose of this meeting is to coordinate activities during said shutdown.

3. The third meeting is to be held during the middle of the extended shutdown to discuss progress and final coordination activities.
- C. The following I&C Coordination Meetings will be attended, as a minimum, by the OWNER's representatives, the CONTRACTOR and CSI, and the ENGINEER's representatives.
1. The first meeting shall be held in advance of the first I&C shop drawing submittal. The purpose of the meeting shall be for the CONTRACTOR to summarize their understanding of the I&C portions of the project, discuss any proposed substitutions or alternatives, schedule testing and delivery milestone dates, provide a forum to coordinate any hardware and software related issues, and request any additional information required from the OWNER.
 2. The second meeting shall be held after the first complete I&C shop drawing package(s) has been reviewed by the OWNER and returned. The purpose of the second meeting is to discuss comments made on the submittal packages, to refine scheduled milestone dates, to coordinate I&C equipment installation activities and to provide a forum to any further required coordination.
 3. The third meeting shall be held one month prior to field testing. The purpose of the third meeting is to discuss any remaining coordination requirements. The CONTRACTOR shall coordinate with the CSI to present a simulation of individual and plantwide system controls with proposed HMI screens.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 LIQUIDATED DAMAGES

- A. The CONTRACTOR understands and agrees that the time of completion is an essential consideration of development of their proposal and that failure to complete the work under this Contract, within the allotted time as specified or subsequently adjusted by Change Orders will result in damages to be sustained by the OWNER. The CONTRACTOR and OWNER further agree in applying Liquidated Damages that such damages cannot be precisely measured or that the ascertainment of actual damages would be unduly difficult after the fact. Therefore, the CONTRACTOR and the OWNER agree in applying Liquidated Damages that for each and every Calendar Day the work, or any portion thereof, remains uncompleted after the specified times or adjusted times if modified by Change Order, the CONTRACTOR shall pay as agreed Liquidated Damages, the amounts specified in the Special Conditions.

END OF SECTION

SECTION 01045

CUTTING AND PATCHING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers the cutting, coring, rough and finished patching of holes and openings. Holes and openings may be in existing construction, or in parts of new construction. Procedures for cutting and patching will be the same for either condition.
- B. Provide all cutting, fitting and patching, including attendant excavation and backfill, required to complete the work or to:
 - 1. Make its several parts fit together properly.
 - 2. Uncover portions of the work to provide for installation of ill timed or improperly scheduled work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to requirements of Contract Documents.
 - 5. Remove samples of installed work as specified for testing.
 - 6. Provide penetrations of structural surfaces and materials for installation of piping, ductwork, equipment and electrical conduit.
 - 7. Provide penetrations of non-structural surfaces and materials for installation of piping, ductwork, equipment and electrical conduit. The determination of what is a nonstructural surface or material shall be made by the ENGINEER.
 - 8. Remove, install, or relocate materials or equipment.

1.02 RELATED WORK

- A. Summary of Work is included in Section 01010.
- B. Site work is included in Division 2.
- C. Concrete is included in Division 3.
- D. Masonry is included in Division 4.
- E. Duct penetration assemblies are included in Division 15.
- F. Conduit sealing methods are included in Division 16.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, a written request prior to executing any cutting or alteration which is not shown or detailed on the Contract Documents which affects or requires:
 - 1. Cutting structural members.
 - 2. Holes drilled in beams or other structural members.
 - 3. Work of the OWNER or any separate contractor.
 - 4. Structural value or integrity of any element of the project.
 - 5. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - 6. Efficiency, operational life, maintenance or safety of operational elements.
 - 7. Visual qualities of sight-exposed elements.
- B. Request shall include:
 - 1. Identification of the project.
 - 2. Description of affected work.
 - 3. The reason for cutting, alteration or excavation.
 - 4. Effect on work of OWNER or any separate contractor, or on structural or weatherproof integrity of project.
 - 5. Description of proposed work:
 - a. Method and extent of cutting, patching, alteration, or excavation.
 - b. Trades who will execute the work.
 - c. Products proposed to be used.
 - d. Extent of refinishing to be done.
 - 6. Alternatives to cutting and patching.
 - 7. If the work is considered out of scope, provide a cost proposal.
 - 8. Confirmation of coordination with any separate contractor whose work will be affected.

- 9. Related shutdown requests if required to do the work.
- 10. Request for hot work permit if required to do the work.
- C. Submit written notice to the ENGINEER designating the date and the time the work will be uncovered.
- D. When a written request is required, do not proceed with the work until a written notice to proceed is received from the ENGINEER.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Comply with specifications and standards for each specific product involved. Where there is no equivalent specification, the CONTRACTOR shall notify the ENGINEER who will provide a specification for the materials to be used.
- B. Concrete and grout for rough patching shall be as specified in Divisions 3.
- C. Materials for finish patching shall be equal to those of adjacent construction. Where existing materials are no longer available, use materials with equivalent properties and that will provide the same appearance. The materials are to be approved by the ENGINEER prior to their use.

PART 3 EXECUTION

3.01 INSPECTION

- A. Inspect existing conditions of project, including elements subject to damage or to movement during cutting and patching.
- B. After uncovering work, inspect conditions affecting installation of products, or performance of work.
- C. Report unsatisfactory or questionable conditions to the ENGINEER in writing; do not proceed with work until the ENGINEER has provided further instructions.

3.02 PREPARATION

- A. Provide adequate temporary support as necessary to assure structural value or integrity of affected portion of work.
- B. Protect surrounding materials and equipment prior to starting work.
- C. Contain and control cooling liquids and slurry produced by the cutting and coring operations.
- D. When the cutting or coring will result in the structure or equipment being exposed provide adequate weather protection.

3.03 PERFORMANCE

- A. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.
- B. Execute excavating and backfilling by methods which will prevent settlement or damage to other work. When excavating in close proximity to piping, duct banks or other items subject to damage, use hand excavation.
- C. All equipment and workplace safety shall conform to OSHA standards and specifications pertaining to plugs, noise and fume pollution, wiring and maintenance.
- D. Where possible, employ original installer or fabricator to perform cutting and patching for:
 - 1. Weather-exposed or moisture-resistant elements.
 - 2. Sight-exposed finished surfaces.
- E. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.
- F. Restore work which has been cut or removed; install new products to provide completed work in accordance with requirements of Contract Documents.
- G. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:
 - 1. For continuous surfaces, refinish to nearest intersection.
 - 2. For an assembly, refinish entire unit.
- H. Remove rubble and excess patching materials from the premises.

3.04 CORING

- A. All coring shall be performed in such a manner as to limit the extent of patching. Locate the rebar before coring to minimize cut throughs.
- B. Coring shall be performed with an approved non-impact rotary tool with diamond core drills.
- C. Size of holes shall be suitable for pipe, conduit, sleeves, equipment or mechanical seals to be installed.
- D. Fit work to minimize space to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- E. Fit to pipes and other penetrations in tanks to be water tight using seals or other methods defined in the specifications.

- F. All holes cut through concrete and masonry walls, slabs or arches shall be core drilled unless otherwise approved. All work shall be performed by mechanics skilled in this type of work.
- G. If holes are cored through floor slabs they shall be drilled from below where possible. If holes are drilled from above, provide protection and containment below the area being drilled to catch the plug and contain liquid and slurry.

3.05 CUTTING

- A. All cutting shall be performed in such a manner as to limit the extent of patching.
- B. Fit work to minimize space to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- C. Cutting shall be performed with a concrete saw and diamond saw blades of proper size.
- D. Provide for control of slurry generated by sawing operation on both sides of wall and from below if cutting a floor.
- E. When cutting a reinforced concrete wall or floor, the cutting shall be done so as not to damage the bond between the concrete and reinforcing steel left in structure. Cut shall be made so that steel neither protrudes nor is recessed from face of the cut.
- F. Adequate bracing of area to be cut shall be installed prior to start of cutting. Check area during sawing operations for partial cracking and provide additional bracing as required to prevent a partial release of cut area during sawing operations.
- G. Provide equipment of adequate size to remove cut panel.
- H. Saw cut concrete and masonry prior to breaking out sections.
- I. Install work at such time as to require the minimum amount of cutting and patching.
- J. All cutting of structural members shall be done in a manner directed by the ENGINEER.
- K. Cut opening only large enough to allow easy installation of the equipment, ducting, piping or conduit.
- L. When existing conduits or pipe sleeves are cut off at the floor line or wall line, they shall be filled with grout or suitable patching material.

3.06 PROTECTION

- A. Provide devices and methods to protect other portions of project from damage.
- B. Provide protection from elements for that portion of the project which may be exposed by cutting and patching work.
- C. Maintain excavations free from water.

3.07 PATCHING

- A. Rough patching shall be such as to bring the cut or cored area flush with existing construction unless otherwise shown.
- B. Finish patching shall match existing surfaces as approved.
- C. Patching shall be of the same kind and quality of material as was removed.
- D. The completed patching work shall restore the surface to its original appearance or better.
- E. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed to include the joint between the existing material and the patch.
- F. Equipment damaged during cutting and patching shall be replaced or repaired by the equipment manufacturer, at the ENGINEER's sole discretion and at the expense of the CONTRACTOR doing the work.
- G. Repaint any damage to factory applied paint finishes using touch-up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted in accordance with the field painting requirements specified in Section 09902 at the expense of the CONTRACTOR doing the work.
- H. Slurry or tailings resulting from coring or cutting operations shall be contained and vacuumed or otherwise removed from the area following drilling or cut.
- I. Equipment shall be protected against mechanical and water damage during cutting and patching. Provide protective covers or use other means such as temporary relocation to protect equipment that is at risk of damage from the cutting and patching.
- J. Provide protection for existing equipment, utilities and critical areas against water or other damage caused by drilling operation.

END OF SECTION

SECTION 01046
CONTROL OF WORK

PART 1 GENERAL

1.01 PLANT

- A. Furnish workforce and equipment, which will be efficient, appropriate and large enough to secure a satisfactory quality of work and a rate of progress, which will ensure the completion of the work within the Contract Time. If at any time, such workforce appears to be inefficient, inappropriate or insufficient for securing the quality of work required or for producing the rate of progress aforesaid, ENGINEER may order the CONTRACTOR to increase the efficiency, change the character or increase the workforce or equipment and the CONTRACTOR shall conform to such order. Failure of the ENGINEER to give such order shall in no way relieve the CONTRACTOR of his obligations to secure the quality of the work and rate of progress required.

1.02 PRIVATE LAND

- A. Do not enter or occupy private land outside of easements, except by permission of the land owner.

1.03 PIPE LOCATIONS

- A. Pipelines shall be located substantially as indicated on the Contract Drawings, but the ENGINEER reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings are noted on the Contract Drawings, such notation is for the CONTRACTOR's convenience and does not relieve him from laying and jointing different or additional items where required.

1.04 MAINTENANCE OF TRAFFIC

- A. Unless permission to close the area roadways is received in writing from the ENGINEER, all material shall be placed so that vehicular, operational and pedestrian traffic may be maintained at all times. If the CONTRACTOR's operations cause traffic hazards, he shall repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the ENGINEER.
- B. The main traffic to and from the plant as well as within the plant shall not be obstructed by the contractor's operations. The CONTRACTOR shall provide alternate acceptable access for all routine deliveries to the plant such as chemical deliveries, the plant operators or other contractors.
- C. Detours around construction will be subject to the approval of the ENGINEER. Where detours are permitted, the CONTRACTOR shall provide all necessary barricades and signs as required to divert the flow of traffic. While traffic is detoured, the CONTRACTOR shall expedite construction operations. Periods

when traffic is being detoured will be strictly controlled by the ENGINEER.

- D. The CONTRACTOR shall take precautions to prevent injury to the public or OWNER personnel due to open trenches. Night watchmen may be required where special hazards exist. The CONTRACTOR shall be fully responsible for damage or injuries whether or not night watchman protection has been provided.

1.05 CARE AND PROTECTION OF PROPERTY

- A. The CONTRACTOR shall be responsible for the preservation of all public and private property, and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the Work on the part of the CONTRACTOR, such property shall be restored by the CONTRACTOR, at his expense, to a condition similar to that existing before the damage was done, or he shall make good the damage in other manner acceptable to the ENGINEER.
- B. All roadways and walkways which are disturbed by the CONTRACTOR's operations shall be restored as directed by the ENGINEER.
- C. Along the location of this Work all fences, walks, bushes, trees, shrubbery, and other physical features shall be protected and restored in a thoroughly workmanlike manner. Fences and other features removed by the CONTRACTOR shall be replaced in the location indicated by the ENGINEER as soon as conditions permit. All grass areas beyond the limits of construction which have been damaged by the CONTRACTOR shall be regraded and seeded or sodded.
- D. Trees close to the Work shall be boxed or otherwise protected against injury. The CONTRACTOR shall trim all branches that are liable to damage because of his operations, but in no case shall any tree be cut or removed without prior notification of the ENGINEER. All injuries to bark, trunk, limbs, and roots of trees shall be repaired by dressing, cutting, painting according to approved methods, using only approved tools and material.
- E. The protection, removal, and replacement of existing physical features along the line of Work shall be a part of the Work under the Contract, and all costs in connection therewith shall be included in the unit and/or lump sum prices established under the items in the Proposal.

1.06 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

- A. The CONTRACTOR shall assume full responsibility for the protection of all buildings, structures, and utilities, public or private, including poles, signs, services to buildings, utilities in the roadway, process piping, gas pipes, water pipes, hydrants, sewers, drains, and electric and telephone cables, whether or not they are shown on the Contract Drawings. The CONTRACTOR shall carefully support and protect all such structures and utilities from injury of any kind. Any damage resulting from the CONTRACTOR's operations shall be repaired by him at his expense.

- B. Assistance will be given to the CONTRACTOR in determining the location of existing underground utilities. The CONTRACTOR, however, shall bear full responsibility for obtaining all locations of underground structures and utilities (such as existing water lines, gas lines, electrical conduit, drain lines, and sewers) whether or not they are shown on the Contract Drawings. Services to buildings shall be maintained, and all costs or charges resulting from damage thereto shall be paid by the CONTRACTOR.

1.07 WATER SUPPLY FOR CONSTRUCTION PURPOSES

- A. The CONTRACTOR shall provide at convenient points ample supplies of water of proper quality and quantity for all the operations required under this Contract. Water shall be supplied by OWNER, but CONTRACTOR shall be responsible for distribution of the water to required locations on the site and for any wasted water.

1.08 MAINTENANCE OF FLOW

- A. Provide for the flow of sewers, drains and water courses interrupted during the progress of the work, and immediately cart away and remove all offensive matter. Discuss the entire procedure of maintaining existing flow with the ENGINEER well in advance of the interruption of any flow.

1.09 COOPERATION WITHIN AND OUTSIDE OF THIS CONTRACT

- A. The CONTRACTOR and his subcontractors shall cooperate with all firms or persons authorized to perform all Work under this Contract, and shall assist in incorporating the Work of other trades where necessary or required.
- B. Cutting and patching, drilling and fitting shall be carried out where required by the trade or subcontractor having jurisdiction, unless otherwise indicated herein.
- C. The CONTRACTOR shall cooperate with outside Contractors that may be conducting work on the Treatment Facility site during the course of the Contract.

1.10 CLEANUP

- A. During the course of the Work, the CONTRACTOR shall keep the site of his operations in as clean and neat a condition as is possible. Further, he shall also be responsible for any cleaning of OWNER's facilities that become soiled due to his Work. He shall properly dispose of all residue resulting from the construction work and, at the conclusion of the Work, he shall remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures, and any other refuse remaining from the construction operations not specified to become the property of the OWNER and shall leave the entire site of the work in a neat and orderly condition.

1.11 BLASTING

- A. No blasting shall be permitted under this Contract.

1.12 DESIGNATED CONTRACTOR AREAS

- A. Designated areas for the CONTRACTOR staging area (including office and parking) shall be as shown on the Drawings.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01136

GENERAL EQUIPMENT REQUIREMENTS

PART 1 GENERAL

1.01 PRIORITY OF OTHER SECTIONS

- A. Where there is a conflict between this Section and other individual Technical Specifications (Divisions 1-16), the latter shall govern.
- B. See individual Sections for additional information.

1.02 ALTITUDE AND ENVIRONMENTAL CONDITIONS

- A. Unless otherwise noted: Pumps, electric motors, compressors, and similar equipment and all outdoor equipment shall be designed, or modified, to operate satisfactorily for the following conditions:
 - 1. Altitude: Approximately 800 feet above Mean Sea Level (NAVD29)
 - 2. Outside ambient air conditions:
 - a. Summer temperature (max): 100 degrees F
 - b. Summer relative humidity: 80 percent
 - c. Winter temperature (min): 30 degrees F
 - d. Winter relative humidity: 60 percent

1.03 ARRANGEMENT OF EQUIPMENT

- A. Unless specifically noted otherwise, 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 particular to a specific manufacturer. Some features of the illustrated equipment installation may require revision to meet actual equipment installation requirements. Structural supports, foundations, connected piping and valves and electrical and instrumentation connections indicated may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alterations. Substantiating calculations and drawings shall be submitted prior to beginning the Work. Also, see Section 01300.

1.04 QUALIFICATIONS/QUALITY CONTROL

- A. All equipment furnished shall consist of standard equipment of proven ability, modified as required for the requirements of these Contract Documents.
- B. All suppliers shall be fully experienced, reputable, qualified, and regularly

engaged in the manufacturing of the equipment to be furnished.

- C. All equipment shall be designed, constructed and installed in accordance with best practices and methods and shall operate satisfactorily as determined by the ENGINEER when installed as shown on the Drawings and/or specified.
- D. The CONTRACTOR shall have the sole responsibility for proper functioning of the equipment.

1.05 MANUFACTURER'S SERVICES

- A. The CONTRACTOR shall supply Manufacturer's services as specified in Section 01715.
- B. The CONTRACTOR shall supply bound sets of Operation and Maintenance (O&M) manuals for each unit or system as required in Section 01730.
- C. Service and parts shall be available from no further away than 100 miles from the project site, except as otherwise specified, and the respective manufacturers shall so certify.

1.06 TOOLS AND SPARE PARTS

- A. All special tools and the manufacturer's standard set of spare parts required for the normal operation and maintenance of respective items of equipment in the Divisions noted in Paragraph 1.05 shall be furnished with those items of equipment by the manufacturer. This includes special tools, instruments, accessories required for proper "in-plant" adjustment, maintenance, overhaul, and operation. Tools shall be high-grade, smooth, forged, alloy tool steel.
- B. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment, whether identified in the manufacturer's standard manual or not.
- C. All spare parts shall be carefully packed in sealed, weather-resistant cartons and all tools packed in metal tool boxes with locking clasps, each labeled with indelible markings, and shall be adequately treated for a long period of storage. Complete ordering information including manufacturer's name and address, part ordering information including manufacturer, part number, part name, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The tools and spare parts shall be delivered and stored in a location directed by the ENGINEER no later than 30 days prior to scheduled field testing. A list of spare parts, respectively, shall be placed in each storage container and a duplicate list included with the operations and maintenance manuals.
- D. Additional and specific spare parts and tools for certain equipment provided have been specified in the pertinent Sections of the Specifications. The CONTRACTOR shall collect and store all spare parts so required in an area to be designated by the ENGINEER. In addition, the CONTRACTOR shall furnish to the ENGINEER an inventory listing all spare parts, the equipment they are associated with, the name and address of the supplier, and the delivered cost of each item. Copies of the actual invoice for each item shall be furnished with inventory to substantiate the delivery.

- E. Special tools and spare parts shall be new and shall not be utilized by the CONTRACTOR.

1.07 REMOVAL OF EQUIPMENT

- A. The CONTRACTOR shall not proceed with the removal of any existing structures, equipment, piping, or appurtenances without specific approval by the ENGINEER. Any equipment, piping, or appurtenances removed without proper authorization, which are necessary for the operation of the existing plant, shall be replaced to the satisfaction of the ENGINEER at the CONTRACTOR's expense.
- B. All existing materials and equipment that are removed are the property of the CONTRACTOR unless otherwise noted.

PART 2 PRODUCTS

2.01 MATERIAL AND EQUIPMENT-GENERAL

- A. These Specifications call attention to certain features, but do not purport to cover all details of construction of the units. However, the CONTRACTOR shall furnish and install the mechanisms and/or systems complete in all details and ready for operation when external connections are made. Where components standard with the manufacturer are not specifically mentioned, such components shall be provided and incorporated in the work as if they had been completely described or detailed, at no additional expense to the Utility.
- B. The structural Drawings show the primary structure and it's framing members. Where materials or equipment not part of the primary structure are to be supported by it, and where the method of attachment is not shown or specified elsewhere, the CONTRACTOR shall provide all members and connection details necessary to transfer the loads of the materials and equipment to the primary structural frame. Subframing necessary for this purpose shall be designed by a Civil or Structural Engineer registered in California, and shall be adequate for all loads caused by the weight and operation of the equipment and other loads required by the Codes used for the design of the structure involved. The designer shall provide the ENGINEER with the design and calculations, and shall specifically reference the resulting loads to be transferred at each connection to the primary frame. Where connections are made to roof framing, penetrations of the waterproof roof covering shall be kept to a minimum, and the steel decking shall not be used to support the loads. The framing provided will be rejected if the ENGINEER determines that it will in any way damage any members of the primary structural frame or any other elements of the building or structure.
- C. All steel members used in the fabrication of the equipment shall conform to the requirements of "Specifications for Structural Steel", ASTM A36.
- D. Fabrication of structural steel members shall be in accordance with the latest edition of AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings". Zinc Coating (hot dip) for Steel Shapes, Bars, Plates and Strip shall be in accordance with the latest edition of ASTM A123. Zinc Coating (hot dip) for Iron and Steel Hardware shall be in accordance with

the latest edition of ASTM A153. All welding shall conform to the latest standards of the American Welding Society.

- E. All parts shall be amply proportioned for all stresses which may occur during fabrication, erection, and operation. All parts of the same size and type shall be identical.

2.02 BOLTS, NUTS AND WASHERS FOR EQUIPMENT

- A. Bolts for the equipment assembly shall be refined bar iron, except that where the equipment body is stainless steel, aluminum or a bronze alloy, the bolts shall be of the same corrosion resistant material. Hexagonal nuts shall be of the same metal as the bolts. All threads shall be clean cut, coarse threads, Class II fit, and shall conform to U.S. Standard BL 1-1060 for United Screw Threads unless otherwise specified.
- B. All flanges, bolts, nuts, washers for piping and equipment assemblies in wet or corrosive environments shall be Type 316 stainless steel.

2.03 SHAFT COUPLINGS

A. General

- 1. Shaft couplings for direct connected electric motor driven equipment 1/2 horsepower or larger shall be type I or type II as specified herein. Where requirements of the equipment dictate specialized features, the manufacturer may substitute the coupling normally supplied for the service. All couplings shall be non-lubricated type, designed for not less than 50,000 hours of operating life.
- 2. Coupling sizes shall be as recommended by the manufacturer for the specific application, considering horsepower, speed of rotation, and type of service. The use of couplings as specified herein shall not relieve the CONTRACTOR of his/her responsibility for precision alignment of all driver-driven units as specified by the equipment manufacturer.

B. Type I Couplings

- 1. Positive displacement pump applications with high torque loads (such as conveyor belts) and reversing equipment or equipment where sudden torque reversals may be expected shall be connected to their drivers by flexible couplings 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 built-up elastic member comprised of synthetic rubber, duct wire reinforcement 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 fit. There shall be no metal-to-metal contact between the driver and driven unit.

C. Type II Couplings

1. Type II couplings shall be employed on normal torque, non-reversing applications. Type II couplings shall be of the pin and preloaded neoprene cylinder type, designed to accommodate shock loading, vibration and shaft misalignment or offset. Stub shafts shall be connected through collars or round flanges firmly keyed to their shafts, to neoprene cylinders held to individual flanges by through pins. Couplings with cylinders pinned to both coupling flanges will not be acceptable.

2.04 GUARDS

- A. All exposed moving parts shall be provided with guards in accordance with the requirements of OSHA. Guards shall be fabricated of flattened expanded metal screen, 3/4-inch No. 10, to provide visual inspection of moving parts without removal of the guard.
- B. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts. Windows shall be provided in the guard for access to lubricating fittings.

2.05 NAMEPLATES

- A. All equipment shall have nameplates.
- B. Equipment nameplates shall be engraved or stamped on stainless steel and fastened to the equipment (except pipework) in an accessible location with oval head stainless steel screws or drive pins.
- C. Nameplates shall as a minimum contain manufacturers name and address; year of manufacturer; serial number; capacity, speed (if applicable) and other applicable information as acceptable to the ENGINEER. See also Section 16001 for motor nameplates.

2.06 BEARINGS AND LUBRICATION FITTINGS

- A. Unless otherwise specified all equipment bearings shall be oil or grease lubricated, ball or roller antifriction type of standard manufacturer. Bearings shall be conservatively designed to withstand all stresses of the service specified and shall be selected on the basis of a 60 degree C ambient temperature. Each bearing except when otherwise noted, shall be rated in accordance with the latest revisions of AFBMA Methods of Evaluating Load Ratings of Ball and Roller Bearings for one of the following classes of B-10 rating life: Class M1, 8,000 hours of operation; Class M2, 20,000 hours of operation; Class M3, 50,000 hours of operation; Class M4, 100,000 hours of operation and Class M5, 200,000 hours of operation.
- B. Unless otherwise noted, all process-associated equipment, including motors, drivers, and driven units shall have, as a minimum, bearings for Class M3 life. See also Section 16001 for additional requirements for motor bearings.
- C. All 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 type designed for use with quick hydraulic couplings attached to grease guns. All equipment shall be equipped with an identical type of pressure grease fittings, Alemite, Zerk, or equal.

- 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 degree C and shall be equipped with a filler pipe and an external level indicator gauge.
- E. To avoid work hardening or "brinelling" damage from vibration, bearings shall be removed and shipped separately, or rotating parts of machinery shall be locked in place to prevent movement during transport.

2.07 EQUIPMENT MOUNTS, GROUTING AND VIBRATION ISOLATION

- A. Equipment mountings shall be as shown on the Drawings. Where a steel or cast base is shown between the equipment and a concrete pedestal, it shall be painted after fabrication in conformance with applicable provisions of Division 9. It also shall be equipped with drain pans and drain connections, including piping, where applicable.
- B. All concrete plan dimensions for bases or pedestals shall be at least 2 inches larger in each dimension than the steel or cast base installed thereon. Dimensions shall be increased as required to obtain the minimum edge distance for anchorage. Conduits, piping connections, drains, etc., shall be installed as shown on the Drawings, or if not shown, as acceptable to the ENGINEER.
- C. Where specified or noted in the Drawings, the equipment, including the base, shall be mounted on or suspended from vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the supporting structure. Vibration isolation available internally in the equipment unit is not equivalent and shall not be provided when vibration isolation as specified herein is required by these Specifications. Normally provided internal vibration isolators need to be replaced with rigid supports in such cases.
- D. Where required for certain units of mechanical equipment, details of the vibration isolators are included in the Specifications for furnishing and installing those units.
- E. The CONTRACTOR shall furnish the necessary materials and construct suitable raised, reinforced concrete foundations for all CONTRACTOR-installed equipment, even though such foundations may not be indicated on the Drawings. The tops of foundations shall be at such elevations as will permit grouting as specified in this Paragraph 2.07.
- F. In setting pumps, motors, and other items of equipment customarily grouted, the CONTRACTOR shall make an allowance of at least one (1) inch for grout under the equipment bases. All shims shall be removed. Unless otherwise approved, all grout shall be nonshrinking grout, acceptable to the ENGINEER.
- G. Grout shall be mixed and placed in accordance with Division 2. Where practicable,

the grout shall be placed through the grout holes in the base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.

- H. Where such procedure is impractical, the method of placing grout shall be as acceptable to the ENGINEER. After the grout has hardened sufficiently, all forms, hoppers and excess grout shall be removed, and all exposed grout surfaces shall be patched in an acceptable manner to the ENGINEER, and if necessary, given a burlap-rubbed finish, and painted with at least two coats of paint, as noted in Division 9.

2.08 EQUIPMENT ANCHORAGE REQUIREMENTS

- A. Structural requirements for equipment anchors shall be as specified in Section 05500.
- B. Anchor bolts, nuts, washers, and bolt sleeves located in or above any wetted water-containing structure or channel, and also chemical containment areas, shall be Type 316 stainless steel; all other anchor bolts, nuts, washers, and bolt sleeves shall be galvanized or zinc coated (after being threaded) by the hot-dip process in conformity with ASTM A153.
- C. Cast-in-concrete anchor bolts shall be installed and used whenever possible. Expansion anchor bolts, nuts, and washers, located in or above any wetted water containing structure or channel, and also chemical containment areas, shall be 316 stainless steel equal to Hilti Kwik Bolt II; in all other areas expansion anchor bolts, nuts, and washers shall be zinc plated steel equal to Hilti Kwik Bolt II. All expansion anchor bolts used shall have current ICBO evaluation reports. Chemical anchor bolts, only if approved by the ENGINEER, shall be Hilti Hit C-100, Ramset/Red Head Epcon, or equal with ICBO evaluation reports. No cinch anchor, expansion anchor, or chemical anchor shall be used on vibrating equipment greater than 2.0 horsepower.
- D. For all equipment weighing 400 pounds (181 kilograms) or more, the minimum anchor bolt (including expansion anchor bolt and chemical anchor bolt) diameter shall be 5/8-inch. The minimum anchor bolt diameter for all other equipment shall be 3/8-inch. All anchor bolts securing equipment to be grouted shall be furnished with leveling nuts, the faces of which shall be tightened against flat surfaces to not less than 10 percent of the bolt's safe tensile stress.
- E. Anchor bolts and expansion bolts shall be set accurately. Anchor bolts shall be set before the concrete has been placed and shall be carefully held in position with suitable templates of an acceptable design. If adhesive or expansion bolts are set after the concrete has been placed, all necessary drilling, grouting, caulking, repairs, and cleaning shall be done by the CONTRACTOR at CONTRACTOR's expense. The CONTRACTOR shall locate existing rebar using non-destructive methods prior to drilling holes for adhesive or expansion anchors and adjust spacing of anchors to miss existing reinforcing. Care shall be taken not to damage the structure or finish by cracking, chipping, spalling or otherwise during the drilling, expanding and caulking.

- F. No equipment shall be anchored to vertical structural elements without written approval of the ENGINEER, except pipe hangers, supports or anchorage as specified.

2.09 ELECTRICAL DEVICES FURNISHED WITH MECHANICAL EQUIPMENT

- A. The electrical Drawings detail only the major components, conduits, and wiring required for the first named mechanical system. Mechanical equipment suppliers are specifically referenced to the electrical Drawings. It is the responsibility of this specification section (exclusive of Division 16 unless otherwise specified) to provide all electrical, instrumentation, and control hardware, conduit and/or wiring which is not detailed, but which is required for complete system operation. Should alternative mechanical systems be submitted and approved which are inconsistent with the electrical, instrumentation, or control requirements of the system design, all additional electrical, instrumentation, and control hardware, conduit, wiring, and appurtenances required shall be provided in conformance with Division 16 and at no additional cost to the OWNER. Drawings noted with the wording "confirm wire size and count with manufacturer's shop drawings" are an aid in determining applicability of this specification section.
- B. All equipment shall be NEMA rated, UL listed, and suitable for the area classification of its location.
- C. The systems governed by this Section shall contain control panels which include instrumentation and control equipment furnished by the mechanical system supplier. In some instances the panels, along with instruments, motors, and connecting wiring, are completely mounted on the units furnished. In other cases, the panels are furnished separately for floor or wall mounting. All panels and equipment requiring field interconnection wiring shall be provided with terminal connections which are clearly marked. The mechanical system supplier shall furnish a complete field wiring diagram showing all required interconnections labeled consistently with the terminal markings. It shall be the responsibility of the mechanical system supplier (in developing the interconnection and riser wiring diagrams) to confirm compatibility of devices furnished with the system and with devices in other systems.
- D. Unless otherwise specified or shown, all electrical power, control, or instrumentation devices and construction furnished as a "package" with mechanical equipment shall conform to the latest issue of and addenda to the Electrical Standard for Industrial Machinery 1985 (ANSI/NFPA 79) or as modified herein, and shall be as specified in the appropriate sections of Division 16 of these Specifications.
- E. Panels housing electrical equipment shall be NEMA 4X (corrosion resistant) or NEMA 12 (dust tight) suitable for floor or wall mounting as per detailed on the electrical Drawings. Where specified to be NEMA 4X refer to Section 16110 for construction details.
- F. Separate power, control and instrumentation terminal strips shall be provided for all external panel connections. All terminal points shall have identification numbers as acceptable to the ENGINEER. For the purposes of this Section, the

following definitions shall apply: power = 480 volts or 120 volts (in excess of 15 amps); control = 120 volts (less than 15 amps); instrumentation = 4-20 ma or miscellaneous low voltage signals (24 VDC, etc).

- G. All panels housing electrical equipment shall be designed for front access only unless otherwise noted.
- H. Conductors extending beyond a panel to other auxiliary equipment which is prewired on a skid type or package base shall be protected by galvanized rigid steel conduit. Where terminating at a motor or other similar device requiring frequent movement or which produces excessive vibration, liquid tight type flexible conduit shall be used. Liquid-tight conduit will be limited to three feet maximum length at any termination.
- I. Gasketed type conduit hubs will be used for all conduit penetrations of the panel.
- J. The main panel power disconnect handle shall be externally mounted (operable with the enclosure door closed) and padlockable in the off position. A main panel power disconnect device shall be an integral part of the panel and shall be one of the following types:
 - 1. A horsepower rated heavy duty fusible safety switch or thermal magnetic circuit breaker for 480 volt, 3 phase panels.
 - 2. A heavy duty fusible safety switch, circuit breaker or fractional horsepower manual motor starter switch without overloads for 120 volt, 1 phase panels.
- K. Unless otherwise noted all panels supplied with a 480 volt power feeder shall be provided with an integrally mounted dual winding 120 volt power or control power transformers with KVA as required. Control power transformers shall have primary and secondary fusing. Power transformers shall have circuit breaker primary and secondary protection. All transformers shall have the neutral grounded.
- L. Starters incorporated into panels shall be of the combination circuit breaker type with thermal type overload relays in each ungrounded conductor. Overloads shall be adjustable for either manual or automatic reset.
- M. All wiring shall be copper conductors with NEC insulation designation of MTW or THWN. All wiring shall be neatly bundled, with continuous color coding and proper identification tagging to coordinate with the schematics.
- N. All devices shall be of a heavy duty industrial type quality. Devices mounted in panel interiors shall be suitable for use in non ventilated panels subjected to a 40 degree C ambient without de-rating the system.
- O. Schematic (elementary) diagrams, wiring (interconnection) diagrams, riser (interconnection with external components) diagrams, panel interior and exterior elevation drawings and equipment lists shall be furnished for all panels. For panels containing a complex control scheme, a written operational theory shall be cross referenced to the schematic diagram. The wiring diagram in its "as-built" form shall

be fastened to the panel door. The equipment list shall identify the manufacturer, manufacturer's part or model number and a cross reference as to its location in the panel. Nameplates shall be attached to the front of the panels to indicate device functions, names, etc.

- P. Contacts for external alarms or equipment interlocking shall be of the isolated contact type and provided as required per individual equipment specifications and Drawings. Contacts shall be rated at 10 amps continuous pilot duty. Unless noted otherwise, alarm contacts shall be of the maintained contact type requiring manual reset at the control panel via a suitably labeled reset pushbutton.
- Q. Input or output instrumentation level signals shall in general be 4-20 ma and provided as required per the Specifications and the Drawings.
- R. Auxiliary devices (solenoid valves, pressure switches, flow switches, etc.) located remotely from panels but furnished with the equipment shall have enclosures in conformance with the area classification noted on the Drawings.
- S. Unless otherwise noted control panels furnished under this section shall contain door mounted control pushbuttons, selector switches, push-to-test red-run-lights, etc., as required for proper system operation, control, and monitoring. This equipment shall be mounted on the door of the control panel and comply with the panel NEMA requirements.
- T. The electrical short circuit interrupting rating of the starters and circuit breakers supplied shall be adequate for its location in the system and shall be (1) equivalent to the rating of the feeder device furnished under Division 16, (2) a UL recognized as a series rated device with the feeder breaker furnished under Division 16, or (3) is adequately protected by the feeder breaker furnished under Division 16.
- U. Panels containing low voltage (less than 120 VAC or DC) digital or 4-20 ma analog control devices and circuits or PLC components shall have physical separation from 480 volt power devices within the panel.
- V. All components and systems shall conform to the requirements of Division 16.

2.10 LUBRICANTS AND FUEL

- A. The CONTRACTOR shall provide all mechanical equipment with a sufficient supply of correct lubricants and fuel for starting, testing, the initial 30-day operation period, and one year's supply of lubricants under normal operating conditions. All lubricants and fuel shall be of types recommended by the applicable equipment manufacturer. The CONTRACTOR, subject to the approval of the equipment's manufacturer, shall limit lubricants to the least number or types required for normal maintenance of all equipment. Lubrication and fittings are included in Paragraph 2.08.

2.11 LIFTING LUGS

- A. Lifting lugs or lifting eye bolts shall be provided for all equipment or any component weighing 50 pounds or more, for setting of units or future removal.

They shall be galvanized or zinc plated steel.

2.12 VIBRATION

- A. Except as subsequently modified for particular cases by these Specifications, all rotating/moving, mechanical equipment shall not exhibit unfiltered readings in excess of the following amplitudes:

<u>Speed Range</u>	<u>Antifriction Bearings^a</u>	<u>Sleeve Bearings^b</u>
900 rpm and below	3.0 3.0 mils	3.5 mils
901-1800 rpm	2.2 3.0	
1801-3000 rpm	1.3 2.5	
3001-4500 rpm	1.0 2.0	
4501 and above	0.5 1.6	

^a Measured on bearing housing in vertical axial and horizontal direction.

^b Relative shaft-to-casting motions for both rigid mounted and isolator mounted equipment.

- B. Axial shaft vibration displacements (relative to casing) shall not exceed 50 percent of the maximum lateral shaft vibration displacements (relative to casing existing at any point along the shaft).
- C. The above vibration responses are to include the range from 5.0 Hz to 5000 Hz and shall therefore encompass both low and high frequency responses of the subject equipment. The measurements shall be obtained with the equipment installed and operating at any capacity within the specified operating range. In addition to these maximum unfiltered readings, it is also required that no narrow band spectral acceleration component, whether subrotational, higher harmonic or asynchronous multiple of running speed, shall exceed 40 percent of the synchronous displacement amplitude component without manufacturer's detailed verification of the origin and ultimate effect of said excitation.
- D. A field vibration test will be required of all rotating or reciprocating machinery. This test will be provided by the CONTRACTOR using an independent testing firm as subcontract work. Test personnel shall be experienced in vibration testing and all testing shall be witnessed by the ENGINEER. The CONTRACTOR shall provide a minimum of 2 working days notification of the testing date to the ENGINEER.

2.13 REQUIREMENTS

A. General

1. Unless otherwise specified, the maximum permissible "free field" noise level for a complete piece of mechanical equipment which is to be located within a structure shall not exceed 85 dBA at a distance of 3 feet from the equipment and 5 feet from the floor with the equipment operating at any load point up to and including rated load in accordance with the specification. For the purposes of this Paragraph, "free field" shall be the noise level measured when the equipment is in a non-reflective environment and shall include the driver, driven equipment and any intermediate couplings, gears and auxiliaries.

2. Maximum permissible noise levels are in decibels as read on the "A" weighting network of a standard sound level meter (dBA); all measurements are made in relation to a reference pressure of .0002 microbar. Measurements of emitted noise levels shall be made on a sound level meter meeting at least the Type II requirements as set forth in ANSI S1.4 "Specification for General Purpose Sound Level Meters". The sound level meter shall be set on the "A" scale and to slow response. Unless changed in the specific section relating to a particular piece of equipment, the point of measurement of sound level shall be made at the specified distance from any major surface along the entire perimeter and at mid-height of the piece of equipment. If midheight is not easily determinable, then line of measurement shall be at a height level with the apparent noise source. To assure accuracy, the sound level meter shall be acoustically calibrated with an appropriate instrument, prior to test measurement.
3. The maximum allowable noise level at the property line shall not exceed 55 dBA.

B. Testing

1. The CONTRACTOR shall furnish for each piece of rotating/moving equipment prior to shipment to the job site, a certified factory noise test report on the actual equipment to be provided or an unconditional guarantee that the equipment when operating under design conditions will not produce noise exceeding the permissible levels specified.
2. Noise measurements shall be accomplished at the factory or at such other location approved by the ENGINEER; in any event, these measurements shall be accomplished prior to shipment of any equipment to the job site. The measurements shall take place in a reverberant or semireverberant condition, with equipment sitting on a hard reflective surface or conditions which duplicate the circumstances under which the equipment will operate in this project.
3. Noise level measurements shall be taken or observed by an independent acoustical laboratory or consultant retained and paid for by the CONTRACTOR. Such independent acoustical laboratory or consultant shall be qualified by experience in the acoustical field to take such measurement and shall be responsible for conducting them in accordance with accepted procedures for the measurement of sound. The laboratory or consultant shall be acceptable to the ENGINEER. Such person responsible for the tests shall certify the maximum noise levels emanating from the equipment, its operating conditions, the environment in which tests were conducted, a list of the acoustical instruments used, and the points at which the measurements were made. The description shall be efficiently detailed to permit the test to be repeated, and it shall include a sketch of the item being measured which shows the points of measurement and the point of maximum encountered noise level on the measurement.
4. If the CONTRACTOR provides an unconditional guarantee, the ENGINEER may request field tests for noise generation which shall be conducted at the CONTRACTOR's expense by an independent acoustical laboratory or

consultant acceptable to the ENGINEER. In the event that the noise level is in excess of the allowable limits, appropriate field noise reduction measures shall be undertaken to reduce the noise to the allowable limits. If the noise level is within the allowable limits the District will pay the CONTRACTOR only for all reasonable expenses directly incurred in conducting the test. Delay, incidental, or extended overhead expenses or claims will not be paid. All field noise reduction measures shall be at the CONTRACTOR's expense and shall be acceptable to the ENGINEER prior to installation. Rated capacities, operation and normal maintenance procedures of the equipment shall not be affected by the noise reduction measures.

(Note: noise and vibration tests can be done by the manufacturer's representatives if they are so qualified).

2.14 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, suitable insulation as acceptable to the ENGINEER shall be provided between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis. The insulation shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials.

2.15 PROVISION FOR TEMPORARY PRESSURE GAUGE CONNECTION

- A. Where pressure gauges are not shown on the suction and discharge piping of pumps, compressors, and blowers, the CONTRACTOR shall make provision for the temporary connection of pressure gauges by providing a 1/2-inch connection and tee handle isolation ball valves or corporation stops.

PART 3 EXECUTION

3.01 FACTORY INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

- A. The ENGINEER shall have the right to inspect and test all materials or equipment prior to shipment from the point of manufacture.
- B. Noise and vibration testing, as noted in this Section shall be performed for all applicable units. In addition, where specified, or where required by the referenced standard specification, the units (and system where applicable) shall have additional required factory tests performed. At least 15 days notice shall be given to the ENGINEER to allow the opportunity for the ENGINEER to be present at the test.
- C. Where a factory test is required, no materials or equipment shall be shipped until the shop drawings and factory test are acceptable to the ENGINEER.
- D. Additional information on factory inspection and testing of pipes is included under the respective pipe Sections.
- E. Unless otherwise noted, the manufacturer will furnish all necessary labor, equipment, tools, water and/or waste water, incidentals and power required for

proper factory testing of equipment and correction of deficiencies, at no change in Contract Price.

3.02 SHOP AND FIELD PAINTING/COATING

- A. Unless otherwise specified herein or elsewhere in these Specifications (See Division 9 and individual Sections): All motors, drives, pumps, and other manufactured items installed above ground or in buildings shall be shop primed and provided with manufacturer's standard synthetic or baked-on enamel finish paint. Generally, all manufactured items will be painted after installation by the CONTRACTOR. Where surfaces have been shop painted but have been damaged during delivery to site, storage, and/or assembly, or where the shop coats have deteriorated, these surfaces shall be properly cleaned and retouched or repainted with matching paint prior to field painting.
- B. Galvanizing, for materials other than bolts subject to Part 2 of this Section, shall conform to Section 05500.

3.03 INSTALLATION OF EQUIPMENT

- A. See Paragraph 1.05 for required manufacturer's services. Unless otherwise noted the CONTRACTOR will furnish, pay for and coordinate all necessary labor, equipment, tools, water, and power required to install, service, and make adjustments necessary for the proper installation and shall perform the installation.
- B. Ensure proper installation of all items in accordance with manufacturer's recommendations and instructions in the location(s) shown to produce a complete workable system; particularly to ensure the correct alignment of drivers and pumps, etc. All units shall be aligned on their foundations by qualified millwrights after their sole plates have been shimmed level at the anchor bolts. Set all anchor bolts in place and tighten all nuts against the shims. After the foundation alignments have been considered acceptable to the ENGINEER, securely bolt in place the bedplates or wing feet of the equipment. Make further and final alignment checks and any adjustments before grouting in the sole plates. Under no circumstances will "pipe springing" be allowed.
- C. Wedges, shims, filling pieces, keys, packing, grout, or other materials necessary to align, level, and secure equipment in place shall be furnished and installed by the CONTRACTOR. All parts intended to be plumb, level or perpendicular must be exactly so. Any grinding required to bring parts to proper bearing shall be done at the expense of the CONTRACTOR.
- D. Normal installation procedures for all items (including City furnished items if any) such as: making connections, adjusting packing, aligning, connection of bases, coupling, wiring, piping, shimming, assembly of normally shipped loose components, use of drift pins, deburring, identification of wires at terminals, following manufacturer's instructions and similar items of standard installation practice shall be performed by the CONTRACTOR whether specifically mentioned herein or not. References are made to: AISC "Code of Standard Practices" Section 5-180; "Standards of the Hydraulic Institute"; American Welding Society

Standards, applicable government codes.

- E. Installation shall include furnishing the grease and lubrication for testing and one year's supply under normal operating conditions.

3.04 FIELD TESTING AND CORRECTION OF DEFICIENCIES

- A. Field testing shall not be conducted until the installation is certified (in writing) as acceptable by the manufacturer. Field testing may not be required for all items. Testing shall be conducted in accordance with the individual Specification Sections and Section 01665.
- B. The manufacturer shall furnish to the ENGINEER and the CONTRACTOR, at least ninety (90) days prior to scheduled field testing, a list of those special items needed to test the equipment and for use during normal operation and maintenance.
- C. See Paragraph 1.05 for required manufacturer's services. Unless otherwise noted the CONTRACTOR will furnish and pay for all necessary labor, equipment, tools, water and/or wastewater, incidentals, and power required for proper testing and initial operation. Unless otherwise noted the CONTRACTOR will operate the equipment and conduct the field test(s).
- D. Field testing shall be as set out in the individual Specifications and herein for vibration and noise, and shall also include the lubrication system and its components. Field testing shall be witnessed by, and acceptable to, the manufacturer's representative and the ENGINEER, unless otherwise noted.
- E. All defects recorded during the above field tests and all defects and failures occurring within the warranty (guarantee) period shall be corrected by and at the expense of the CONTRACTOR.
- F. In the event the items or system performance does not meet the requirements of the Specifications, the necessary corrective measures shall be made at the expense of and by the CONTRACTOR, unless otherwise specifically noted, and the item or system retested. If the items or system remains unable to meet the design requirements to the satisfaction of the ENGINEER, they shall be removed and replaced with satisfactory items or system(s) at the CONTRACTOR's expense, unless otherwise specifically noted.
- G. The above testing and/or correction procedures shall continue until the items are acceptable to the ENGINEER.

END OF SECTION

SECTION 01170

SPECIAL PROVISIONS

PART 1 GENERAL

1.01 INSTALLATION OF EQUIPMENT

- A. Special care shall be taken to ensure proper alignment of all equipment with particular reference to the pumps and electric drives. The units shall be carefully aligned on their foundations by qualified millwrights after their sole plates have been shimmed to true alignment at the anchor bolts. The anchor bolts shall be set in place and the nuts tightened against the shims. After the foundation alignments have been approved by the ENGINEER, the bedplates or wing feet of the equipment shall be securely bolted in place. The alignment of equipment shall be further checked after securing to the foundations, and after conformation of all alignments, the sole plates shall be finally grouted in place. The CONTRACTOR shall be responsible for the exact alignment of equipment with associated piping and under no circumstances, will “pipe springing” be allowed.
- B. All wedges, shims, filling pieces, keys, packing, grout, or other materials necessary to properly align, level and secure apparatus in place shall be furnished by the CONTRACTOR. All parts intended to be plumb or level must be proven exactly so. Perform all grinding necessary to bring parts to proper bearing after erection.

1.02 REALTED WORK

- A. Disinfection of Piping is included in Section 15141.

1.03 SLEEVES AND OPENINGS

- A. Provide all openings, channels, chases, etc, in new construction and furnish and install anchor bolts and other items to be embedded in concrete, as required to complete the work under this Contract. Perform all cutting, coring and rough and finish patching required in existing construction for the work of all trades.

1.04 CONSTRUCTION PHOTOGRAPHS/VIDEOTAPING OF EXISTING CONDITIONS

- A. All photographic work shall be done by a qualified photographer acceptable to the ENGINEER. All photographs shall be taken in color, not black and white. All photos are to remain confidential and not used for purposes outside of this scope.
- B. The CONTRACTOR shall have twenty-four (24) photographs of the existing facility taken prior to start of construction. The same views shall be rephotographed upon completion of all construction activities.

- C. The CONTRACTOR shall have an average of ten (10) photographs per month made of the work during its progress and thirty-six (36) photographs of the completed facilities, in addition to those required above in paragraph B. The photographs shall be of such views and taken at such times as the ENGINEER directs.
- D. Prior to construction of additions or modifications to existing structures, there shall be taken for each existing structure a minimum of twelve (12) photographs to be used for indicating the condition of existing structure. These photographs shall be in addition to those specified above.
- E. The photographer shall release all copyrights, or other restrictions, on the use of the photographic prints, film negatives and or image files.
- F. Each photograph shall be labeled with the following:
 - 1. Project Name
 - 2. Short Description of View
 - 3. Photo No. and Date Taken
 - 4. Engineering Firm's Name
- G. Prior to the initiation of any construction activities, the CONTRACTOR, as directed by the ENGINEER, shall videotape, in Digital format, the anticipated staging and work areas of the Olivenhain Municipal Water District David C. McCollom Water Treatment Plant site, including the interior and exterior of the buildings and the access driveway. The original of the USB Flash Drive shall be released to the OWNER. The CONTRACTOR shall also provide two (2) copies of the USB Flash Drive to the ENGINEER. A minimum of one (1), two hour color video shall be used to document the existing plant site conditions.

1.05 NAMEPLATES

- A. Each piece of equipment shall be provided with a substantial stainless steel nameplate, securely fastened in place and clearly and permanently inscribed with the manufacturer's name, year of manufacture, model or type designation, serial number, principal rated capacities, electrical or other power characteristics, and similar information as appropriate. These nameplates shall not be painted or of printed type.

1.06 PROGRESS MEETINGS

- A. The ENGINEER shall schedule and administer the progress meetings. It shall be the CONTRACTOR's responsibility to prepare agenda, distribute written notice of the meetings, and make physical arrangements for meetings. The ENGINEER will record the meeting minutes and distribute copies of minutes after each meeting. Regular meetings shall be scheduled at a minimum of biweekly. The

ENGINEER shall call special meetings as progress of work dictates. The meetings will be of hybrid formatting offering both in person and virtual attendance. In person attendance will be held in the CONTRACTOR's construction trailer, or as directed by the ENGINEER.

- B. meetings will be attended by the OWNER's representatives, the GENERAL CONTRACTOR, Prime Contractors and/or subcontractors as pertinent to agenda.

At a minimum, the agenda will include the following:

1. Review of the previous meetings;
2. Review of the work progress since last meeting;
3. Review of safety precautions and potentially hazardous items;
4. Review of housekeeping practices;
5. Discussion of field observations, problems, and decisions;
6. Identification of problems, which impede planned progress;
7. Review of any off-site fabrication problems;
8. Discussion of corrective measures and procedures to regain planned schedule;
9. Review of the Construction Schedule as indicated;
10. Plan progress during next work period and review of the 3 week look ahead;
11. Review submittal schedules, and expedite as required to maintain schedule;
12. Review the maintenance of quality and work standards;
13. Review any changes proposed by OWNER for:
 - a. Effect on Construction Schedule
 - b. Effect on Completion Date
14. Update the summary list and review status of any outstanding Requests for Information;
15. Complete other current business;
16. Coordinate projected progress with other contractors on the project site.

1.07 EXISTING CONDITIONS

- A. Existing conditions shown on the Contract Drawings are approximate only. The CONTRACTOR is responsible for field verifying existing conditions prior to construction, including locations of existing pipelines, conduits and underground utilities that may interfere with the proposed work.

- B. Coordinates shown for existing buildings are approximate only and must be field verified. Coordinates are for the outside corner of the building.

1.08 TWO YEAR CORRECTION PERIOD

- A. Except as otherwise required by other specific provisions of the Contract Documents, the CONTRACTOR shall promptly repair, replace, restore or rebuild, as the OWNER determines, any finished work in which defects of materials or workmanship may appear or to which damage may occur because of such defects during the period of two (2) calendar years commencing on the date of final acceptance, per General Conditions.

1.09 OBSTRUCTIONS

- A. The attention of the CONTRACTOR is drawn to the fact that during excavation at the Project site, the possibility exists of the CONTRACTOR encountering various water, chemical, electrical, or other lines not shown on the Drawings. Exercise extreme care before and during excavation to locate and flag these lines so as to avoid damage to the existing lines. Should damage occur to an existing line, repair the line at no cost to the OWNER.
- B. It is the responsibility of the CONTRACTOR to ensure that all utility or other poles, the stability of which may be endangered by the close proximity of excavation, are temporarily stayed in position while work proceeds in the vicinity of the pole and that the utility or other companies concerned be given reasonable advance notice of any such excavation by the CONTRACTOR.

1.10 DISINFECTION

- A. Clean, disinfect and bacteriologically test and clear in accordance with applicable regulations all water supply facilities affected by this project which shall come into contact with raw water, water being treated or treated water prior to placing the facility in operation. The above statement shall apply to both new facilities installed and existing facilities which are to be modified.
- B. Employ a disinfection method approved by the ENGINEER and OWNER and shall fully satisfy the OWNER that adequate disinfection has been achieved prior to placing a facility on-line.
- C. The cost of all disinfection work and bacteriological clearance tests shall be included in the prices quoted in the Bid Form.
- D. Disinfection shall be performed in accordance with California Department of Public Health requirements.

1.11 UTILITY CROSSINGS

- A. It is intended that wherever existing utilities such as water, chemical, electrical or other service lines must be crossed, deflection of the pipe within recommended limits and cover shall be used to satisfactorily clear the obstruction unless otherwise indicated on the Drawings. However, when in the opinion of the OWNER or ENGINEER this procedure is not feasible he/she may direct the use of fittings for a utility crossing as detailed on the Drawings.

1.12 EXISTING UTILITY PROTECTION

- A. Existing utilities are shown in their approximate locations. Locate and protect all utilities whether shown on the Drawings or not.
- B. Contact utility companies at least 5 business days before starting construction so utility personnel can locate and protect facilities, if required by the utility company.

1.13 ARCHEOLOGICAL FINDS

- A. Notwithstanding anything to the contrary herein, in the event any archeological artifacts within the project are discovered during the course of the Work, the OWNER shall have and retain all right, title, and interest to such artifacts and shall have the further right, during the course of the Contract, to examine or cause to have examined, the site of the Work for any such artifacts and to perform or have performed archeological excavations and all other related work to explore for, discover, recover and remove such artifacts from the site of the Work. In the event the work or archeological examination and related work delays the CONTRACTOR's work, he shall be entitled to an extension of time to complete the work equal to the number of days he is thus delayed. Such delay shall be considered an excusable delay as defined in the supplementary conditions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01200
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Items listed in this Section refer to and are the same pay items listed in the Bid Form and constitute all pay items for completing the Work.
2. Compensation for all services, items, materials, and equipment shall be include in prices stipulated for lump sum and unit price pay items listed in this Section and included in the Contract.
3. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, bonds, insurance, or other requirements of the General Conditions, Supplementary Conditions, General Requirements, and other requirements of the Contract Documents.
4. Each lump sum and unit bid price shall include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

B. Related Sections:

1. Payments to Contractor: Refer to General Provisions and Supplement to General Provisions.
2. Schedule of Values: Refer to General Conditions, Supplementary Conditions, and Section 01370 - Schedule of Values.

1.02 ENGINEER'S ESTIMATE OF QUANTITIES

- A. ENGINEER'S and OWNER's estimated quantities for unit price pay items, as listed in the Bid Form, are approximate only and are included solely for the purpose of comparison of Bids. Owner does not expressly or by implication agree that the nature of the materials encountered below the surface of the ground or the actual quantities of material encountered or required will correspond therewith and reserves the right to increase or decrease any quantity or to eliminate any quantity as Owner may deem necessary. Contractor will not be entitled to any adjustment in a unit bid price as a result of any change in an estimated quantity and agrees to accept the aforesaid unit bid prices as complete and total compensation for any additions caused by changes or alterations in the Work ordered by Owner.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Contractor shall include all additional Work items, services, goods, resources, and manpower necessary for installation of the Work to provide a completely functional system in accordance with the Contract Documents. Contractor shall include these costs associated with providing a completely functional system within the listed items on the Bid Form and as specified herein.

1.04 SCHEDULING, MEASUREMENTS AND PAYMENTS

- A. Initial mobilization: Measurement for payment of Mobilization will be based upon completion of such work as a lump sum, non-proratable pay item, and shall require completion of all listed items during the first 25 days following the Notice to Proceed. Mobilization shall include but not be limited to the following principal items:
 - 1. Obtaining and paying for all bonds, insurance, and permits;
 - 2. Moving onto the site all Contractor's plant and equipment required for the first month's operations;
 - 3. Installing temporary construction power, wiring and lighting facilities;
 - 4. Establishing a fire protection system;
 - 5. Developing and installing a construction water supply per the Standard Specifications;
 - 6. Providing on-site sanitary facilities and potable water facilities as specified per Cal-OSHA;
 - 7. Furnishing, installing, and maintaining all storage buildings or sheds required for temporary storage of products, equipment, or materials that have not yet been installed in the Work. All such storage shall meet manufacturer's specified storage requirements and the specific provisions of the specifications, including temperature and humidity control, if recommended by the manufacturer and call all security;
 - 8. Arranging for erection of Contractor's work and storage yard;
 - 9. Posting all OSHA required notices and establishment of safety programs per Cal-OSHA;
 - 10. Having the Contractor's superintendent at the job site full time;
 - 11. Submittal of Proposed Construction Schedule on or before the pre-construction conference, acceptable to the Engineer;
 - 12. Submittal of detailed Preliminary Construction Schedule for the Engineer's approval within seven (7) calendar days after commencement;
 - 13. Submittal of an as-planned Construction Schedule, embodying all corrections required by the Engineer within thirty (30) calendar days of the Notice to Proceed. No payment for mobilization can be made until this has been approved and submitted.

B. In addition to the requirements specified above, all submittals shall conform to the applicable requirements of the Standard Specifications. No payment for any of the listed mobilization work items will be made until all of the listed items have been complete to the satisfaction of the Engineer. The aforementioned amount will be withheld by the District as the agreed, estimated value of completing all of the mobilization items listed. Any such withholding of money for failure to complete all such mobilization items as a lump sum shall be in addition to the retention of any payments pursuant to the provisions of the Public Contract Code.

C. Pay Line Items:

1. Item 1: General Conditions

- a. Measurement and Payment: Lump sum for Item 1 will be full compensation for contract bonds, insurance, permits, project management, mobilization of equipment, materials, and labor prior to starting the Work and demobilization and cleanup after completing all Contract Work. Payment shall be split at 60% mobilization, 40% demobilization. This bid item shall not exceed 6% of the Contract Value.

2. Item 2: Demolition

- a. Measurement and Payment: This item is for furnishing all demolition activities as identified in the Contract Documents.

3. Item 3: Site Grading, Site Piping, Paving, Concrete Foundations, and All Other Miscellaneous Site Work

- a. Measurement and Payment: This item is for furnishing and performing all site paving, grading, excavation work, site piping, concrete foundations, and miscellaneous site work as outlined in the Contract Documents. For excavation, grading, and paving, payment shall be per cubic yard, which includes excavation and disposal of unsuitable material, placement of select fill and compaction of select fill. The quantity of additional excavation and replacement to be paid for shall be the actual quantity of cubic yards of unsuitable material that has been removed and replaced with select fill as indicated on the Drawings and as specified. For site piping, payment shall be for furnishing and installing all site piping as indicated on the Drawings, as specified, and directed by Owner. This item includes all piping that is required for a fully functioning system. For concrete work, payment shall be for forming, furnishing and installing concrete pads, all equipment pads, and grouting as indicated on the Drawings and as specified.

4. Item 4: Centrifuge, Furnishing

- a. Measurement and Payment: Payment shall be for furnishing of Centrifuge equipped with diverter gate, new diverter gate for existing centrifuge and associated electrical panels as indicated in the Drawings and as specified.

Payment shall be split 15% for approved submittals, 70% upon delivery, and 15% upon acceptance. Refer to Appendix A for Alfa Laval equipment details and terms.

5. Item 5: Centrifuge, Complete in Place
 - a. Measurement and Payment: Payment shall be for installation and startup of Centrifuge equipped with diverter gate and new diverter gate for existing centrifuge and associated electrical panels, as indicated in the Drawings and as specified.
6. Item 6: Centrate Pumps, Complete in Place
 - a. Measurement and Payment: Payment shall be for furnishing, installing, and start-up of centrate pumps as indicated on the Drawings and as specified.
7. Item 7: Centrate Storage Tank, Complete in Place
 - a. Measurement and Payment: Payment shall be for furnishing and installation, and startup of the centrate storage tank as indicated on the Drawings and as specified.
8. Item 8: Polymer System, Complete in Place
 - a. Measurement and Payment: Payment shall be for furnishing, installing, and startup of the polymer day tank, polymer dosing skids, and polymer drum rack with containment system as indicated in the Drawings and as specified.
9. Item 9: Centrifuge Feed Pump, Complete in Place
 - a. Measurement and Payment: Payment shall be for relocating, installing, testing and startup the centrifuge feed pump of as indicated in the Drawings and as specified.
10. Item 10: Structural modifications, Complete in Place
 - a. Measurement and Payment: Payment shall be for concrete platforms and appurtenant items, bin rails modifications, winches furnishing, installation and testing as indicated in the Drawings and as specified.
11. Item 11: Startup and Performance Testing
 - a. Measurement and Payment: Payment for startup and performance testing shall include furnishing all labor, materials, and equipment as indicated on the Drawings and as specified.
12. Item 12: Operation and Maintenance Manuals
 - a. Measurement and Payment: Payment for Operation and Maintenance Manuals shall include furnishing all labor, materials, and equipment as indicated on the Drawings and as specified.
13. Item 13: Completion of Balance of Project Including All Work Not Specifically Called Out in Bid Items 1-12 for a functioning facility
 - a. Measurement and Payment: Payment for this item shall include all work necessary for a functioning facility not specifically listed in

Items 1-12.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

- A. This Section specifies the general methods and requirements of submissions applicable to the following work-related submittals: Shop Drawings, Product Data, Certifications, Calculations, Operation and Maintenance Manuals, Test Procedures, Samples, Mock Ups, Construction Photographs, and Construction or Submittal Schedules, unless otherwise described in the technical specification sections. Additional general submission requirements are contained in Paragraph 5-9 of the General Provisions. Additional detailed submittal requirements are specified in the technical specifications sections.
- B. All submittals shall be clearly identified by reference to Specification Section, Paragraph, Drawing Number or Detail as applicable. Submittals shall be clear and legible and of sufficient size for sufficient presentation of data.
- C. Procedures for requesting changes, substitutions, or deviations for material or equipment specified herein shall be in accordance with Section 01630.
- D. Prior to transmission to the ENGINEER, the CONTRACTOR shall carefully review each submittal to confirm that it is complete and to verify whether or not the proposed items or work conform to the contract requirements. Each submittal shall be dated, signed, and certified by the CONTRACTOR as being correct and in conformance with the Drawings and the Specifications.
- E. All submittals shall be in English and as a minimum, in foot-pound-second system units.

1.02 SHOP DRAWINGS, PRODUCT DATA, SAMPLES

- A. Shop Drawings
 - 1. Shop drawings, as defined in the General Provisions, and as specified in individual work Sections include, but are not necessarily limited to, custom-prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shopwork manufacturing instructions, custom templates, special wiring diagrams, coordination drawings, individual system or equipment inspection and test reports including performance curves and certifications, as applicable to the Work.
 - 2. All shop drawings submitted by subcontractors for approval shall be sent directly to the CONTRACTOR for checking. The CONTRACTOR shall be responsible for their submission at the proper time so as to prevent delays in delivery of materials.

3. The CONTRACTOR shall check all subcontractor's shop drawings regarding measurements, size of members, materials and details to satisfy himself that they conform to the intent of the Drawings and Specifications. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractors for correction before submission thereof.
4. All details on shop drawings submitted for approval shall show clearly the relation of the various parts to the main members and lines of the structure and where correct fabrication of the work depends upon field measurements; such measurements shall be made and noted on the drawings before being submitted for approval.
5. Drawings shall be 8.5-in by 11-in, 11-in by 17-in, or 22-in by 34-in, and shall clearly indicate the unit of measure.
6. Piping and layout drawings shall be submitted at a scale of 1/8 inch to 1 foot or larger. Dimensioned equipment, panel, and anchorage drawings shall be 2 inch to 1 foot or larger scale.
7. Submittals for equipment specified under Divisions 11, 13, 14, 15 and 16 shall include a listing of all installations where identical or similar equipment has been installed and been in operation for a period of at least one year, unless otherwise specified.

B. Product Data

1. Product data as specified in individual Sections, include, but are not necessarily limited to, standard prepared data for manufactured products (sometimes referred to as catalog data), such as the manufacturer's product specification and installation instructions, availability of colors and patterns, manufacturer's printed statements of compliances and applicability, roughing-in diagrams and templates, catalog cuts, product photographs, standard wiring diagrams, printed performance curves and operational-range diagrams, production or quality control inspection and test reports and certifications, mill reports, product operating and maintenance instructions and recommended spare-parts listing and printed product warranties, as applicable to the Work.
2. Where product data may describe several models and/or options, the CONTRACTOR shall clearly mark or highlight the applicable information and cross out or delete the non-applicable information.

C. Samples

1. Samples specified in individual Sections, include, but are not necessarily limited to, physical examples of the work such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols and units of

work to be used by the ENGINEER or OWNER for independent inspection and testing, as applicable to the Work.

D. Quality Control Data

1. Quality control data shall include, but is not necessarily limited to, certifications, welding procedures, destructive or non-destructive examination procedures, system or equipment inspection reports, mill test reports, as applicable to the work.

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. The CONTRACTOR shall review shop drawings, product data and samples, including those by subcontractors, prior to submission to determine and verify the following:
 1. Field measurements
 2. Field construction criteria
 3. Catalog numbers and similar data
 4. Conformance with the Specifications
- B. Each shop drawing, sample and product data submitted by the CONTRACTOR shall have affixed to it the following Certification Statement including the CONTRACTOR's Company name and signed by the CONTRACTOR:
"Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements." Shop drawings and product data sheets 11-in x 17-in and smaller shall be bound together in an orderly fashion and bear the above Certification Statement on the cover sheet. The cover sheet shall fully describe the packaged data and include a listing of all items within the package. Provide to the Resident Project Representative a copy of each submittal transmittal sheet for shop drawings, product data and samples at the time of submittal of said drawings, product data and samples to the ENGINEER.
- C. The CONTRACTOR shall utilize a 10-character submittal identification numbering system in the following manner:
 1. The first character shall be a D, S, P, M, or R, which represents Shop/Working Drawing and other Product Data (D), Sample (S), Preliminary Submittal (P), Operating/ Maintenance Manual (M), or Request for Information (R).
 2. The next five digits shall be the applicable Specification Section Number.
 3. The next three digits shall be the numbers 001 to 999 to sequentially number

each initial separate item or drawing submitted under each specific Section number.

4. The last character shall be a letter, A to Z, indicating the submission, or resubmission of the same Drawing, i.e., "A=1st submission, B=2nd submission, C=3rd submission, etc. A typical submittal number would be as follows:

D-03300-008-B

D.	= Shop Drawing
03300	= Specification Section for Concrete
008	= The eighth initial submittal under this specification section
B.	= The second submission (first resubmission) of that particular shop drawing

- D. Notify the ENGINEER in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.
- E. The review and approval of shop drawings, samples or product data by the ENGINEER shall not relieve the CONTRACTOR from his responsibility with regard to the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the CONTRACTOR and the ENGINEER will have no responsibility therefore.
- F. No portion of the work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to approved shop drawings and data shall be at the CONTRACTOR's risk. The OWNER will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
- G. Project work, materials, fabrication, and installation shall conform with approved shop drawings, applicable samples, and product data.

1.04 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule and in such sequence as to cause no delay in the Work or in the work of any other contractor.
- B. Each submittal, appropriately coded, will be returned within 30 calendar days following receipt of submittal by the ENGINEER.
- C. Number of submittals required:
 1. Shop Drawings as defined in Paragraph 1.02 A: Electronic Format.
 2. Product Data as defined in Paragraph 1.02 B: Electronic Format.

3. Samples: Submit the number stated in the respective Specification Sections.

D. Submittals shall contain:

1. The date of submission and the dates of any previous submissions.
2. The Project title and number.
3. CONTRACTOR identification.
4. The names of:
 - a. CONTRACTOR
 - b. Supplier
 - c. Manufacturer
5. Identification of the product, with the specification section number, page and paragraph(s).
6. Field dimensions, clearly identified as such.
7. Relation to adjacent or critical features of the Work or materials.
8. Applicable standards, such as ASTM or Federal Specification numbers.
9. Identification of deviations from Contract Documents.
10. Identification of revisions on resubmittals.
11. An 8-in by 3-in blank space for CONTRACTOR and ENGINEER stamps.
12. Where calculations are required to be submitted by the CONTRACTOR, the calculations shall have been checked by a qualified individual other than the preparer. The submitted calculations shall clearly show the names of the preparer and of the checker.

1.05 REVIEW OF SHOP DRAWINGS, PRODUCT DATA, WORKING DRAWINGS AND SAMPLES

- A. The review of shop drawings, data and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:
1. as permitting any departure from the Contract requirements;
 2. as relieving the CONTRACTOR of responsibility for any errors, including details, dimensions, and materials;
 3. as approving departures from details furnished by the ENGINEER, except as otherwise provided herein.

- B. The CONTRACTOR remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.
- C. If the shop drawings, data or samples as submitted describe variations and show a departure from the Contract requirements which ENGINEER finds to be in the interest of the OWNER and to be so minor as not to involve a change in Contract Price or time for performance, the ENGINEER may return the reviewed drawings without noting an exception.
- D. Submittals will be returned to the CONTRACTOR under one of the following codes.

Code 1 - "APPROVED" is assigned when there are no notations or comments on the submittal. When returned under this code the CONTRACTOR may release the equipment and/or material for manufacture.

Code 2 - "APPROVED AS NOTED" this code is assigned when a confirmation of the notations and comments IS NOT required by the CONTRACTOR. The CONTRACTOR may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.

Code 3 - "APPROVED AS NOTED/CONFIRM" this combination of codes is assigned when a confirmation of the notations and comments IS required by the CONTRACTOR. The CONTRACTOR may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the ENGINEER within 30 calendar days of the date of the ENGINEER's transmittal requiring the confirmation.

Code 4 - "APPROVED AS NOTED/RESUBMIT" this combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. The CONTRACTOR may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the ENGINEER within 30 calendar days of the date of the ENGINEER's transmittal requiring the resubmittal.

Code 5 - "NOT APPROVED" is assigned when the submittal does not meet the intent of the Contract Documents. The CONTRACTOR must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.

Code 6 - "COMMENTS ATTACHED" is assigned where there are comments attached to the returned submittal, which provide additional data to aid the CONTRACTOR.

Codes 1 through 5 designate the status of the reviewed submittal with Code 6 showing there has been an attachment of additional data.

- E. Resubmittals will be handled in the same manner as first submittals. On resubmittals the CONTRACTOR shall identify all revisions made to the submittals, either in writing on the letter of transmittal or on the shop drawings by use of revision triangles or other similar methods. The resubmittal shall clearly respond to each comment made by the ENGINEER on the previous submission. Additionally, the CONTRACTOR shall direct specific attention to any revisions made other than the corrections requested by the ENGINEER on previous submissions.
- F. Partial submittals may not be reviewed. The ENGINEER will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the CONTRACTOR and will be considered "Not Approved" until resubmitted. The ENGINEER may at his option provide a list or mark the submittal directing the CONTRACTOR to the areas that are incomplete.
- G. If the CONTRACTOR considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, the CONTRACTOR shall give written notice thereof to the ENGINEER at least seven working days prior to release for manufacture.
- H. When the shop drawings have been completed to the satisfaction of the ENGINEER, the CONTRACTOR shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the ENGINEER.
- I. CONTRACTOR shall pay OWNER for ENGINEER's time to review shop drawings past the third submission.

1.06 DISTRIBUTION

- A. Distribute reproductions of approved shop drawings and copies of approved product data and samples, where required, to the job site file and elsewhere as directed by the ENGINEER.

1.07 MOCK UPS

- A. Mock Up units as specified in individual Sections, include but are not necessarily limited to, complete units of the standard of acceptance for that type of work to be used on the Project. Remove at the completion of the Work or when directed.

1.08 CONSTRUCTION PHOTOGRAPHS/VIDEO TAPES

- A. The CONTRACTOR shall submit construction photographs and videotapes in accordance with Section 01170.

1.09 CONSTRUCTION SCHEDULE

- A. The GENERAL CONTRACTOR shall comply with the requirements of Section 5-9 of the General Provisions and Section 01311.

1.10 PROFESSIONAL ENGINEER (P.E.) CERTIFICATION FORM

- A. If specifically required in other Sections of these Specifications, the CONTRACTOR shall submit a P.E. Certification for each item required, in the form attached to this Section, completely filled in and stamped.

1.11 GENERAL PROCEDURES FOR SUBMITTALS

- A. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work sections, of the Specifications, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. No extension of time will be authorized because of the CONTRACTOR's failure to transmit submittals sufficiently in advance of the Work.

END OF SECTION

P.E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a Professional Engineer registered in the State of California and that he/she has been employed by

_____ to design (Name of CONTRACTOR)

(Insert P.E. Responsibilities)

in accordance with Specification Section _____ for the

David C. McCollom Water Treatment Plant Stage 4 Upgrades Project.

(Name of Project)

The undersigned further certifies that he/she has performed the design of the _____

_____, that said design is in conformance

(Name of Project)

with all applicable local, state and federal codes, rules, and regulations, and that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the

Olivenhain Municipal Water District

(Insert Name of OWNER)

or OWNER's representative with seven days following written request therefore by the OWNER.

P.E. Name

Signature

Address

CONTRACTOR's Name

Signature

Title

Address

SECTION 01311 CONSTRUCTION SCHEDULING

PART 1 GENERAL

1.01 PROGRAM DESCRIPTION

- A. A Critical Path Method (CPM) construction schedule shall be used to control the work of this Contract and to provide a definitive basis for determining job progress. The construction schedule shall be prepared by the CONTRACTOR. All work shall be done in accordance with the established CPM schedule and the CONTRACTOR and his subcontractors shall be responsible for cooperating fully with the ENGINEER and the OWNER in effectively utilizing the CPM schedule.
- B. The CPM schedule to be prepared and submitted by the CONTRACTOR shall consist of a CPM network (diagram of activities) and a computer-generated schedule (print-out) as specified herein. The format shall be time scaled-logic diagram.
- C. Computer-based schedule shall be the latest version of Primavera or approved equal.

1.02 QUALIFICATIONS

- A. The CONTRACTOR shall have the capability of preparing and utilizing the specified CPM scheduling technique. A written statement of CPM capability shall be submitted in writing to the ENGINEER within 15 calendar days of the Notice of Award and will verify that either the CONTRACTOR's organization has in-house capability qualified to use the technique or that the CONTRACTOR employs a consultant who is so qualified. Capability shall be verified by description of the construction projects of at least one-half of the bid price of this project, to which the CONTRACTOR or his consultant has successfully applied the CPM scheduling technique and which were controlled throughout the duration of the project by means of systematic use and updating of a computer-based CPM schedule. The submittal shall include the name of the individual on the CONTRACTOR's staff who will be responsible for the CPM schedule and for providing the required updating information.

1.03 COMPUTER-GENERATED SCHEDULE REQUIREMENTS

- A. Each computer-generated schedule submittal from the CPM activity network shall include the following tabulations: a list of activities in numerical order, a list of activity precedences, a schedule sequenced by Early Start Date and a schedule sequenced by Total Float. Each schedule shall include the following minimum items:
 - 1. Activity numbers
 - 2. Estimated duration
 - 3. Activity description
 - 4. Early start date (calendar dated)

5. Early finish date (calendar dated)
6. Interim Milestones
7. Latest allowable start date (calendar dated)
8. Latest allowable finish date (calendar dated)
9. Status (whether critical)
10. Estimated cost of the activity
11. Total float and free float

B. In addition, each schedule shall be prefaced with the following summary data:

1. Contract name and number
2. CONTRACTOR's Name
3. Contract duration
4. Contract schedule
5. The effective or starting date of the schedule (the date indicated in the Notice to Proceed).

C. The work day to calendar date correlation shall be based on an 8-hour day and 40-hour week with adequate allowance for holidays, adverse weather and all other special requirements of the work. The CONTRACTOR is to provide in writing to the ENGINEER any exceptions factored into the schedule with the initial schedule submittal.

1.04 INITIAL CONFERENCE

- A. Within 15 days following the receipt of the Notice to Proceed, meet with the ENGINEER to discuss and agree on the proposed standards for the CPM schedule. At this conference submit to the ENGINEER a preliminary network defining the planned operations during the first 60 calendar days after Notice to Proceed. The general approach for the balance of the project shall be indicated. Cost of activities expected to be completed or partially completed before submission and review of the complete network shall be included.

1.05 APPROVED CPM SCHEDULE

- A. Within 21 days following the receipt of the Notice to Proceed, submit two prints bearing the CONTRACTOR's stamp of approval of the proposed CPM activity network and an electronic copy of the computer-generated schedule to the ENGINEER. Following review by the ENGINEER, the CONTRACTOR shall make appropriate adjustments or corrections to the network and submit five prints of the revised network and two electronic copies of the computer-generated schedule. This final submittal shall be delivered to the ENGINEER within 21 days after the Notice to Proceed.

- B. CPM schedules which contain activities showing negative float or which extend beyond the contract completion date in the computer-generated schedule are not allowable.
- C. Participate in the initial review and evaluation of the proposed network diagram and schedule by the ENGINEER. The conforming network shall then be the most current contract schedule to be used for planning, organizing and directing the work, and reporting progress.
- D. The ENGINEER's review of the CPM activity network is advisory only and shall not relieve the CONTRACTOR of responsibility for accomplishing the work within the contract completion date. Omissions and errors in the approved CPM schedule shall not excuse performance less than that required by the Contract. Review by the ENGINEER in no way makes the ENGINEER an insurer of the CPM schedule's success or liable for time or cost overruns flowing from its shortcomings. The OWNER hereby disclaims any obligation or liability by reason of review by its agent, the ENGINEER, of the CPM schedule.
- E. The network shall be submitted on sheets 24-in by 36-in and may be divided into as many separate sheets as required.

1.06 PROGRESS REPORTING

- A. Progress of CPM schedule shall be evaluated monthly by the CONTRACTOR and the ENGINEER. Not less than 7 days prior to each monthly progress meeting, they shall meet at the jobsite and jointly evaluate the status of each activity on which work has started or is due to start, based on the preceding CPM schedule; to show actual progress, to identify those activities started and those completed during the previous period, to show the estimated time required to complete or the percent complete of each activity started but not yet completed and to reflect any changes indicated for the network. Activities shall not be considered to be complete until they are, in fact, 100 percent complete.
- B. The CONTRACTOR will produce from this evaluation, at no expense to the OWNER, an updated computer-generated CPM schedule and CPM Status Report for the project.
- C. At each progress meeting, submit a narrative report based on the CPM schedule evaluation described above, in a format agreed upon by the CONTRACTOR and the ENGINEER. The report shall include a description of the progress during the previous period in terms of completed activities, an explanation of each activity which is showing a delay, a description of problem areas, current and anticipated delaying factors and their estimated impact on performance of other activities and completion dates and an explanation of corrective action taken or proposed. This report, as well as the CPM Status Report, will be discussed at each progress meeting.

The narrative shall include the information shown in the following outline in a narrative form:

1. Construction progress (refer to activity number in the Detailed Schedule) including:

- a. Activities completed this reporting period.
 - b. Activities in progress this reporting period.
 - c. Activities scheduled to commence next reporting period.
2. Description of problem areas.
3. Current and anticipated delays.
 - a. Cause of the delay.
 - b. Corrective action and schedule adjustments to correct the delay.
 - c. Impact of the delay on other activities, on milestones, and on completion dates.
4. Changes in construction sequence.
5. Pending items and status thereof.
 - a. Permits
 - b. Change Orders
 - c. Time extensions
 - d. Other
6. Contract completion date status
 - a. Ahead of schedule and number of days.
 - b. Behind schedule and number of days.

1.07 RESPONSIBILITY FOR SCHEDULE COMPLIANCE

- A. The CONTRACTOR's attention is directed to the form of Agreement, included in Division 0, which specifies contract times for Work.
- B. Whenever it becomes apparent from the current CPM schedule and CPM Status Report that delays to the critical path have resulted and the contract completion date will not be met, or when so directed by the ENGINEER, take some or all of the following actions at no additional cost to the OWNER. Submit to the ENGINEER for approval, a written statement of the steps intended to take to remove or arrest the delay to the critical path in the approved schedule.
 1. Increase construction workforce in such quantities and crafts as will substantially eliminate the backlog of work.

2. Increase the number of working hours per shift, shifts per day, working days per week, the amount of construction equipment, or any combination of the foregoing, sufficiently to substantially eliminate the backlog of work.
 3. Reschedule activities to achieve maximum practical concurrence of accomplishment of activities and comply with the revised schedule.
- C. If when so requested by the ENGINEER, failure to submit a written statement of the steps intended to take or should fail to take such steps as approved by the ENGINEER, the ENGINEER may direct the CONTRACTOR to increase the level of effort in workforce (trades), equipment and work schedule (overtime, weekend and holiday work, etc) to be employed by the CONTRACTOR in order to remove or arrest the delay to the critical path in the approved schedule and the CONTRACTOR shall promptly provide such level of effort at no additional cost to the OWNER.

1.08 ADJUSTMENT OF CONTRACT SCHEDULE AND COMPLETION TIME

- A. If the CONTRACTOR desires to make changes in his method of operating which affect the current contract CPM schedule, the CONTRACTOR shall notify the ENGINEER in writing stating what changes are proposed and the reason for the change. After the ENGINEER reviews the changes, the CONTRACTOR shall revise and submit the network schedule, without additional cost to the OWNER, all of the affected portions of the CPM network. The CPM schedule shall be adjusted by the CONTRACTOR only after prior review of his proposed changes by the ENGINEER. Adjustments may consist of changing portions of the activity sequence, activity durations, division of approved activities, or other adjustments. The addition of extraneous, non-working activities and activities which add unapproved restraints to the CPM schedule are not allowed.
- B. If the completion of any activity, whether or not critical, falls more than 100 percent behind its current schedule duration, submit a schedule adjustment showing each such activity divided into two activities reflecting completed versus uncompleted work.
- C. Shop drawings which are not approved on the first submittal or within the schedule time and equipment which do not pass the specified tests shall be immediately rescheduled.
- D. The contract completion time will be adjusted only for causes specified in this Contract. In the event the CONTRACTOR requests an extension of any contract completion date, he shall furnish such justification and supporting evidence as the ENGINEER may deem necessary to determine whether the CONTRACTOR is entitled to an extension of time under the provisions of this Contract. The ENGINEER will, after receipt of such justification and supporting evidence, make findings of fact and will advise the CONTRACTOR in writing thereof. If the ENGINEER finds that the CONTRACTOR is entitled to any extension of any contract completion date, the ENGINEER's determination as to the total number of days extension shall be based upon the current contract CPM schedule and on all data relevant to the extension. Such data shall be included in the next updating of the schedule. Actual delays in activities which, according to the CPM schedule, do

not affect any contract completion date shown by the critical path in the network will not be the basis for a change therein.

- E. Each request for change in any contract completion date shall be submitted by the CONTRACTOR to the ENGINEER within 30 days after the beginning of the delay for which a time extension is requested but before the date of final payment under this Contract. No time extension will be granted for requests which are not submitted within the foregoing time limit.
 - 1. From time to time it may be necessary for the contract schedule or completion time to be adjusted by the OWNER to reflect the effects of job conditions, weather, technical difficulties, strikes, unavoidable delays on the part of the OWNER or its representatives and other unforeseeable conditions which may indicate schedule adjustments or completion time extensions. Under such conditions, the ENGINEER will direct the CONTRACTOR to reschedule the work or contract completion time to reflect the changed conditions and the CONTRACTOR shall revise his schedule accordingly. No additional compensation will be made to the CONTRACTOR for such schedule changes except for unavoidable overall contract time extensions beyond the actual completion of all unaffected work, in which case the CONTRACTOR shall take all possible action to minimize any time extension and any additional cost to the OWNER. Available float time in the CPM schedule may be used by the OWNER as defined by the ENGINEER, as well as by the CONTRACTOR.
- F. The OWNER controls the float time in the contract CPM network and, therefore, without obligation to extend either the overall completion date or any intermediate completion dates set out in the CPM network, the OWNER may initiate changes to the work that absorb float time only. OWNER initiated changes that affect the critical path on the approved CPM network shall be the sole grounds for extending (or contracting) said completion dates.
CONTRACTOR-initiated changes that encroach on the float time identified in the approved CPM network may be accomplished with the OWNER's concurrence. Such changes, however, shall give way to OWNER-initiated changes competing for the same float time.

1.09 COORDINATING SCHEDULES WITH OTHER CONTRACT SCHEDULES

- A. Where work is to be performed under this Contract concurrently with or contingent upon work performed on the same facilities or area under other contracts, the CONTRACTOR's CPM Schedule shall be coordinated with the schedules of the other contracts. Obtain the schedules of the other appropriate contracts from the OWNER for the preparation and updating of the CPM schedule and make the required changes in the schedule when indicated by changes in corresponding schedules.
- B. In case of interference between the operations of different contractors, the OWNER will determine the work priority of each contractor and the sequence of work necessary to expedite the completion of the entire project. In all such cases, the decision of the OWNER shall be accepted as final. The temporary delay of the CONTRACTOR's work due to such circumstances shall not be considered as

justification for claims for additional compensation.

1.10 SCHEDULE DISTRIBUTION

- A. Distribute copies of the CONTRACTOR's Construction Schedule and the Submittal Schedule to the ENGINEER, OWNER, subcontractors, and parties required to comply with submittal dates. Post copies in the field office.
 - 1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their Work and are no longer involved in construction activities.
 - 2. Updating: Revise the schedule after each meeting or activity where revisions have been made. Issue the updated schedule concurrently with the report of each meeting.

1.11 DAILY CONSTRUCTION REPORTS

- A. Prepare a daily report recording events at the site. Submit duplicate copies to the ENGINEER at weekly intervals. Include the following information:
 - 1. List of subcontractors at the site.
 - 2. High and low temperatures, general weather conditions.
 - 3. Accidents and unusual events.
 - 4. Stoppages, delays, shortages and losses.
 - 5. Meter readings and similar recordings.
 - 6. Emergency procedures.
 - 7. Orders and requests of governing authorities.
 - 8. Services connected, disconnected.
 - 9. Equipment or system tests and startups.
 - 10. Substantial Completions authorized.
- B. Prepare a 3-week look ahead for each biweekly progress meetings. Submit duplicate copies to the ENGINEER at biweekly intervals.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01350

ANCHORAGE AND BRACING OF NONSTRUCTURAL COMPONENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all equipment, labor, materials, and services required to design and provide anchorage and bracing for all nonstructural components in accordance with the Contract Documents and Building Code requirements, including the seismic design requirements of Chapter 13 in ASCE 7.
- B. This Section covers requirements for only the anchorage and bracing of nonstructural components. Design requirements for nonstructural components (other than their anchorage and bracing) are covered in the Section for that component.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01450 – Special Inspections
- B. Section 05010 – Metal Materials
- C. Section 05050 – Metal Fastening
- D. Further requirements for anchorage and bracing are included in other Sections of the Specifications. See Section for the specific nonstructural component in question.

1.03 DEFINITIONS

- A. Nonstructural components: All architectural, mechanical, electrical, or plumbing elements or systems and their supports or attachments provided under this contract which are permanently attached to new or existing structures.
 - 1. Architectural nonstructural components include, but are not limited to, interior nonstructural walls and partitions, exterior wall panels and glazing elements, glass curtain walls, skylights, cabinets, suspended ceilings, fascia, and cladding.
 - 2. Mechanical nonstructural components include, but are not limited to, HVAC units, fans, water and wastewater treatment process equipment, instrumentation cabinets, piping and ductwork.
 - 3. Electrical nonstructural components include, but are not limited to, conduit systems, cable tray systems, boxes, transformers, panelboards, switchboards,

switchgear, busway, individual motor controllers, motor control centers, variable frequency drives, automatic transfer switches, and lighting systems.

4. Plumbing nonstructural components include, but are not limited to, sprinkler systems and associated piping, and sump pumps.
- B. Attachment: Elements including anchor bolts, welded connections, and mechanical fasteners which secure nonstructural components or supports to the structure.
- C. Essential Components: Nonstructural components considered necessary to public safety for which the component importance factor I_p is required by chapter 13 in ASCE 7 to be taken as 1.5, including:
1. Life safety systems which must function following an earthquake, including but not limited to, sprinklers for fire protection, emergency lighting, egress corridors and stairways, and smoke purge systems.
 2. Components which contain, convey or support toxic, highly toxic, or explosive substances where the quantity of the material exceeds a threshold quantity established by the Building Code.
 3. Components which are within or attached to an Occupancy or Risk Category IV structure as defined in ASCE 7 Chapter 1 and are needed for continued operation of the facility or failure could impair the continued operation of the facility.
 4. Components which contain, convey, or support hazardous substances and are attached to a structure or portion thereof classified by the Building Code as a hazardous occupancy.
 5. Process systems and elements designated below:
 - a. Centrifuge in Residuals Handling Building
 - b. Centrate & Polymer Tanks
 - c. Mechanical Equipment
 - d. Electrical Equipment
- D. Nonbuilding Structures: All self-supporting structures which are supported by an independent foundation or by other structures which include, but are not limited to, storage tanks, silos, exhaust stacks, storage racks, and towers.
- E. Delegated Design: Design of a structure or structural element(s) which has been deferred by the contract documents to be performed during the project construction

stage, by a registered design professional retained by the CONTRACTOR and with the design submitted as a shop drawing to the ENGINEER.

1.04 REQUIREMENTS

- A. Anchorage and bracing of nonstructural components shall be designed and installed to resist the controlling load combination of gravity loads, operational forces (including static and dynamic), wind forces, seismic forces and any other applicable forces required in accordance with the governing Building Code.
- B. Anchorage and bracing of nonstructural components shall comply with seismic design requirements of ASCE 7 Chapter 13 unless the nonstructural component meets the criteria to be exempt. The following nonstructural components are exempt from requirements specific to seismic anchorage and bracing: (See paragraph 1.07.F.3 herein for Seismic Design Category)
 - 1. Storage cabinets no more than 6 feet tall, furniture, and movable equipment, regardless of Seismic Design Category.
 - 2. All architectural, mechanical, electrical, and plumbing nonstructural components in Seismic Design Category A.
 - 3. All mechanical, electrical, and plumbing nonstructural components in Seismic Design Category B.
 - 4. Architectural nonstructural components in Seismic Design Category B, other than parapets, provided that $I_p = 1.0$.
 - 5. Mechanical, electrical, and plumbing nonstructural components in Seismic Design Category C provided that either:
 - a. $I_p = 1.0$, and the component is positively attached to the structure, or
 - b. Component weighs 20 lbs. or less, or 5 lb/ft or less for distribution systems.
 - 6. Mechanical, electrical, and plumbing nonstructural components in Seismic Design Category D, E or F that are positively attached to the structure, provided that either:
 - a. $I_p = 1.0$, component weighs 400 lbs or less and its center of mass is 4 ft or less above a floor level, and flexible connections are provided between the components and associated ductwork, piping and conduit:
or
 - b. Component weighs 20 lbs. or less, or 5 lb/ft or less for distribution systems.
 - 7. Other exemptions as allowed by the Specifications, Codes and Standards referenced herein.

1.05 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. The Building Code shall be the version in effect at the time of Bid within the jurisdiction where the Work is located. All other referenced specifications, codes, and standards refer to the version as referenced by the Building Code. If no version is referenced by the Building Code, then the most current issue available at the time of Bid shall be used.
1. California Building Code
 2. ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures
 3. NFPA 13 Standard for Installation of Sprinkler Systems
 4. FEMA 412 Installing Seismic Restraints for Mechanical Equipment
 5. FEMA 413 Installing Seismic Restraints for Electrical Equipment
 6. FEMA 414 Installing Seismic Restraints for Duct and Pipe
 7. SMACNA Sheet Metal and Air Conditioning Contractors' National Association, Seismic Restraint Manual: Guidelines for Mechanical Systems
 8. ACI 318 Building Code Requirements for Structural Concrete and Commentary
 9. ACI 355.2 Qualifications of Post-Installed Mechanical Anchors in Concrete
 10. ACI 355.4 Qualifications of Post-Installed Adhesive Anchors in Concrete

1.06 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittal Procedures.
1. Anchorage and bracing submittals for all architectural, mechanical, electrical, and plumbing nonstructural components, elements and systems that do not have a design for anchorage and bracing provided within the Contract Documents. Submittals shall include the following:
 - a. Component manufacturer's cut sheets and fabrication details for equipment bases and foundations, including dimensions, structural member sizes, support point locations and equipment operational loads. Equipment anchorage details shall clearly indicate anchor size, pattern, embedment, and edge distance requirements to satisfy operational, wind, seismic and other forces required by the governing Building Code. Details shall also indicate grout, bearing pads, isolators, etc. required for complete installation.

- b. Design calculations, signed and sealed by a Professional Engineer registered in the State of California. Design shall include all loads and load combinations required by the governing Building Code. Separate calculation submittals for vertical and lateral load support systems shall not be allowed.
- c. Detailed Shop Drawings, signed and sealed by a Professional Engineer registered in the State of California, showing specific details of the support design including material, installation, attachments, connection hardware, etc., and the layout and location of all hangers and supports (resisting both gravity and lateral loads), including bracing orientation and direction of force(s) to be resisted.
- d. Seismic loads and requirements are not required to be included in design for anchorage and bracing of components which are exempt in accordance with Section 1.04B.
- e. For components required to be certified as seismically qualified in accordance with paragraph 1.06.A.2 below, submit installation guidelines provided by the equipment manufacturer for proper seismic mounting of the equipment.
- f. Seismic qualification testing shall be based on ASCE 7 and on a nationally recognized testing standard procedure such as ICC-ES AC 156.

1.07 DESIGN REQUIREMENTS

- A. Mechanical fasteners used to secure nonstructural components shall meet the requirements of Section 05050 – Metal Fastening. Post-installed concrete anchors shall be prequalified for use in seismic applications.
- B. No reaction loads (either vertical or lateral) from nonstructural component anchorage and bracing shall be allowed on any element where design has been delegated unless the additional loads on the element have been coordinated with the delegated designer and the submittal is accompanied by a sealed letter from the delegated designer indicating the element has been designed to support the reaction loads.
- C. Reaction loads from nonstructural component anchorage and bracing shall be transferred directly to the primary structural members (girders, beams, etc.), with no components supported from secondary members (purlins, bracing, etc.) unless otherwise approved.
- D. No holes shall be drilled into any structural steel for attachment of component supports without prior approval of the ENGINEER.

E. Attachments of nonstructural component anchorage and bracing that cause overstressing of any structural element shall not be permitted.

F. Seismic Requirements

1. Seismic anchorage and bracing for nonstructural components shall be subject to the current local Building Code in conjunction with the seismic provisions of the California Building Code (CBC) Section 1613 and referenced ASCE 7 Chapter 13.
2. Where the weight of a nonstructural component is greater than or equal to 25 percent of the effective seismic weight (as defined by ASCE 7) of the structure it is attached to, the component shall be classified as a nonbuilding structure for purposes of seismic design. Seismic design for nonbuilding structures shall comply with Building Code requirements in conjunction with the provisions of ASCE 7 Chapter 15.
3. Nonstructural components shall be assigned to the same Seismic Design Category as the structure they occupy or to which they are attached. Design of seismic support system and anchorage shall incorporate the site-specific seismic criteria given on the Contract Drawings. Criteria shall include site-specific spectral response coefficients, Site Class, Seismic Design Category, and Risk Category.
4. Component Importance Factor I_p shall be 1.5 for all essential nonstructural components noted in item 1.03.E above. All other nonstructural components shall utilize $I_p = 1.0$ unless noted otherwise.
5. Components shall be anchored and braced for earthquake forces both in the vertical and each orthogonal direction. Seismic anchorage and bracing shall limit deflections of components per ASCE 7, and the displacements shall not impede component functionally and containment.
6. Anchorage design shall account for disparate seismic response behavior of supporting structures. Seismic supports or bracing shall not cross structural expansion joints. Nonstructural components shall not be attached to multiple structural elements which may respond differently during a seismic event without provisions to accommodate independent movement. Flexible expansion loops or offsets, flexible joints, bellows type pipe expansion joints, couplings, etc. shall be provided at structure expansion joints to allow for independent structure movement and thermal movement of piping, ductwork, and conduit. Minimum movement capability in the vertical and each orthogonal direction shall equal the width of the joint.
7. Provide flexible connections, piping, conduit, etc. at foundation levels where below grade utilities enter the structure.

8. Design of support system for components with multiple attachments shall consider the stiffness and ductility of the supporting members. Equipment designed as free-standing shall only be attached at its base. Use of non-free-standing equipment requiring both vertical and lateral attachment is contingent upon loads applied to the structure and requires approval by the ENGINEER.
 9. The seismic anchorage and bracing design shall be based on actual equipment data (dimensions, weight, center of gravity, etc.) obtained from the specifications or the approved equipment manufacturer. The equipment manufacturer shall verify the attachment points on the equipment can safely withstand the combination of seismic, self- weight and other loads imposed.
- G. Powder actuated fasteners in steel or concrete shall not be used for sustained tension loads in Seismic Design Categories D, E or F unless approved for seismic loading or specifically exempted by ASCE 7. Powder actuated fasteners in masonry shall not be used unless approved for seismic loading regardless of Seismic Design Category.
- H. Friction clips shall not be used in Seismic Design Categories D, E or F for supporting sustained tension loads in combination with resisting seismic forces. C-type and large flange clamps may be used for hanger attachments provided restraining straps meeting NFPA 13 requirements are utilized and loosening of threaded connections is prevented by lock nuts, burred threads, etc.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Anchorage and bracing of nonstructural components shall be constructed of appropriate materials and connecting hardware to provide a continuous load path between the component and supporting structure of sufficient strength and stiffness to resist the calculated design seismic forces and displacements.
- B. Component anchorage, bracing and connection materials shall be compatible with and in general match the component and component gravity support materials. Contact between dissimilar metals shall be prevented.

PART 3 – EXECUTION

3.01 INSTALLATION OF ANCHORAGE AND BRACING

- A. No anchorage and bracing of nonstructural components shall be installed prior to review and acceptance by the ENGINEER and permitting agency.

- B. Equipment shall be installed per the manufacturer's recommendations. Fasteners shall meet manufacturer's requirements.
- C. Following installation, all anchorage and bracing and seismically qualified equipment shall be inspected. See Section 01450 – Special Inspections for requirements.

END OF SECTION

SECTION 01370
SCHEDULE OF VALUES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Submit to the ENGINEER a Schedule of Values allocated to the various portions of the Work, within 15 days after the NTP.
- B. Upon request of the ENGINEER, support the values with data, which will substantiate their correctness.
- C. The accepted Schedule of Values shall be used only as the basis for the CONTRACTOR's Applications for Payment.

1.02 RELATED REQUIREMENTS

- A. General Provisions are included in Division 0.

1.03 FORM AND CONTENT OF SCHEDULE OF VALUES

- A. Type schedule on an 8-1/2-in by 11-in, 8-1/2-in by 14-in or 11-in by 17-in white paper. CONTRACTOR's standard forms and automated printout will be considered for approval by the ENGINEER upon CONTRACTOR's request. Identify schedule with:
 - 1. Title of Project and location.
 - 2. ENGINEER and Project number.
 - 3. Name and Address of CONTRACTOR.
 - 4. Contract designation.
 - 5. Date of submission.
- B. Schedule shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction.
 - 1. With the exception of major equipment items, scheduled items shall not exceed 5% of the total value of the associated Phase of the work.
- C. Identify each line item with the number and title of the respective major section of the specifications.
- D. For each major line item list sub-values of major products or operations under the item.

- E. To the extent possible, the scheduled values shall correspond to the Critical Path Method (CPM)

schedule tasks and align with bid form. For the various portions of the Work:

1. Each item shall include a directly proportional amount of the CONTRACTOR's overhead and profit.
2. For items on which progress payments will be requested for stored materials, break down the value into:
 - a. The cost of the materials, delivered and unloaded, with taxes paid. Paid invoices are required for materials upon request by the ENGINEER.
 - b. The total installed value.

- F. Major Equipment Items Breakdowns into: Submittals, Materials delivered, Testing and Operation and Maintenance Manuals.

- G. The sum of all values listed in the schedule shall equal the total Contract Sum.

1.04 SUBSCHEDULE OF UNIT MATERIAL VALUES

- A. Submit a sub-schedule of unit costs and quantities for:

1. Products on which progress payments will be requested for stored products.

- B. The form of submittal shall parallel that of the Schedule of Values, with each item identified the same as the line item in the Schedule of Values.

- C. The unit quantity for bulk materials shall include an allowance for normal waste.

- D. The unit values for the materials shall be broken down into:

1. Cost of the material, delivered and unloaded at the site, with taxes paid.
2. Copies of invoices for component material shall be included with the payment request in which the material first appears.
3. Paid invoices shall be provided with the second payment request in which the material appears or no payment shall be allowed and/or may be deleted from the request.

- E. The installed unit value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.

1.05 PROGRESS PAYMENT SCHEDULE

- A. Based on the Schedule of Values and the approved Project Schedule, the CONTRACTOR shall submit a projection of monthly progress payments for the life of the project. Total of progress payments shall equal the Contract amount.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01445

PIPELINE TESTING AND CLEANING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and test and clean all new pipelines installed under this Contract as specified herein, including chlorination of all potable water lines.

1.02 RELATED WORK

- A. Buried pipelines are included in Division 2.
- B. Above grade and exposed pipelines are included in Division 15.
- C. Disinfection of Piping is included in Section 15141.
- D. Pressure Testing of Piping is included in Section 15144.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Furnish all necessary equipment and labor for cleaning, testing, and chlorinating the pipelines. The procedures and methods shall be approved by the ENGINEER.
- B. Make any taps and furnish all necessary caps, plugs, etc, as required in conjunction with testing pipelines. Furnish a test pump, gauges and any other equipment required in conjunction with carrying out the hydrostatic tests.

3.02 CLEANING PIPELINES

- A. As pipe laying progresses and at the conclusion of the work thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed.

3.03 TESTING GRAVITY PIPELINES

All gravity pipelines shall be tested for leakage by an infiltration or exfiltration test. Buried piping shall be tested by an infiltration test if the groundwater is more than 2-ft above the crown of the pipe for the full length of the section to be tested. Air testing may be used in lieu of an exfiltration test subject to approval of the ENGINEER.

A. Exfiltration Test

1. Leakage tests by exfiltration shall be made by creating a head in the pipeline to be tested by filling the line and either a manhole or temporary riser on one end of the line with water. The length of pipe to be tested shall be such that the head over the crown at the upstream end is not less than 2-ft and the head over the downstream crown is not more than 6-ft. The pipe shall be plugged by pneumatic bags or mechanical plugs in such a manner that the air can be released from the pipe while it is being filled with water. Before any measurements are made, the pipe shall be kept full of water long enough to allow absorption and the escape of any trapped air to take place. Following this, a test period of at least one hour shall begin. Provisions shall be made for measuring the amount of water required to maintain the water at a constant level during the test period.
2. If any joint shows an appreciable amount of leakage, the jointing material shall be removed and the joint repaired. If any pipe is defective, it shall be removed and replaced. If the quantity of water required to maintain a constant head in the pipe does not exceed 1.9 gallons per inch of diameter per day per 100-ft of pipe and if all the leakage is not confined to a few joints, workmanship shall be considered satisfactory.

B. Infiltration Test

1. Pipe shall be tested for infiltration after the backfill has been placed and the ground water allowed to return to normal elevation. The length of line to be tested shall be not less than the length between adjacent manholes and not more than the total length of each size of pipe. The allowable infiltration shall be 1.9 gallons per inch of diameter per day per 100-ft of pipe in each section tested. There shall be no gushing or spurting leaks.
2. If an inspection of the completed pipeline or any part thereof shows pipes or joints which allow noticeable infiltration of water, the defective work or material shall be replaced or repaired as directed.
3. Rates of infiltration shall be determined by means of V-notch weirs, pipe spigots, or by plugs in the end of the pipe installed in an approved manner and at such times and locations as may be directed by the ENGINEER.

- C. When the pipeline to be tested is reinforced concrete pipe, the allowable leakage in the above tests shall be 4.7 gallons per inch of diameter per 100-ft of pipe.

D. Low Pressure Air Test

1. Low-pressure air tests shall be made with equipment specifically designed and manufactured for the purpose of testing pipelines using low-pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal air pressure in the pipeline cannot exceed 8 psig. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. All air used shall pass through a single control panel.

2. Install plugs at manholes. Brace plugs securely as required for safety and allow no one in the manholes while pressurizing the line or during the test.
3. Low-pressure air shall be introduced into the sealed line until the internal air pressure reaches 4 psig. The internal air pressure in the sealed line shall not be allowed to exceed 8 psig. At least 2 minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period, the low-pressure air supply hose shall be quickly disconnected from the control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig shall not be less than that shown in Table 1 of ASTM C924 and F1417.
4. If the pipe section does not pass the air test, sectionalize the section tested to determine the location of the leak. Once the leak has been located, repair and retest.

END OF SECTION

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SECTION 01450
SPECIAL INSPECTIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. This Section defines the requirements for Special Inspections as required by Section 1704 of the California Building Code (CBC) and any State or local amendments.
- B. Either the Engineer of Record (EOR) or Registered Design Professional in Responsible Charge (RDPIRC) will prepare a Statement of Special Inspections, which identifies the type and extent of required Special Inspections.
- C. The Owner will retain one or more Special Inspections Agencies to perform Special Inspection services. These Agencies shall be independent from the CONTRACTOR and approved by the Owner's Representative. The EOR may perform Special Inspection services where qualifications for a specific inspection task are met.
- D. The CONTRACTOR shall plan and conduct his operations as to schedule and allow Special Inspections, providing adequate time and safe access for inspections. The CONTRACTOR shall coordinate requirements for Special Inspections with the Special Inspections Agency.
- E. Special Inspections shall be in addition to inspections performed by Owner's Representatives that are specified in CBC Section 104.
- F. Special Inspections shall be in addition to any Structural Observations required by CBC Section 1704.6.
- G. Special Inspections do not supersede other inspections and testing required by the Contract Documents to satisfy the CONTRACTOR's quality control responsibility. Contractor shall be responsible for all costs associated with quality control requirements as required by other Sections of the Specifications.
- H. Special Inspections shall not relieve CONTRACTOR's obligation to perform and complete work in accordance with Contract Documents. Results of Special Inspections activities, including any discrepancies that are noted or not noted, shall never constitute an acceptance of work that is not in accordance with the Contract Documents.
- I. This Section does not apply to construction equipment, shoring, earth retention

systems, and temporary structures used by the CONTRACTOR in construction and not detailed in the Contract Documents. The CONTRACTOR shall be solely responsible for means, methods, techniques, sequences, or procedures of construction and any associated building code requirements.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Special Inspections requirements apply to work detailed in other Sections of the Specifications. Special Inspections requirements shall be in addition to any other inspection or quality control requirements detailed in other Sections of the Specifications. See individual Specification Sections for type of work in question.

1.03 DEFINITIONS

- A. Periodic Special Inspections: The part-time or intermittent observation of work requiring Special Inspection by a Special Inspector who is present in the area where the work has been or is being performed and at the completion of the work.
- B. Continuous Special Inspections: The full-time observation of work requiring Special Inspection by a Special Inspector who is present in the area where the work is being performed.
- C. Engineer of Record (EOR): The engineer of each system in responsible charge for the design of each specific building system including structural, mechanical, electrical, and architectural components
- D. Registered Design Professional in Responsible Charge (RDPIRC): The RDPIRC in charge of Special Inspections during construction for each specific building system including structural, mechanical, electrical, and architectural components. The RDPIRC shall be a currently Registered Professional Engineer in the State of California. The EOR may serve in this role.
- E. Special Inspections Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, which has been approved by the Owner's Representative and is retained by the Owner. The EOR may serve in this role where qualifications for specific inspection tasks are met.
- F. Special Inspector: Individual employed by or retained by the Special Inspections Agency who is qualified in inspection of specific aspects or components of the construction and conducts inspection activities in these specific aspects of the construction, as required by this Section. The EOR may serve in this role where qualifications for specific inspection tasks are met.
- G. Statement of Special Inspections: Document prepared by the EOR or RDPIRC and submitted to the Owner's Representative which identifies the type and extent of required Special Inspections.

- H. Approved Fabricator: Fabricator who has been registered and approved by the Owner's Representative to manufacture or fabricate specific components of the construction without Special Inspections.
- I. Owner's Representative: RDPIRC or other representative appointed by Owner.

1.04 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents and all other documents referenced in the Specifications. All referenced Specifications, codes, and standards refer to the most current issue available at the time of Bid.

- 1. California Building Code
- 2. ACI 318 – Building Code Requirements for Structural Concrete
- 3. TMS 402/TMS 602 – Building Code for Masonry Structures/Specifications for Masonry Structures
- 4. AISC – Code of Standard Practice
- 5. AISC 341 – Seismic Provisions for Structural Steel Buildings
- 6. AISC 360 – Specification for Structural Steel Buildings
- 7. AISC 348 – Specification for Structural Joints Using High Strength Bolts
- 8. AWS – Structural Welding Code
- 9. ADMI – Aluminum Design Manual: A Specification for Aluminum Structures

1.05 SUBMITTALS

- A. The CONTRACTOR shall submit the following in accordance with Section 01300 - Submittal Procedures.
 - 1. The Contractor shall submit a written statement of responsibility to the Owner's Representative and RDPIRC prior to beginning work. A statement is required from each CONTRACTOR who has responsibility for construction or fabrication of a main wind- or seismic-force-resisting system, designated seismic system, or a wind- or seismic-resisting-component listed in the Statement of Special Inspections.
 - 2. The CONTRACTOR shall submit qualifications of any fabricators they

intend to use that may qualify as Approved Fabricators to the Special Inspections Agency for review.

- B. The Special Inspections Agency shall submit the following in accordance with Section 01300 – Submittal Procedures.
1. The Special Inspections Agency shall provide a statement of qualifications showing relative experience, training, and certification(s) for each Special Inspector to the Owner's Representative, if requested.
 2. The Special Inspections Agency shall review fabricator qualifications and submit them to the Owner's Representative for approval as an Approved Fabricator if requested.
 3. Special Inspectors shall keep detailed inspection records, including all inspections, tests, similar services, and any discrepancies and corrections. Any discrepancies and corrections shall be reported to the Owner's Representative, the EOR, and the RDPIRC in all required reports, unless otherwise required by the Owner's Representative.
 4. The Special Inspections Agency shall submit Interim Reports to the Owner's Representative and the RDPIRC documenting required Special Inspections and correction of any discrepancies at the frequency specified in the Statement of Special Inspections.
 5. The Special Inspections Agency shall submit to the Owner's Representative and the RDPIRC a Final Report documenting required Special Inspections and correction of any discrepancies. The Final Report shall be submitted at a point in time agreed upon by the Owner and the Owner's Representative at the Pre-inspection Meeting.
 6. Where work is done by Approved Fabricators, the Special Inspections Agency shall coordinate the submittal of a certificate of compliance to the Owner's Representative, the EOR, and the RDPIRC.

1.06 SPECIAL INSPECTOR QUALIFICATIONS

- A. Special Inspectors shall meet minimum qualifications established by the Owner's Representative and shall be approved by the Owner's Representative.

1.07 OFF-SITE FABRICATIONS

- A. When structural elements or assemblies are fabricated off site, Special Inspections shall be performed in the fabricator's shop unless the fabricator is an Approved Fabricator. Special Inspections are not required if work is done on the premises of an Approved Fabricator.

- B. Fabricators shall maintain detailed fabrication and quality control procedures to ensure workmanship and conformance with Contract Documents and reference standards. The Special Inspections Agency shall review the fabricator's quality control procedures and coordinate required Special Inspections with the fabricator and the CONTRACTOR.
- C. The CONTRACTOR shall submit qualifications of fabricators seeking Approved Fabricator status to the Special Inspections Agency for review. Approval as an Approved Fabricator shall be given by the Owner's Representative upon the recommendation of the Special Inspections Agency or upon review of the fabricator's written fabrication procedures and quality control manuals that provide a basis for control of materials and workmanship, with periodic auditing of fabrication and quality control practices by an Approved Agency or the Owner's Representative.
- D. At completion of fabrication, the Approved Fabricator shall submit a certificate of compliance to the Owner or the RDPIRC for submittal to the Owner's Representative stating that the work was performed in accordance with the approved Contract Documents.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PRE-INSPECTION MEETING

- A. At least two weeks prior to beginning work, a Pre-inspection Meeting shall be held to discuss the Special Inspection procedures and submittals. The following parties shall participate: EOR, RDPIRC, Special Inspections Agency representative, Contractor, Subcontractors, Testing Agencies, and Owner's Representative. The type of meeting (in-person or teleconference) and location of meeting shall be determined by the Owner's Representative.

3.02 STATEMENT AND SCHEDULE OF SPECIAL INSPECTIONS

- A. The Special Inspections Agency and all Special Inspectors are required to comply with all requirements of the Statement of Special Inspections and the Schedule of Special Inspections. Together, these documents identify materials, systems, components, and work that are required to have Special Inspections, the type and extent of Special Inspections, and whether they will be continuous or periodic. The Schedule of Special Inspections is included at the end of this Section. A form which may be used for the Statement of Special Inspections is also included at the end of this Section.

3.03 SPECIAL INSPECTIONS AGENCY REQUIREMENTS AND RESPONSIBILITIES

- A. The Special Inspections Agency shall be an established and recognized agency regularly engaged in conducting tests or furnishing inspection services, which has been approved by the Owner's Representative and is retained by the Owner. The Agency shall demonstrate competence, to the satisfaction of the Owner's Representative, for the inspection of the specific aspects of construction or operation requiring Special Inspection.
- B. The Special Inspections Agency shall maintain detailed inspection records, including a copy at the jobsite, and all records shall be available upon request by the EOR, RDPIRC or the Owner's Representative. The Agency shall submit all required reports to the EOR, RDPIRC and Owner's Representative. Where EOR approval is required for corrections, the Special Inspector shall maintain copies of all related correspondence and submit with all required reports. The Agency shall coordinate all required Special Inspection activities with the Special Inspectors, the Contractor, and any fabricators and shall coordinate designation of fabricators as Approved Fabricators when requested.

3.04 SPECIAL INSPECTORS' REQUIREMENTS AND RESPONSIBILITIES

- A. All Special Inspectors shall meet the qualification requirements determined by the Owner's Representative for the specific type of inspection services they will be providing and shall be approved by the Owner's Representative. Special Inspectors shall submit written documentation demonstrating their competence and experience or training to the Owner's Representative for approval of their qualifications.
- B. Special Inspections shall be performed in accordance with all requirements of the Statement of Special Inspections, the Schedule of Special Inspections, the CBC, and any State or local amendments. Special Inspectors shall maintain detailed inspection records, including a copy at the jobsite, and all records shall be available upon request by the EOR, RDPIRC, or the Owner's Representative. Special Inspectors shall submit all required reports to the RDPIRC and the Owner's Representative. Where EOR approval is required for corrections, the Special Inspector shall maintain copies of all related correspondence and submit with all required reports. Special Inspectors shall coordinate inspection requirements and time when inspections can be conducted with the CONTRACTOR.
- C. Any discrepancies in work noted by the Special Inspector shall be brought to the immediate attention of the CONTRACTOR for correction. Special Inspectors shall coordinate correction of discrepancies with the CONTRACTOR. Any corrections of discrepancies that result in changes to the work as shown on the Contract Documents shall be approved by the EOR. If noted discrepancies are not corrected, the Special Inspector shall notify the CONTRACTOR, the EOR, the RDPIRC and the Owner's Representative. All noted discrepancies and corrections shall be documented in all inspection records and all required reports.

3.05 CONTRACTOR RESPONSIBILITIES

- A. Each CONTRACTOR responsible for the construction or fabrication of a main wind- or seismic-force- resisting system, designated seismic system, or a wind- or seismic-resisting-component listed in the Statement of Special Inspections shall submit a Statement of Responsibility to the Owner's Representative, RDPIRC, and EOR prior to the commencement of work. The Statement of Responsibility shall contain acknowledgement of the specific requirements contained in the Statement of Special Inspections.
- B. The CONTRACTOR shall coordinate requirements of Special Inspections with the Special Inspections Agency and the Special Inspectors and shall provide adequate time and access to conduct inspections. The CONTRACTOR is solely responsible for providing safe access and any necessary safety equipment required to conduct inspections. The Special Inspector shall not supervise, direct, control, or have authority over or be responsible for the CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of the CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work.
- C. Special Inspections shall not relieve the CONTRACTOR's obligation to perform and complete work in accordance with the Contract Documents. Results of Special Inspections activities, including any discrepancies that are noted or not noted, shall never constitute an acceptance of work that is not in accordance with the Contract Documents.
- D. The CONTRACTOR shall provide advance notice of work to be conducted that will require Special Inspections. If the Special Inspector is delayed in inspecting the work due to inadequate notice or completion of the work, the CONTRACTOR shall reimburse the Owner for the cost of additional subsequent Special Inspections.
- E. The CONTRACTOR shall promptly correct any discrepancies noted by the Special Inspectors. Any corrections of discrepancies that result in changes to the work as shown on the Contract Documents shall be approved by the EOR. Where EOR approval is required, the CONTRACTOR shall report the discrepancy to the EOR in accordance with provisions of the General Conditions. The EOR will authorize any changes to the Contract Documents required for the correction in accordance with provisions of the General Conditions. Copies of all correspondence related to the correction shall be submitted concurrently to the Special Inspections Agency.

3.06 OWNER'S REPRESENTATIVE OR AUTHORITY RESPONSIBILITIES

- A. The Owner's Representative will approve qualifications of the Special Inspections Agency, all Special Inspectors, and any Approved Fabricators. The Owner's

Representative will approve all forms submitted by the CONTRACTOR, any Approved Fabricators, the EOR, the RDPIRC, the Special Inspections Agency, and the Special Inspectors. The Owner's Representative and the Special Inspections Agency shall agree to the frequency of Interim Reports and the submittal deadline for the Final Report.

3.07 RDPIRC RESPONSIBILITIES

- A. The RDPIRC shall complete the Statement of Special Inspections and the Schedule of Special Inspections, unless previously completed by the EOR. The Statement of Special Inspections form included in this Section shall be used unless the Owner's Representative has a preferred form for the Statement of Special Inspections, in which case the Owner's Representative's form may be used and shall be completed by the RDPIRC.
- B. The RDPIRC shall review and coordinate certain aspects of the project, as determined by the Owner's Representative, for compatibility with the design of the building, structure or building system, including, but not limited to, submittal documents prepared by others, deferred submittal documents and phased submittal documents.

3.08 OWNER RESPONSIBILITIES

- A. The Owner will retain a Special Inspections Agency to perform Special Inspections during construction. The Special Inspections Agency will retain the RDPIRC.

3.09 MINIMUM INSPECTION REQUIREMENTS

- A. Detailed requirements for Special Inspections are shown in the Statement of Special Inspections and the Schedule of Special Inspections, which references the CBC, applicable code standards, and any State or local amendments. Special Inspections shall be performed in accordance with all requirements of the Statement of Special Inspections, the Schedule of Special Inspections, the CBC, and any State or local amendments. Additional requirements for specific materials listed in other Sections of these Specifications shall also be satisfied. The frequency of inspections shall be continuous or periodic as indicated in the Schedule of Special Inspections and in accordance with applicable building codes.

3.10 REPORTS

- A. Special Inspectors shall maintain detailed inspection records, including a copy at the jobsite, and all records shall be available upon request by the EOR, RDPIRC or the Owner's Representative. The Special Inspections Agency shall submit all required reports to the Owner's Representative, EOR, and RDPIRC as agreed upon with the Owner's Representative. Reports shall indicate the inspections and testing performed

and whether work inspected was or was not completed in conformance to Contract Documents and any corrective measures taken. Where EOR approval is required for corrections, the Agency shall maintain copies of all related correspondence and submit with all required reports.

3.11 SPECIAL INSPECTIONS FORMS

- A. This Section includes forms which may be used to meet requirements for written documentation during the performance of Special Inspections in accordance with the CBC. These forms may be replaced with forms meeting CBC requirements provided by the Owner's Representative if available.

SCHEDULE OF SPECIAL INSPECTIONS (CBC 2022 VERSION)

1.1 SCHEDULE OF SPECIAL INSPECTIONS—STEEL CONSTRUCTION (CBC 2022)

Inspection Task	Frequency		Applicable to project		Reference Standard	CBC Reference
	CONT	PER	Y/N	Agent		
1. Inspection Tasks Prior to Welding:					AISC 360 Section N.5.4	1705.2.1
a. Welder qualification records and continuity records			Y			
1) Quality Assurance provided by inspector		O	Y			
2) Quality Control provided by fabricator, erector, or contractor	P		Y			
b. WPS available	P		Y			
c. Manufacturer certifications for welding consumables available	P		Y			
d. Material identification (type/grade)		O	Y			
e. Welder identification system ^a		O	Y			
f. Fit-up of groove welds (including joint geometry)		O	N			
1) Joint preparations			N			
2) Dimensions (alignment, root opening, root face, bevel)			N			
3) Cleanliness (condition of steel surfaces)			N			
4) Tacking (tack weld quality and location)			N			
5) Backing type and fit (if applicable)			N			

Inspection Task	Frequency		Applicable to project		Reference Standard	CBC Reference
	CONT	PER	Y/N	Agent		
g. Fit-up of CJP groove welds of HSS T-, Y- and K-joints without backing (including joint geometry) - Quality Assurance provided by inspector 1) Joint preparations 2) Dimensions (alignment, root opening, root face, bevel) 3) Cleanliness (condition of steel surfaces) 4) Tacking (tack weld quality and location)		O	N		AISC 360 Section N.5.4	1705.2.1
			N			
			N			
			N			
			N			
h. Fit-up of CJP groove welds of HSS T-, Y- and K-joints without backing (including joint geometry) - Quality Control provided by fabricator, erector, or contractor 1) Joint preparations 2) Dimensions (alignment, root opening, root face, bevel) 3) Cleanliness (condition of steel surfaces) 4) Tacking (tack weld quality and location)	P		N			
			N			
			N			
			N			
			N			
i. Configuration and finish of access holes		O	Y			
j. Fit-up of fillet welds 1) Dimensions (alignment, gaps at root) 2) Cleanliness (condition of steel surfaces)		O	Y			
			Y			
			Y			

Inspection Task	Frequency		Applicable to project		Reference Standard	CBC Reference
	CONT	PER	Y/N	Agent		
3) Tacking (tack weld quality and location)			Y			
k. Check welding equipment		O	Y			
^a Fabricator or erector, as applicable, shall maintain a system by which a welder who has welded a joint or member can be identified. Stamps, if used, shall be the low-stress type.						
2. Inspection Tasks During Welding:					AISC 360 Section N.5.4	1705.2.1
a. Control and handling of welding consumables		O	Y			
1) Packaging			Y			
2) Exposure control			Y			
b. No welding over cracked tack welds		O	Y			
c. Environmental conditions		O	Y			
1) Wind speed within limits			Y			
2) Precipitation and temperature			Y			
d. WPS followed		O	Y			
1) Settings on welding equipment						
2) Travel speed						
3) Selected welding materials						
4) Shielding gas type/flow rate						
5) Preheat applied						
6) Interpass temperature maintained (min/max)						
7) Proper position (F, V, H, OH)						
e. Welding techniques		O	Y			
1) Interpass and final cleaning			Y			
2) Each pass within profile limitations			Y			

Inspection Task	Frequency		Applicable to project		Reference Standard	CBC Reference
	CONT	PER	Y/N	Agent		
3) Each pass meets quality requirements			Y			
f. Placement and installation of steel headed stud anchors	P		N			
3. Inspection Tasks After Welding:					AISC 360 Section N.5.4	1705.2.1
a. Welds cleaned		O	Y			
b. Size, length, and location of welds	P		Y			
c. Welds meet visual acceptance criteria	P		Y			
1) Crack prohibition			Y			
2) Weld/base-metal fusion			Y			
3) Crater cross section			Y			
4) Weld profiles			Y			
5) Weld size			Y			
6) Undercut			Y			
7) Porosity			Y			
d. Arc strikes	P		Y			
e. k-area ^b	P		Y			
f. Weld access holes in rolled heavy shapes and built-up heavy shapes ^c	P		N			
g. Backing removed and weld tabs removed (if required)	P		N			
h. Repair activities	P		N			
i. Document acceptance or rejection of welded joint or member	P		Y			
j. No prohibited welds have been added without the approval of the EOR		O	Y			

Inspection Task	Frequency		Applicable to project		Reference Standard	CBC Reference
	CONT	PER	Y/N	Agent		
<div><div>^b When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks within 3 in. of the weld.</div><div>^c After rolled heavy shapes (see AISC 360 Section A3.1c) and built-up heavy shapes (see AISC 360 Section A3.1d) are welded, visually inspect the weld access hole for cracks.</div></div>						

Inspection Task	Frequency		Applicable to project		Reference Standard	CBC Reference
	CONT	PER	Y/N	Agent		
4. Inspection Tasks Prior to Bolting:					AISC 360 Section N.5.6	1705.2.1
a. Manufacturer's certifications available for fastener materials 1) Quality Assurance provided by inspector 2) Quality Control provided by fabricator, erector, or contractor						
	O		Y			
		P	Y			
b. Fasteners marked in accordance with ASTM requirements		O	Y			
c. Correct fasteners selected for the joint detail (grade, type, bolt length if threads are to be excluded from shear plane)		O	Y			
d. Correct bolting procedure selected for joint detail		O	Y			
e. Connecting elements, including the appropriate faying surface condition and hole preparation, if specified, meet applicable requirements		O	Y			
f. Pre-installation verification testing by installation personnel observed and documented for fastener assemblies and methods used 1) Quality Assurance provided by inspector 2) Quality Control provided by fabricator, erector, or contractor			Y			
		O	Y			
	P		Y			
g. Protected storage provided for bolts, nuts,		O	Y			

Inspection Task	Frequency		Applicable to project		Reference Standard	CBC Reference
	CONT	PER	Y/N	Agent		
washers, and other fastener components						
5. Inspection Tasks During Bolting:					AISC 360 Section N.5.6	1705.2.1
a. Fastener assemblies placed in all holes and washers and nuts are positioned as required		O	Y			
b. Joint brought to the snug-tight condition prior to the pre-tensioning operation		O	N			
c. Fastener component not turned by the wrench prevented from rotating		O	Y			
d. Fasteners are pre-tensioned in accordance with the RCSC Specification, progressing systematically from the most rigid point toward the free edges		O	N			
6. Inspection Tasks After Bolting:					AISC 360 Section N.5.6	1705.2.1
a. Document acceptance or rejection of bolted connections	P		Y			
7. Steel elements of composite construction prior to concrete placement:					AISC 360 Section N.6	1705.2.1
a. Placement and installation of steel deck	P		N			
b. Placement and installation of steel headed stud anchors	P		N			
c. Document acceptance or rejection of steel elements	P		N			
Structural Steel Definitions: Observe (O) – the inspector shall observe these items on a random basis. Operations need not be delayed pending these inspections. Perform (P) – these tasks shall be performed for each welded joint or member.						

2. SCHEDULE OF SPECIAL INSPECTIONS—CONCRETE CONSTRUCTION (CBC 2022)

Inspection Task	Frequency		Applicable to project		Reference Standard	CBC Reference
	CONT	PER	Y/N	Agent		
1. Inspect reinforcement, including prestressing tendons, and verify placement		X	Y		ACI 318: Ch 20, 25.2, 25.3, 26.6.1-26.6.3	1705.3, 1908.4
2. Reinforcing bar welding:					AWS D1.4, ACI 318: 26.6.4	1705.3
a. Verify weldability of reinforcing bars other than ASTM A706		X	N			
b. Inspect single-pass fillet welds, maximum 5/16"		X	N			
c. Inspect all other welds	X		N			
3. Inspect anchors cast in concrete		X	N		ACI 318: 17.8.2	1705.3
4. Inspect anchors post-installed in hardened concrete members ^f:	X	X			ACI 318:17.8.2.4, ACI 318: 17.8.2	1705.3
a. Adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads			Y			
b. Mechanical anchors and adhesive anchors not defined in 4. a			Y			
5. Verify use of required design mix		X	Y		ACI 318: Ch 19, 26.4.3, 26.4.4	1705.3, 1904.1, 1904.2, 1908.2, 1908.3
6. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete	X		N		ASTM C172, ASTM C31, ACI 318: 26.5, 26.12	1705.3, 1908.10
7. Inspect concrete and shotcrete placement for proper application techniques	X		N		ACI 318: 26.5	1705.3, 1908.6, 1908.7, 1908.8
8. Verify maintenance of specified curing temperature and techniques		X	Y		ACI 318: 26.5.3-26.5.5	1705.3, 1908.9
9. Inspect formwork for shape, location, and dimensions of the concrete member being formed		X	Y		ACI 318: 26.11.1.2(b)	1705.3
^e Where applicable, see IBC Section 1705.13, Special Inspections for seismic resistance.						

Inspection Task	Frequency		Applicable to project		Reference Standard	CBC Reference
	CONT	PER	Y/N	Agent		
f Specific requirements for special inspection shall be included in the research report for the anchor issued by an approved source in accordance with 17.8.2 in ACI 318, or other qualification procedures. Where specific requirements are not provided, special inspection requirements shall be specified by the registered design professional and shall be approved by the Owner's Representative prior to the commencement of the work.						

3. SCHEDULE OF SPECIAL INSPECTIONS—MECHANICAL AND ELECTRICAL COMPONENTS (CBC 2022)

Inspection Task	Frequency		Applicable to project		Reference Standard	CBC Reference
	CONT	PER	Y/N	Agent		
1. Observe anchorage of electrical equipment for emergency and standby power systems in structures assigned to SDC C, D, E or F		X	N			1705.13.6
2. Observe anchorage of other electrical equipment in structures assigned to SDC D, E or F		X	Y			1705A.13.6
3. Observe installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units in structures assigned to SDC C, D, E or F		X	N			1705.13.6
4. Observe installation and anchorage of ductwork designed to carry hazardous materials in structures assigned to SDC C, D, E or F		X	N			1705.13.6
5. Observe installation and anchorage of vibration isolation systems in structures assigned to SDC C, D, E or F where the approved construction documents require a nominal clearance of ¼ inch or less between the equipment support frame and restraint		X	Y			1705.13.6
6. Observe installation of mechanical and electrical equipment, including duct work, piping systems and their structural supports, where automatic fire sprinkler systems are installed in structures assigned to SDC C, D, E or F to verify one of the following:		X	N			1705.13.6
a. Minimum clearances have been provided as required by Section 13.2.3 ASCE 7.			N			
b. A nominal clearance of not less than 3 inches has been provided between fire protection sprinkler system drops and sprigs and: structural members not used			N			

Inspection Task	Frequency		Applicable to project		Reference Standard	CBC Reference
	CONT	PER	Y/N	Agent		
collectively or independently to support the sprinklers; equipment attached to the building structure; and other systems' piping.						
c. Where flexible sprinkler hose fittings are used, special inspection of minimum clearances is not required.			N			1705.13.6
7. Observe anchorage of storage racks that are 8 feet or greater in height in structures assigned to SDC D, E or F			N			1705.13.7
a. Materials used, to verify compliance with one or more of the material test reports in accordance with the approved construction documents		X	N			
b. Fabricated storage rack elements		X	N			
c. Storage rack anchorage installation		X	N			
d. Completed storage rack system, to indicate compliance with the approved construction documents		X	N			
8. Observe seismic isolation systems in seismically isolated structures assigned to SDC B, C, D, E or F during the fabrication and installation of isolator units and energy dissipation devices		X	N			1705.13.8

9. Special Inspections Agency Contact Information:

1.

2.

3.

4.

STATEMENT OF SPECIAL INSPECTIONS

PROJECT: Olivenhain Municipal Water District David C. McCollom Water Treatment Plant Stage 4 Upgrades

LOCATION: 19090 Via Ambiente Road, Escondido, CA 92029

PERMIT APPLICANT: _____

APPLICANT'S ADDRESS: _____

ARCHITECT OF RECORD: _____

CIVIL/STRUCTURAL ENGINEER OF RECORD: Wyatt T. Dressler, PE

MECHANICAL ENGINEER OF RECORD: Silvana M. Ghiu, PE

ELECTRICAL ENGINEER OF RECORD: Paul J. Giorsetto, PE

REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE: _____

This Statement of Special Inspections is submitted in accordance with Section 1704 of the California Building Code. It shall be considered in conjunction with the Schedule of Special Inspections included in this Specification Section 01450. If applicable, it includes *Requirements for Seismic Resistance and/or Requirements for Wind Resistance*.

Are Requirements for Seismic Resistance included in the Statement of Special Inspections? ☒ Yes ☐ No

Are Requirements for Wind Resistance included in the Statement of Special Inspections? ☐ Yes ☒ No

The Special Inspector(s) shall keep detailed records of all inspections, including a copy at the jobsite. All records shall be available upon request by the Engineer or the Owner's Representative. Any discrepancies shall be brought to the immediate attention of the Contractor. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the Owner's Representative and the Engineer prior to completion of that phase of work. The Special Inspections Agency shall furnish Interim Reports to the Owner's Representative and to the Engineer at the frequency indicated in the Statement of Special Inspections. A Final Report shall be submitted to the Owner's Representative and the Engineer at the time agreed upon by the Owner and the Owner's Representative.

Frequency of Interim Report submittals to the Owner's Representative:

___ Weekly ___ Bi-Weekly ___ Monthly Other; specify: _____

Frequency of Interim Report submittals to the Engineer:

___ Weekly ___ Bi-Weekly ___ Monthly Other; specify: _____

Special Inspections do not relieve the Contractor of the obligation to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

Statement of Special Inspections Prepared by:

Type or print name

Signature

Date

Owner's Representative's Acceptance:

Type or print name

Signature

Date

Registered Design Professional's Seal

STATEMENT OF SPECIAL INSPECTIONS

REQUIREMENTS FOR SEISMIC RESISTANCE

See the Schedule of Special Inspections for inspection and testing requirements.

Seismic Design Category: D

Statement of Special Inspection for Seismic Resistance Required (Yes/No): Yes

Description of seismic force-resisting system subject to special inspection and testing for seismic resistance:

N/A

Description of designated seismic systems in accordance with Chapter 13 of ASCE 7 subject to special inspection and testing for seismic resistance. Special inspector shall verify that the label, anchorage and mounting of these systems conforms to the Contract Documents and Approved Submittals:

- New centrifuge and attached components including vibration isolators
- Electrical equipment associated with both new and existing centrifuges

Description of additional seismic systems and components requiring special inspections:

N/A

Description of additional seismic systems and components requiring testing:

N/A

Statement of Responsibility:

Each Contractor responsible for the construction or fabrication of a system or component described above must submit a Statement of Responsibility.

STATEMENT OF SPECIAL INSPECTIONS

REQUIREMENTS FOR WIND RESISTANCE

See the Schedule of Special Inspections for inspection and testing requirements.

Basic Wind Speed (3 second gust): 102 m.p.h. **Wind Exposure Category:** C

Statement of Special Inspection for Wind Resistance Required (Yes/No): No

Description of main wind force-resisting system subject to special inspection for wind resistance:

N/A

Description of wind force-resisting components subject to special inspection for wind resistance:

N/A

Statement of Responsibility:

Each Contractor responsible for the construction or fabrication of a system or component described above must submit a Statement of Responsibility

INTERIM REPORT OF SPECIAL INSPECTIONS

City/County of:							
Project Name/Address:				Inspection Type(s) Coverage:			
				<input type="checkbox"/> Continuous		<input type="checkbox"/> Periodic	
Describe Inspections Made, Including Locations:							
Tests Made:							
Total Inspection Time Each Day	Date:						
	Hours:						
List items requiring Special Inspection, and any discrepancies and corrections. If Engineer approval is required for any corrections, note this, and indicate that approval was obtained. Attach copies of all related correspondence.							
Comments:							

To the best of my knowledge, work inspected was in accordance with the Contract Documents and applicable standards except as noted above.

Signed: _____ Date: _____

Print Full Name: _____ I.D.: _____

Phone Number: _____

This report is to be submitted to the Owner's Representative and the Engineer. A copy shall be maintained at the jobsite.

FINAL REPORT OF SPECIAL INSPECTIONS

PROJECT: Olivenhain Municipal Water District David C. McCollom Water Treatment Plant Stage 4 Upgrades

LOCATION: 19090 Via Ambiente Road, Escondido, CA 92029

PERMIT APPLICANT: _____

APPLICANT'S ADDRESS: _____

ARCHITECT OF RECORD: _____

CIVIL/STRUCTURAL ENGINEER OF RECORD: Wyatt T. Dressler, PE

MECHANICAL ENGINEER OF RECORD: Silvana M. Ghiu, PE

ELECTRICAL ENGINEER OF RECORD: Paul J. Giorsetto, PE

REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE: _____

To the best of my information, knowledge, and belief, Special Inspections required for this Project in accordance with Section 1704 of the California Building Code and any State or local amendments have been performed, and all work has been completed in accordance with the Contract Documents and all applicable standards, except as indicated.

The Special Inspection program does not relieve the Contractor of the obligation to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

This Final Report includes information submitted in previous Interim Reports numbered _____ to _____, as well as any Special Inspections, discrepancies, and corrections occurring since the last Interim Report, dated _____.

All items requiring Special Inspection are listed below. All inspections, tests, and similar services that were performed are listed and any discrepancies and corrections are indicated. If Engineer approval was required for any corrections, this is noted, and copies of all related correspondence are attached.

(Attach 8 1/2"x11" continuation sheet(s) if required to complete the description of corrections)

Prepared By:

Special Inspection Agency:

Type or print name

Special Inspector's Seal

Signature _____ Date _____

CONTRACTOR'S STATEMENT OF RESPONSIBILITY

Each Contractor responsible for the construction or fabrication of a main-wind- or seismic-force-resisting system, designated seismic system, or a wind- or seismic-resisting-component listed in the Statement of Special Inspections must submit this Statement of Responsibility prior to commencement of work on the system or component.

Project: _____

Contractor's Name: _____

Address: _____

License No.:

Description of building systems and components included in Statement of Responsibility:

Contractor's Acknowledgement of Special Requirements

I hereby acknowledge that I have received, read, and understand the Statement of Special Inspections and its requirements.

Name and Title (type or print)

Signature

Date

FABRICATOR’S CERTIFICATE OF COMPLIANCE

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per Section 1704 of the California Building Code must submit this Fabricator’s Certificate of Compliance at the completion of fabrication.

Project: _____

Fabricator’s Name: _____

Address: _____

Description of structural members and assemblies that have been fabricated:

I hereby certify that items described above were fabricated on my premises in strict accordance with the Contract Documents and applicable standards.

Name and Title (type or print)

Signature

Date

Attach copy of Owner’s Representative’s approval of fabricator as an Approved Fabricator.

NOTIFICATION OF FAILURE TO CORRECT DISCREPANCY

City/County of:
Project Name/Address:
List discrepancies, proposed correction, and Contractor response. If Engineer approval is required for any corrections, note this, and indicate whether approval was obtained. Attach copies of all related correspondence.
Comments:

Signed: _____

Date: _____

Print Full

Name: _____

I.D.: _____

Phone

Number: _____

This report is to be submitted to the Owner's Representative, the Contractor, and the Engineer.

END OF SECTION

SECTION 01500
TEMPORARY FACILITIES

PART 1 GENERAL

1.01 SITE OFFICES

- A. CONTRACTOR shall provide offices to be used for the duration of the Contract for its own personnel and its subcontractors on the job site at locations approved by the ENGINEER or OWNER. Such office shall be maintained in a clean, orderly condition. An authorized representative shall be present at all times the Work is in progress. Instructions received there from the ENGINEER shall be considered as delivered to the CONTRACTOR.
 - 1. Temporary offices shall be installed in accordance with local codes including permitting and ADA accessibility, if applicable. CONTRACTOR shall pay all fees.
 - 2. CONTRACTOR provide septage, storage, and their own pumping and bottled water services.

1.02 TEMPORARY POWER AND LIGHT

- A. CONTRACTOR shall furnish temporary light and power, including 220 Volt service for welding, complete with wiring, lamps and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the project needs. Make all necessary arrangements with the local electric company for temporary electric service and pay all expenses in connection therewith.
- B. Provide connections to existing facilities sized to provide service required for power and lighting. CONTRACTOR shall pay the costs of power used.
- C. Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 Volt plugs into higher voltage outlets. For connection of power tools and equipment, provide outlets equipped with ground-fault circuit interrupters, reset button and pilot light.
- D. Provide grounded extension cords. Use heavy duty cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if more than one length is required.
- E. Provide general service incandescent lamps as required for adequate illumination. Provide guard cages or tempered glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.

1.03 WEATHER PROTECTION

- A. The CONTRACTOR furnish temporary air conditioning and heating units (UL or

FM listed) to maintain reasonable temperatures within temporary enclosures.

1.04 TEMPORARY AIR, STEAM AND WATER

- A. Provide all air, steam and water, including temporary piping and appurtenances required for cleaning and testing pipelines and equipment. Remove temporary piping and appurtenances upon approval of equipment being tested.

1.05 SANITARY FACILITIES

- A. Provide self-contained, single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed in a fiberglass or other approved non-absorbent shell.

1.06 FIRE EXTINGUISHERS

- A. Provide portable UL-rated, Class A fire extinguishers for site offices and similar spaces. In other locations, provide portable UL-rated Class ABC dry chemical extinguishers or a combination of NFPA recommended Classes for the exposure. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

PART 2 PRODUCTS

2.01 CONTRACTOR'S FIELD OFFICE

A. General:

1. Provide minimum 12-ft by 50-ft office trailer to be used by the CONTRACTOR for the duration of the project. Field office trailer shall have at least one office, one conference room, one bathroom, one closet, and two exterior doors.
2. The bathroom shall include toilet, sink and faucet, medicine cabinet, and exhaust fan.
3. The conference room shall include built-in plan table.
4. The field office shall be weather-tight construction with floor, walls, and ceiling completely insulated. Each room shall have at least one operating window. Each window shall have a venetian blind and full insect screen. Furnish two sets of keys for each exterior door. Provide fully insulated skirting on all sides of the field office trailer. Provide steps, platforms, handrails, and boot scrapers for each exterior door.
5. Field office trailer shall be Mobile Mini, ModSpace, Williams Scotsman, or equal. Converted storage or box containers will not be acceptable.

B. Furnishings

1. CONTRACTOR shall provide the following furnishings for the temporary field

office for the duration of the project. All furnishings shall be new – or in very good condition – subject to approval of the OWNER.

- a. Three 60-in by 30-in desks with file drawer and 5 drawers, all lockable, one upholstered swivel type chair with arms for each desk.
- b. One 30-in by 84-in conference table
- c. Eight armless side chairs (stacking type)
- d. Two steel bookcase units, 4 shelves high, Hon No. HN-S48 ABC, or equal
- e. One electric bottled water dispenser with hot and cold outlets and refrigerator unit. Adequate water bottles shall be provided (and paid for by the Contractor) until Final Completion
- f. One wall-mounted first aid kit, McMaster-Carr 9501T1 or equal
- g. Two smoke detectors, with batteries
- h. One dry erase boards, aluminum frame, 36-in by 60-in, markers and eraser, Quartet Model No. TS-S 535 or equal
- i. One first aid kit, OSHA (1910.151.b) and ANSI (Z308.1-2003) compliant, suitable for ten people.

C. Equipment

1. Contractor shall provide the following equipment for the temporary field office for the duration of the project. All equipment shall be new.
 - a. A multifunction Photocopier and printer.
 1. With 50-sheet auto-feeder, capable of copying and printing
 2. Letter-sized, legal-sized, and 11x17-inch documents.
 3. Contractor to provide paper and ink cartridges, as required, for the duration of the project.
 - b. Four 8-outlet surge protectors with six foot cord and minimum 1800-joule energy rating or greater; as manufactured by Belkin, or equal.

D. Services

1. Provide the following services for the duration of the project. Services shall include all costs for installation, use, maintenance, and removal of all products, services and equipment billed by each provider for each service specified herein.
2. Field office shall have complete and fully functional electrical, plumbing, and HVAC systems. Provide at least two smoke detectors hard-wired into the

electrical system. Perform all scheduled and unscheduled maintenance for all systems and as directed by the Engineer.

3. Electrical System: Provide connection to temporary electric service. Comply with the electrical requirements of the furnished office trailer. Provide main circuit panel, sufficient GFCI outlets and lighting in each room, exterior lights at each exterior door, and proper grounding of entire electrical system.
 4. Plumbing system: Connect to existing potable water supply. Provide hot water heater and hot and cold water to each fixture. Connect waste pipes to existing porta potties or a waste holding tank. Where potable water service is not available, Contractor shall provide bottle water service with water chiller/dispenser.
 5. HVAC System: Provide central heating and air conditioning system with programmable thermostat. System shall be capable of maintaining an interior temperature of 70°F when the exterior temperature is 0°F and an interior temperature of 75°F when the exterior temperature is 100°F.
 6. Janitorial service: Provide janitorial services (at least weekly) that include disinfection, and trash removal.
 7. Sanitary service: Provide regular pumping of waste holding tank, if applicable, as needed.
 8. Communications: Provide high-speed internet access for the duration of the project.
 9. Pay all costs for installation, maintenance, and removal of the telephone and internet service and instruments. The monthly cost of all calls made and received, including toll and long distance calls, shall be paid for by the CONTRACTOR for the duration of the project.
- E. Supplies: Provide the following supplies for the duration of the project: copy paper, toner, toilet paper, paper towels, soap, light bulbs, and other consumables as required.

PART 3 EXECUTION

- A. Temporary offices shall be set up and ready for occupancy within 30 days of the Notice to Proceed.
1. Provide regular office cleaning services for the duration of the project.

Provide supplies including, but not limited to restroom supplies (toilet tissue paper, paper towel, and soap), as well as light bulbs, air conditioner filters, etc.

2. Provide office supplies for printers and fax machines, etc.
 3. Supply all fuel for heating and pay all utility bills.
- B. Temporary offices shall be removed and the site shall be cleaned up and restored

before Final Completion of the project.

END OF SECTION

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SECTION 01562
DUST CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Perform dust control operations, in an approved manner, whenever necessary or when directed by the ENGINEER, even though other work on the project may be suspended. Dust control shall be generally accomplished by the use of water; however, the use of calcium chloride may be used when necessary to control dust nuisance.
- B. Calcium chloride shall conform to AASHTO M144, Type I except the requirements for "total alkali chlorides" and other impurities shall not apply.
- C. Methods of controlling dust shall meet all air pollutant standards as set forth by Federal and State regulatory agencies.

PART 2 PRODUCTS (NOT

USED) PART 3

EXECUTION (NOT

USED)

END OF SECTION

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SECTION 01600 PRODUCT DELIVERY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. General requirements for preparing for shipping, delivering, and handling materials and equipment.
2. Contractor shall make all arrangements for transporting, delivering, and handling of materials and equipment required for prosecution and completion of the Work.

1.02 SUBMITTALS

- A. Refer to individual Specification Sections for submittal requirements relative to delivery and handling materials and equipment.

1.03 SHIPMENT REQUIREMENTS

- A. When practical, factory-assemble materials and equipment. Match mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable, protective coating.
- B. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate the associated purchase order number, bill of lading number, contents by name, Owner's contract name and number, Contractor name, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.
- C. Protect materials and equipment from exposure to the elements and keep thoroughly dry and dust-free at all times. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Lubricate bearings and other items requiring lubrication in accordance with manufacturer's instructions.
- D. Advance Notice of Shipments:
1. Keep Engineer informed of delivery of all materials and equipment to be incorporated in the Work.
- E. Do not ship materials and equipment until:

1. Related Shop Drawings, Samples, and other submittals have been approved or accepted (as applicable) by Engineer, including, but not necessarily limited to, Submittals associated with the materials and equipment being delivered.
2. Manufacturer's instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by Engineer in accordance with the Specifications.
3. Results of source quality control testing (factory testing), when required by the Contract Documents for the associated materials or equipment, have been reviewed and accepted by Engineer.
4. Facilities required for handling materials and equipment in accordance with manufacturer's instructions are in place and available.
5. Required storage facilities have been provided.

1.04 DELIVERY REQUIREMENTS

A. Scheduling and Timing of Deliveries:

1. Arrange deliveries of materials and equipment in accordance with the accepted Progress Schedule and in ample time to facilitate inspection prior to installation.
 - a. Equipment and material shall not be delivered to the Site prior to 90 days in advance of scheduled installation.
 - b. Partial payment requests will not be processed for materials delivered prior to 90 days before installation or for materials that are improperly stored.
2. Schedule deliveries to minimize space required for and duration of storage of materials and equipment at the Site or delivery location, as applicable.
3. Coordinate deliveries to avoid conflicting with the Work and conditions at Site, and to accommodate the following:
 - a. Work of other contractors and Owner.
 - b. Owner's operations and maintenance.
 - c. Storage space limitations.
 - d. Availability of equipment and personnel for handling materials and equipment.
 - e. Owner's use of premises.
4. Deliver materials and equipment to the Site during regular working hours.

5. Deliver materials and equipment to avoid delaying the Work and the Project, including work of other contractors, as applicable. Deliver anchor system materials, including anchor bolts to be embedded in concrete or masonry, in ample time to avoid delaying the Work.

B. Deliveries:

1. Shipments shall be delivered with Contractor's name, Subcontractor's name (if applicable), Site name, Project name, and contract designation clearly marked.
2. Site may be listed as the "ship to" or "delivery" address; but Owner shall not be listed as recipient of shipment unless otherwise directed in writing by Engineer.
3. Provide Contractor's telephone number to shipper; do not provide Owner's telephone number.
4. Arrange for deliveries while Contractor's personnel are at the Site. Contractor shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when Contractor is not present will be refused by Owner, and Contractor shall be responsible for the associated delays and additional costs, if incurred.

C. Containers and Marking:

1. Have materials and equipment delivered in manufacturer's original, unopened, labeled containers.
2. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.

D. Inspection of Deliveries:

1. Immediately upon delivery, Contractor shall inspect shipment to verify that:
 - a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) submittals.
 - b. Quantities are correct.
 - c. Materials and equipment are undamaged.
 - d. Containers and packages are intact and labels are legible.
 - e. Materials and equipment are properly protected.
2. Promptly remove damaged materials and equipment from the Site and expedite delivery of new, undamaged materials and equipment, and remedy incomplete or lost materials and equipment to furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.

3. Advise Engineer in writing when damaged, incomplete, or defective materials and equipment are delivered, and advise Engineer of the associated impact on the Progress Schedule.

1.05 HANDLING REQUIREMENTS

- A. Provide equipment and personnel necessary to handle materials and equipment, including those furnished by Owner, by methods that prevent soiling or damaging materials and equipment and packaging.
- B. Provide additional protection during handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and surrounding surfaces.
- C. Handle materials and equipment by methods that prevent bending and overstressing.
- D. Lift heavy components only at designated lifting points.
- E. Handle materials and equipment in safe manner and as recommended by the manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during handling. Hand-carry or use suitable handling equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01610
MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Material and equipment incorporated into the Work:
 - 1. Conform to applicable specifications and standards.
 - 2. Comply with size, make, type and quality specified, or as specifically approved in writing by the ENGINEER.
 - 3. Manufactured and Fabricated Products
 - a. Design, fabricate and assemble in accord with the best engineering and shop practices.
 - b. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
 - c. Two or more items of the same kind shall be identical, by the same manufacturer.
 - d. Products shall be suitable for service conditions.
 - e. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
 - 4. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.02 RELATED REQUIREMENTS

- A. General Provisions
- B. Summary of Work is included in Section 01010.
- C. Special Provisions are included in Section 01170.
- D. Submittals are included in Section 01300.
- E. Cleaning is included in Section 01710.
- F. Equipment Operation and Maintenance Training is included in Section 01715.

- F. Operating and Maintenance Manuals are included in Section 01730.
- G. Warranties and Bonds are included in Section 01740.

1.03 APPROVAL OF MATERIALS

- A. Only new materials and equipment shall be incorporated in the work except where indicated otherwise on the Contract Drawings or directed otherwise by the ENGINEER. All materials and equipment furnished by the CONTRACTOR shall be subject to the inspection and approval of the ENGINEER. No material shall be delivered to the site without prior approval of the ENGINEER.
- B. CONTRACTOR shall submit to the ENGINEER, data relating to materials and equipment he proposes to furnish for the work. Such data shall be in sufficient detail to enable the ENGINEER to identify the particular product and to form an opinion as to its conformity to the specifications. The data shall comply with Section 01300.
- C. Facilities and labor for handling and inspection of all materials and equipment shall be furnished by the CONTRACTOR. If the ENGINEER requires, either prior to beginning or during the progress of the Work, the CONTRACTOR shall submit samples of materials for such special tests as may be necessary to demonstrate that they conform to the specifications. Such samples shall be furnished, stored, packed, and shipped as specified in the General Conditions at the CONTRACTOR's expense. Except as otherwise noted, the CONTRACTOR will pay for the tests.
- D. The CONTRACTOR shall submit data and samples sufficiently early to permit consideration and approval before materials are necessary for incorporation in the Work. Any delay of approval resulting from the CONTRACTOR's failure to submit samples or data promptly shall not be used as a basis of claim against the OWNER or the ENGINEER.
- E. In order to demonstrate the proficiency of workmanship or to facilitate the choice among several textures, types, finishes, and surfaces, the CONTRACTOR shall provide such samples of workmanship or finish as may be required.
- F. The materials and equipment used on the work shall correspond to the approved samples or other data.
- G. When required, the CONTRACTOR shall furnish to the ENGINEER triplicate sworn copies of manufacturer's shop tests (or reports from independent testing laboratories) relative to materials and equipment performance ratings.
- H. If the Work is to be inspected on behalf of the OWNER during its fabrication, manufacture, or testing, or before shipment, the CONTRACTOR shall give at least 30 days advance notice to the ENGINEER of the place and time where such fabrication, manufacture, testing, or shipping is to be done. Such notice shall be in writing and delivered to the ENGINEER.

1.04 MANUFACTURER'S INSTRUCTIONS FOR INSTALLATION

- A. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including five copies to the ENGINEER.
 - 1. Maintain one set of complete instructions at the job site during installation and until completion.
- B. Handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements.
 - 1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with ENGINEER for further instructions.
 - 2. Do not proceed with work without clear instructions.
- C. Perform work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.05 PACKAGING FOR SHIPMENT

- A. All shipments shall be properly boxed, crated, packed, or otherwise protected to prevent damage in transit and storage. Shipments involving sea transportation shall be crated with dry materials, shall be packed with a desiccant, shall be sprayed or treated with a fungicide or give equivalent treatment, and shall be otherwise protected to insure delivery with no fungus growth, rust, or other damage due to such transportation.
- B. All tools, spare parts, materials, and equipment shall be properly protected so no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed and the equipment is ready for operation.
- C. To avoid work hardening or "Brinelling" damage from vibrations, bearings shall be removed and shipped separately or rotating parts of equipment shall be blocked and locked in place to prevent movement during transport.
- D. After completion of shop assembly, test, and approval, all electrical gear and variable frequency drives, control cabinets, panels, and consoles shall be enclosed in heavy-duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Desiccant dryers or dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be pallet or skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at both the warehouse and work site.

- E. All items shall be prepared for shipment so that slings for handling can be readily attached while the items are on the car or truck. Where it is unsafe to attach slings to the box, boxed items shall be packaged with slings attached to the items so that attachments can readily be made. Before shipment, all finished iron and steel external parts shall be covered with a readily removable rust-preventing compound approved by the ENGINEER. All finished bright work shall be suitably wrapped or otherwise protect from damage.
- F. Pumps shall be cleaned and lubricated before shipment in preparation for testing and field painting.
- G. Factory assembled parts and components shall not be dismantled for shipment

unless permission is received in writing from the ENGINEER. All mechanical equipment to be shipped disassembled shall be assembled in the manufacturers' shop to ensure proper filling of parts, then match-marked for field assembly and disassembled for shipment.
- H. Special instructions for proper field handling and installation required by manufacturer for proper protection shall be securely attached to each piece of equipment prior to packaging and shipment. Each package shall be stored in resealable plastic bags or other acceptable means of protection and be plainly marked with the following:
 - 1. An identifying number, which also shall appear on the bill of lading and other documents relating to shipment.
 - 2. A permanent stainless steel or other noncorrosive material tag firmly attached and permanently and indelibly marked with the identifying number shall be provided on each piece of equipment furnished.
 - 3. Name and address of consignor and CONTRACTOR.
 - 4. Sufficient information to identify the contents, and when possible, the name of the machine or equipment of which the contents form a part.
 - 5. Shipping and weight.
- I. The finished surfaces of all exposed flanges shall be protected by wooden blank flanges, strongly built and securely bolted thereto. Pipes, fittings, and flanges, which have been oxygen cleaned prior to shipment shall be plugged with plastic inserts and protected with wooden blank flanges as described above.
- J. Each sub-component that is separately packaged shall be tagged to identify its location, number, and function in the system. Identification shall be prominently displayed on the outside of the package.
- K. Each package shall contain a detailed packing list containing package and

contract numbers and a description of the contents, including quantities, part or unit identifications, and part numbers, if applicable.

- L. All equipment delivered by truck shall be capable of being unloaded from 3 sides of the truck bed with a forklift loader or from above with an overhead crane.

1.06 WARRANTY

- A. For all major pieces of equipment, submit a warranty from the equipment manufacturer as specified in Section 01740.

1.07 GREASE, OIL AND FUEL

- A. All grease, oil and fuel required for testing of equipment shall be furnished with the respective equipment. The OWNER shall be furnished with a year's supply of required lubricants including grease and oil of the type recommended by the manufacturer with each item of equipment supplied under Divisions 11, 12, 13, 14, 15 and 16.
- B. The CONTRACTOR shall be responsible for changing the oil in all drives and intermediate drives of each mechanical equipment after initial break-in of the equipment, which in no event shall be any longer than three weeks of operation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01630

SUBSTITUTIONS AND PRODUCT OPTIONS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Furnish and install Products specified, under options and conditions for substitutions stated in this Section.
- B. Whenever a product, material or item of equipment is specified or described by using the name of a proprietary product or the name of a particular manufacturer or vendor, followed by the phrase "or equal," the specific item mentioned shall be the basis upon which bids are to be prepared, and shall be understood as establishing the type, function, dimension, appearance and quality desired. Other manufacturer's or vendor's products not named will be considered as substitutions, provided the required information is submitted in the manner set forth in this section and provided the substitution will not require substantial revision to the Contract Documents.

1.02 SUBMITTAL OF LIST OF PROPOSED SUBSTITUTIONS

- A. Bidders shall submit their list of proposed substitutions and the proposed monetary changes associated therewith to the OWNER on the standard form provided together with their bids.

1.03 CONTRACTOR'S OPTIONS

- A. For Products specified only by reference standard, select product meeting that standard, by any manufacturer.
- B. For Products specified by naming several products or manufacturers, select any one of products and manufacturers named which complies with Specifications.
- C. For Products specified by naming one or more products or manufacturers and stating "or equal," submit a request as for substitutions, for any product or manufacturer which is not specifically named.
- D. For Products specified by naming only one product and manufacturer, there is no option and no substitution will be allowed.

1.04 SUBSTITUTIONS

- A. In order for substitutions to be considered, the CONTRACTOR shall submit within 30 days of issuance of Notice of Award, complete data as set forth herein to permit complete analysis of all proposed substitutions noted on his substitutions list. No substitution shall be considered unless the CONTRACTOR provides the

required data in accordance with the requirements of this Section.

B. Submit separate request for each substitution. Support each request with:

1. Complete data substantiating compliance of proposed substitution with requirements stated in Contract Documents:
 - a. Product identification, including manufacturer's name and address.
 - b. Manufacturer's literature; identify:
 - 1) Product description.
 - 2) Reference standards.
 - 3) Performance and test data.
 - 4) Operation and maintenance data.
 - c. Samples, as applicable.
 - d. Name and address of similar projects on which product has been used, and date of each installation.
2. Itemized comparison of the proposed substitution with product specified; List significant variations. Substitution shall not change design intent and shall perform equal to that specified.
3. Data relating to impact on construction schedule occasioned by the proposed substitution.
4. Any effect of substitution on separate contracts.
5. List of changes required in other work or products.
6. Accurate cost data comparing proposed substitution with product specified.
 - a. Amount of any net change to Contract Sum.
7. Designation of required license fees or royalties.
8. Designation of availability of maintenance services, sources of replacement materials.

C. Substitutions will not be considered for acceptance when:

1. They are indicated or implied on shop drawings or product data submittals without a formal request from CONTRACTOR.
2. They are requested directly by a subcontractor or supplier.

3. Acceptance will require substantial revision of Contract Documents.
- D. Requests for substitutions submitted after Notice of Award will not be considered unless evidence is submitted to the ENGINEER that all of the following circumstances exist:
1. The specified product is unavailable for reasons beyond the control of the CONTRACTOR. Such reasons shall consist of strikes, bankruptcy, discontinuance of manufacturer, or acts of God.
 2. The CONTRACTOR placed, or attempted to place, orders for the specified products within 10 days after Notice of Award.
 3. Request for substitution is made in writing to the ENGINEER within 10 days of the date on which the CONTRACTOR ascertains that he cannot obtain the item specified.
 4. Complete data as set forth herein to permit complete analysis of the proposed substitution is submitted with the request.
- E. The ENGINEER's decision regarding evaluation of substitutions shall be considered final and binding. Requests for time extensions and additional costs based on submission of, acceptance of, or rejection of substitutions will not be allowed. All approved substitutions will be incorporated into the Agreement by Change Order.

1.05 CONTRACTOR'S REPRESENTATION

- A. In making formal request for substitution, CONTRACTOR represents that:
1. CONTRACTOR has investigated proposed product and has determined that it is equal to or superior in all respects to that specified.
 2. CONTRACTOR will provide same warranties or bonds for substitution as for product specified.
 3. CONTRACTOR will coordinate installation of accepted substitution into the Work, and will make such changes as may be required for the Work to be complete in all respects.
 4. CONTRACTOR waives claims for additional costs caused by substitution which may subsequently become apparent.
 5. Cost data is complete and includes related costs under his Contract, but not:
 - a. Costs under separate contracts.
 - b. ENGINEER's costs for redesign or revision of Contract Documents.

1.06 ENGINEER DUTIES

- A. Review CONTRACTOR's requests for substitutions with reasonable promptness.
- B. Notify CONTRACTOR, in writing, of decision to accept or reject requested substitution.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01660
PRODUCT STORAGE AND PROTECTION REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. General requirements of storing and protecting equipment and materials.

1.02 STORAGE

- A. Store and protect materials and equipment in accordance with manufacturer's recommendations and the Contract Documents.
- B. Contractor shall make all arrangements and provisions necessary for, and pay all costs for, storing materials and equipment. Construction equipment, and materials and equipment to be incorporated into the Work shall be placed to avoid injuring the Work and existing facilities and property, and so that free access is maintained at all times to all parts of the Work and to public utility installations in vicinity of the Work. Store materials and equipment neatly and compactly in locations that cause minimum inconvenience to Owner, other contractors, public travel, and owners, tenants, and occupants of adjoining property. Arrange storage in manner to allow easy access for inspection.
- C. Areas available at the Site for storing materials and equipment are shown or indicated in the Contract Documents, or as approved by Engineer.
- D. Store materials and equipment to become Owner's property to facilitate their inspection and ensure preservation of quality and fitness of the Work, including proper protection against damage by freezing, moisture, and high ambient temperatures. Store in indoor, climate-controlled storage areas all materials and equipment subject to damage by moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to Owner.
- E. Contractor shall be fully responsible for loss or damage (including theft) to stored materials and equipment.
- F. Do not open manufacturer's containers until time of installation, unless recommended by the manufacturer, directed by Engineer or otherwise specified in the Contract Documents.
- G. Do not store materials or equipment in structures being constructed unless approved by Engineer in writing.
- H. Do not use lawns or other private property for storage without written permission of the owner or other person in possession or control of such premises.
- I. Contractor shall not store unnecessary equipment and materials at the Site.

- J. Contractor shall prevent structures from being loaded with a weight that endanger its security and/or safety of persons.
- K. Stored equipment and materials shall not be placed within 10 feet of fire hydrants.
- L. Gutters, drainage channels and inlets shall be kept unobstructed at all times.

1.03 PROTECTION

- A. Contractor shall provide temporary storage containers/facilities, if required, to protect equipment and materials at the Site.
- B. Equipment to be incorporated into the Work shall be boxed, crated, or otherwise completely enclosed and protected during shipping, handling, and storage, in accordance with Section 01600 Product Delivery Requirements.
- C. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.
- D. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Painted equipment surfaces that are damaged or marred shall be repainted in their entirety in accordance with equipment manufacturer and paint manufacturer requirements, to the satisfaction of Engineer.

1.04 SPECIFIC STORAGE REQUIREMENTS

- A. Uncovered:
 - 1. The following types of materials may be stored outdoors without cover on supports so there is no contact with the ground:
 - a. Piping, except polyvinyl chloride (PVC) or chlorinated PVC (CPVC) pipe.
- B. Covered:
 - 1. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:
 - a. Grout and mortar materials.
 - b. Rough lumber.
 - c. PVC and CPVC pipe.
 - 2. Tie down covers with rope, and slope covering to prevent accumulation of water.
- C. Fully Protected:

1. All materials and equipment not named as uncovered or covered in this Section, shall be stored on supports in buildings or trailers that have concrete or wooden flooring, roof, and fully closed walls on all sides. Covering with plastic sheeting or similar material in space without floor, roof, and walls is not acceptable. Comply with the following:
 - a. Provide heated storage for materials and equipment that could be damaged by low temperatures or freezing.
 - b. Provide air-conditioned storage for materials and equipment that could be damaged by high temperatures.
 - c. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.
 - d. Maintain humidity at levels recommended by manufacturers of electrical and electronic equipment.
 - e. Energize space heaters for electrical equipment and material.

D. Maintenance of Storage: On scheduled basis, periodically inspect stored materials and equipment to ensure that:

1. Condition and status of storage facilities is adequate to provide required storage conditions.
2. Required environmental conditions are maintained on continuing basis.
3. Materials and equipment exposed to elements are not adversely affected.

1.05 RECORDS

- A. Keep up-to-date account of materials and equipment in storage to facilitate preparation of Applications for Payment, if the Contract Documents provide for payment for materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01665

EQUIPMENT TESTING AND STARTUP

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide a competent field services technician of the manufacturers of all equipment furnished by the CONTRACTOR under Divisions 11, 13, 15 and 16 to supervise installation, adjustment, initial operation and testing, performance testing, final acceptance testing and startup of the equipment.
- B. Perform specified equipment field performance tests, final acceptance tests and startup services.

1.02 RELATED WORK

- A. Operation and Maintenance Manuals are included in Section 01730.
- B. Performance and acceptance testing and startup requirements are included in the respective sections of Divisions 11, 13, 15 and 16.

1.03 SUBMITTALS

- A. Submit for review in accordance with Section 01300 detailed testing procedures for shop tests, field performance tests and final acceptance tests as specified in the various equipment specification sections. Test procedures shall be submitted at least 6 weeks in advance of the proposed test dates and shall include at least the following information:
 - 1. Name of equipment to be tested, including reference to specifications section number and title.
 - 2. Testing schedule of proposed dates and times for testing.
 - 3. Summary of power, lighting, chemical, water, sludge, gas, etc, needs and identification of who will provide them.
 - 4. Outline specific assignment of the responsibilities of the CONTRACTOR and manufacturers' factory representatives or field service personnel.
 - 5. Detailed description of step-by-step testing requirements, with reference to appropriate standardized testing procedures and laboratory analyses by established technical organizations (e.g., ASTM, WPCF Standard Methods, etc).

6. Samples of forms to be used to collect and record test data and to present tabulated test results.
- B. Submit in accordance with Section 01300 copies of test reports upon completion of specified shop, performance and acceptance tests. Test reports shall incorporate the information provided in the test procedures submittals, modified to reflect actual conduct of the tests and the following additional information:
1. Copy of all test data sheets and results of lab analyses.
 2. Summary comparison of specified test and performance requirements versus actual test results.
 3. Should actual test results fail to meet specified test and performance requirements, describe action to be taken prior to re-testing equipment.
- C. Submit in accordance with Section 01300 copies of the manufacturer's field service technician's report summarizing the results of his/her initial inspection, operation, adjustment and pre-tests. The report shall include detailed descriptions and tabulations of the points inspected, tests and adjustments made, quantitative results obtained, suggestions for precautions to be taken to ensure proper maintenance, and the equipment supplier's Certificate of Installation in the format specified hereinafter.

1.04 REFERENCE STANDARDS

- A. American Water Works Association (AWWA)
1. AWWA C653 - Disinfection for Water Treatment Plants
- B. American Society for Testing and Materials (ASTM)
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. Field service technicians shall be competent and experienced in the proper installation, adjustment, operation, testing and startup of the equipment and systems being installed.
- B. Manufacturers' sales and marketing personnel will not be accepted as field service technicians.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PRELIMINARY REQUIREMENTS

- A. After installation of the equipment has been completed and the equipment is presumably ready for operation, before it is operated by others, the manufacturer's

field service technician shall inspect, operate, test and adjust the equipment. The inspection shall include at least the following points where applicable:

1. Soundness (without cracked or otherwise damaged parts).
 2. Completeness in all details, as specified and required.
 3. Correctness of setting, alignment and relative arrangement of various parts.
 4. Adequacy and correctness of packing, sealing and lubricants.
- B. The operation, testing and adjustment shall be as required to prove that the equipment has been left in proper condition for satisfactory operation under the conditions specified.
- C. Upon completion of this work, the manufacturer's field service technician shall submit a signed report of the results of his inspection, operation, adjustments and tests. The certificate of installation shall be attached to its respective specification and to be signed by the owner's agent after a preliminary inspection has been completed.

3.02 WITNESS REQUIREMENTS

- A. Shop tests or factory tests may be witnessed by the OWNER and/or OWNER's representatives, as required by the various equipment specifications.
- B. Field performance and acceptance tests shall be performed in the presence of the OWNER, the OWNER's designed personnel and/or OWNER's representatives.

3.03 CONTRACTOR RESPONSIBILITY FOR STARTUP AND ACCEPTANCE OF STAGE 4 UPGRADES

- A. Preparation for Startup
1. Upon completion of the Stage 4 Upgrades including all its related systems, all pipelines shall be flushed with potable water and hydraulically checked for leaks, cracks, and defects as specified herein.
 2. All mechanical and electrical equipment shall be checked to insure that it is in good working order and properly connected. Preliminary run-ins of the various valves, pumps, and other remaining equipment shall be made. All systems shall be cleaned and purged as required. All systems and pipelines which are hydraulically checked shall be drained and returned to their original condition once the water testing is complete.
 3. All instruments and controls shall be calibrated through their full range. All other adjustments required for proper operation of all instrumentation and control equipment shall be made.

4. Perform all other tasks needed for preparing and conditioning the facilities for proper operation.
5. No testing or equipment operation shall take place until it has been verified by the ENGINEER and the Contactor's CSI that all specified safety equipment has been installed and is in good working order, and that all lubricants, tools, maintenance equipment, spare parts and approved equipment operation and maintenance manuals have been furnished as specified.

B. Facilities Startup

1. Startup period shall not begin until all new facilities and equipment have been tested as specified and are ready for operation. The OWNER shall receive spare parts, safety equipment, tools and maintenance equipment, lubricants, approved operation and maintenance data and the specified operation and maintenance instruction prior to the startup with raw water. All valve tagging shall also be complete prior to this startup.
2. The CONTRACTOR shall provide electricians, instrumentation and controls technicians, plumbers and mechanics to make repairs or correct any deficiencies identified by the OWNER, and ENGINEER during the facility demonstration conducted by the OWNER as a prerequisite of Substantial Completion and Acceptance.
3. In the event of failure to demonstrate satisfactory performance of the facility on the first or any subsequent attempt, all necessary alterations, adjustments, repairs and replacements shall be made. When the facility is again ready for operation, it shall be brought on line and a new test shall be started. This procedure shall be repeated as often as necessary until the facility has operated continuously to the satisfaction of the OWNER and ENGINEER, for the specified duration.
4. The OWNER will furnish all operating personnel (other than vendor's or the CONTRACTOR'S or subcontractor's service personnel) needed to operate equipment during the final test period; however, said personnel will perform their duties under CONTRACTOR's direct supervision. Until performance tests are completed and units and systems are accepted by the OWNER as substantially complete, the CONTRACTOR shall be fully responsible for the operation and maintenance of all new facilities.
5. The OWNER will provide all necessary chemicals and electricity. However, the CONTRACTOR shall provide all necessary personnel of the various construction trades, i.e., electricians, plumbers, etc, and field service personnel of the major equipment suppliers as necessary during the startup period.
6. Do not, at any time, during startup allow the facility to be operated in a manner which subjects equipment to conditions that are more severe than the maximum allowable operating conditions for which the equipment was designed.

EQUIPMENT SUPPLIER'S CERTIFICATE OF INSTALLATION

OWNER Olivenhain Municipal Water District

Project David C. McCollom Water Treatment Plant – Stage 4 Upgrades Project

Contract No. _____

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized
representative of (Print Name)

(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial no.)

installed for the subject project has (have) been installed in a satisfactory manner, has (have)
been tested and adjusted, and is (are) ready for final acceptance testing and operation on:

Date _____

Time _____

CERTIFIED BY: _____
(Signature of Manufacturer's Representative)

Date: _____

APPROVED BY: _____
(Signature of Owner's Representative)

Date: _____

END OF SECTION

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SECTION 01700
CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section outlines the procedure to be followed in closing out the contract.

1.02 SUBSTANTIAL COMPLETION

- A. The substantial completion date shall be established as stated in the Contract Documents.

1.03 FINAL CLEANING

- A. At the completion of work and immediately prior to final inspection, cleaning of the entire project shall be accomplished according to the following provisions:
 - 1. The CONTRACTOR shall thoroughly clean, sweep, wash, and polish all work (including coatings and finishes) and equipment provided under the Contract. The cleaning shall leave the structures and site in a complete and finished condition to the satisfaction of the ENGINEER.
 - 2. The CONTRACTOR shall remove all temporary structures and all debris, including all dirt, sand, gravel, rubbish and waste material. All disposal must be off the OWNER's property.
 - 3. Should the CONTRACTOR not remove rubbish or debris or not clean the buildings and site as specified above, the OWNER reserves the right to have the cleaning done at the expense of the CONTRACTOR.
- B. Employ experienced workers, or professional cleaners, for final cleaning.
- C. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
- D. Use cleaning materials only on surfaces recommended by cleaning material manufacturers.
- E. In preparation for substantial completion or occupancy, conduct final inspection of sight- exposed interior and exterior surfaces, and of concealed spaces.
- F. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight- exposed interior and exterior finished surfaces.
- G. Repair, patch, and touch up marred surfaces to specified finish, to match adjacent surfaces.

- H. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.
- I. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly-painted surfaces.

1.04 FINAL INSPECTION

- A. After final cleaning and restoration and upon written notice from the CONTRACTOR that the work is completed, the ENGINEER will make a preliminary inspection with the OWNER and the CONTRACTOR present. Upon completion of this preliminary inspection, the ENGINEER will notify the CONTRACTOR, in writing, of any particulars in which this inspection reveals that the work is defective or incomplete.
- B. Upon receiving written notice from the ENGINEER, the CONTRACTOR shall immediately undertake the work required to remedy deficiencies and complete the work to the satisfaction of the ENGINEER. The certificate of substantial completion will be signed by the owner's representative after the preliminary inspection has been completed.
- C. When the CONTRACTOR has corrected or completed the items as listed in the ENGINEER's written notice, he shall inform the ENGINEER, in writing, that the required work has been completed. Upon receipt of this notice, the ENGINEER, in the presence of the OWNER and the CONTRACTOR, will make his final inspection of the project.
- D. Should the ENGINEER find all work satisfactory at the time of his inspection, the CONTRACTOR will be allowed to make application for final payment in accordance with the provisions of the GENERAL CONDITIONS. Should the ENGINEER still find deficiencies in the work, the ENGINEER will inform the CONTRACTOR of the deficiencies and will deny the CONTRACTOR's request for final payment until such time as the CONTRACTOR has satisfactorily completed the required work.

1.05 FINAL SUBMITTALS

- A. No application for final payment will be accepted until all submittals have been made and approved by the ENGINEER, including, but not limited to, the following:
 - 1. Final shop drawings.
 - 2. All information required to prepare record drawings.
 - 3. All interface information.
 - 4. All Operation and Maintenance Manuals.
 - 5. All required indices and schedules.
 - 6. All Manufacturers' Certificates of Proper Installation.
 - 7. All construction photographs and video tapes, including those of the completed project.
 - 8. All operator training materials and actual training.

1.06 ACCESSORY ITEMS

- A. The CONTRACTOR shall provide to the OWNER upon acceptance of the equipment, all special accessories required to place each item of equipment in full operation. These special accessory items include, but are not limited to, the specified spare parts, and other expendable items as required for initial startup and operation of all equipment.

1.07 GUARANTEES, BONDS, AND AFFIDAVITS

- A. No application for final payment will be accepted until all guarantees, bonds, certificates, licenses, and affidavits required for work or equipment as specified are satisfactorily filed with the ENGINEER.

1.08 RELEASE OF LIENS OR CLAIMS

- A. No application for final payment will be accepted until satisfactory evidence of release of liens has been submitted to the OWNER as required by the GENERAL CONDITIONS.

1.09 FINAL PAYMENT

- A. Final payment will be made to the CONTRACTOR in accordance with the GENERAL CONDITIONS.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION

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SECTION 01710

CLEANING

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Execute cleaning, during progress of the Work, and at completion of the Work, as required by General Conditions.

1.02 RELATED REQUIREMENTS

- A. General Provisions of the Construction Contract are included in Division 0.
- B. Each Specification Section: Cleaning for specific Products or work.
- C. Dust Control is included in Section 01562.
- D. Final Cleaning is included in Section 01700.

1.03 DISPOSAL REQUIREMENTS

- A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations and anti-pollution laws.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 EXECUTION

3.01 DURING CONSTRUCTION

- A. Execute periodic cleaning to keep the Work, the site and adjacent properties free from accumulation of waste materials, rubbish and windblown debris, resulting from construction operations.
- B. Provide on-site containers for the collection of waste materials, debris and rubbish.

- C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3.02 DUST CONTROL

- A. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.03 FINAL CLEANING

- A. Perform final cleaning in accordance with Section 01700.

END OF SECTION

SECTION 01715

EQUIPMENT OPERATION AND MAINTENANCE

TRAINING PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

- A. This Section describes the project requirements for equipment manufacturer representative's instruction of the OWNER's plant operation and maintenance personnel in the proper operation and maintenance of the equipment furnished under the Contract.
- B. The equipment manufacturer or supplier are to include the costs for the onsite operation and maintenance equipment instruction specified herein in their price quotations for the equipment to be furnished under the Contract.
- C. It is the goal and intent of the equipment operation and maintenance instruction specified herein to provide the OWNER's plant operation and maintenance personnel with site specific, technically accurate and current information on the theory, design, practical operation and maintenance, appropriate hands-on or field experience such that the equipment or components can be efficiently operated and maintained by the OWNER's plant operation and maintenance staff upon completion of the instruction program.
- D. Two training sessions shall be provided for each topic to allow for two separate shifts of the OWNER's personnel to attend. The training sessions shall be held at times that are determined by the OWNER.

1.02 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. An experienced and authorized representative of the manufacturer or supplier of each item of equipment listed below shall conduct a plant site instruction program on the proper operation and maintenance of the equipment. Instruction shall be given only by qualified persons who are familiar with the equipment and systems installed in the Work. Sales representatives are not qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper instruction. If, in the opinion of the ENGINEER or OWNER, the person is not appropriately knowledgeable, the training session shall be rescheduled and repeated with a suitable instructor at the CONTRACTOR's expense.
- B. Approved, draft equipment manufacturer operation and maintenance manuals, conforming to the requirements of Sections 01300 and 01730 of these Specifications, shall be furnished at least seven days in advance of the start of the on-site instruction.
- C. Schedule the respective equipment operation and maintenance instruction sessions with the OWNER. The instruction sessions shall be scheduled at least two weeks in advance of the time the instruction will be given and shall be conducted after the

installed equipment is fully tested, adjusted and operational. The equipment operation and maintenance instruction may be scheduled to immediately follow the manufacturer or supplier representative's field inspection and final adjustment of the equipment provided that the representative can certify that the equipment has been installed in accordance with manufacturer's instructions and procedures and the equipment and controls operate properly.

- D. The equipment operation and maintenance instruction sessions shall as a minimum cover the material presented in the manufacturer O&M user manuals which shall serve as the manual for the instruction program, and the instruction sessions shall consist of both classroom instruction and field hands-on instruction. Provide suitable representative demonstration units if the hands- on field training would require the disassembly of installed piping or operating equipment. The manufacturer's representative who will be conducting the training program shall prepare an agenda for the material to be covered during both the classroom and hands-on field portions of instruction. The agenda shall briefly describe what is to be discussed under each item and audio visual aids and other materials to be used in support of the O&M user manual material. Submit the training program agenda to the ENGINEER at least 45 days in advance of the start of the program to allow the OWNER and ENGINEER adequate time to review its contents. The format and contents of the respective equipment instruction programs shall be changed to incorporate the OWNER's and ENGINEER's review comments on the program outline.
- E. The OWNER shall have the right to video tape, photograph, or otherwise document any of the equipment operations and maintenance instruction programs for use in training future plant operation and maintenance personnel.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 OPERATION TRAINING

- A. The operation training sessions shall include, but not be limited to, the following:
 - 1. Overview of the equipment and auxiliary or support systems covering nomenclature, function and theory of operation for this specific facility. The instructor shall review the control description, process set points, design criteria and overall plant operations strategy to describe the proper operation of the system.
 - 2. General safety requirements for operation of the equipment and auxiliary or support systems, including suggested safety equipment.
 - 3. Pre-startup safety and equipment check.
 - 4. Equipment and auxiliary or support systems startup procedures covering manual and automatic modes, if available.
 - 5. Equipment operation and monitoring requirements; including specifics on

normally expected ranges for items such as oil, water pressure and temperature, discharge pressures, sensory observations and procedures to change operating parameters (such as air or flow rate).

6. Equipment and systems shut down procedures covering manual and automatic modes (if available).
7. Operational troubleshooting of equipment and auxiliary or support systems.
8. Procedure for handling non-routine operational problems such as response to alarms, power failures, emergency shutdown and auxiliary or support system failures.

3.02 MAINTENANCE TRAINING

- A. The maintenance training sessions shall be coordinated as explained hereunder. All sessions shall be video recorded.
 1. If a session is specific to a discipline (electrical, mechanical, electrical/instrumentation) include only appropriate maintenance items for that discipline; if sessions are to include multiple disciplines, include all items for those disciplines and indicate in submittal outline which discipline the material refers to.
 2. All disciplines shall include, but not be limited to, the following:
 - a. Overview of the equipment and auxiliary or support systems covering nomenclature, function and theory of operation.
 - b. General safety requirements for maintenance of the equipment and auxiliary support systems appropriate to each discipline included suggested safety equipment and practices. Cover local and remote lockout procedures, safe procedure for handling alarms and built in safety devices during preventive and corrective maintenance.
 - c. Overview of pre-startup, routine operation monitoring and shutdown procedures covering automatic and manual modes (if applicable).
 3. Each specific discipline shall include, but not be limited to, the following:
 - a. Provide preventive maintenance procedures to be followed; include parts, lubrication quantities, types, frequencies, application points and time requirements to perform procedures.
 - b. Specific procedures to cover adjustments required for alignment, wear, calibration for all preventive maintenance and corrective maintenance procedures including time required to perform.
 - c. Special tools, techniques or procedures required for either preventive or corrective maintenance of equipment or its auxiliary or support

systems.

- d. Assembly and disassembly procedures required for preventive or corrective maintenance shall include the use of representative models when disassembly of installed equipment is not recommended. Training on the actual equipment or representative models will be supplemented with "exploded" views and parts lists. Include time requirements for procedures performed.
- e. Maintenance troubleshooting of equipment and auxiliary or support systems.

END OF SECTION

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SECTION 01720
PROJECT RECORD DOCUMENTS

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. Provide all labor, materials, equipment, and incidentals required to prepare and maintain record documents for the project to accurately reflect the project construction work as built. The Documents must be submitted at the completion of the construction work as a condition of final acceptance of the Work by the OWNER.

1.02 MAINTENANCE OF RECORD DOCUMENTS

- A. The CONTRACTOR shall maintain at the project site, a minimum of two copies (unless otherwise noted) each of the following record documents:
 - 1. Contract Drawings (full size).
 - 2. Specifications.
 - 3. Addenda.
 - 4. Reviewed shop drawings (one copy).
 - 5. Contract change orders and field orders.
 - 6. Supplemental drawings and written material provided by the ENGINEER to clarify the Contract Documents.
 - 7. Other contract modifications.
 - 8. Field test records.
 - 9. Correspondence (one copy).
 - 10. Approved samples (one copy).
- B. The CONTRACTOR shall store the Contract record documents in an approved project site location apart from documents used for construction. Record documents are not to be used for construction purposes. The CONTRACTOR shall provide files and racks for orderly storage of the documents; maintain the documents in clean, dry, legible condition, and make all documents and samples available during regular business hours for inspection and reproduction by the ENGINEER.

1.03 MARKING DEVICES

- A. Mark all changes legibly with red pencil or red pen.

1.04 PROJECT RECORD DOCUMENTS

- A. The CONTRACTOR shall keep the record documents current with construction in progress. Completed construction work shall not be permanently concealed until required information has been recorded.
- B. The CONTRACTOR shall label each record document except correspondence "PROJECT RECORD" in neat, large, printed letters. Legibly mark contract drawings to record actual construction deviations as follows:
 - 1. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements or plant coordinates.
 - 2. Field changes of dimension and detail.
 - 3. Changes made by change order or field order.
 - 4. Details not on original Contract Drawings.
- C. The CONTRACTOR shall legibly mark specifications and addenda to record:
 - 1. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed.
 - 2. Changes made by change order or field order.
 - 3. Other matters not originally specified.

1.05 SUBMITTAL

- A. As a prerequisite for monthly progress payments, the CONTRACTOR is to exhibit the currently updated "Record Documents" for review by the ENGINEER and the OWNER. The partial record drawings shall be up-to-date through the end of the progress payment application period. The OWNER may withhold funds from progress payments if OWNER does not find the record documents to be satisfactory. These funds will be forfeited to the OWNER if corrections satisfactory to the OWNER are not made within 60 days.
- B. At completion of construction, and prior to the final inspection and final acceptance of the Work by the OWNER, the CONTRACTOR shall deliver the following Contract record documents to the ENGINEER in the following form:
 - 1. Contract Drawings and Shop Drawings (2 copies): Bound into sets of convenient size for ease of handling.
 - 2. Specifications and Addenda (2 copies): Bound into 3-ring vinyl binders with clear plastic spine label pockets.

3. Field Test Records (2 copies): Bound into 3-ring vinyl binders with clear plastic spine label pockets. Number all pages. Provide a complete, neat, word-processed table of contents for each binder, with page numbers for each entry.
- C. Accompany the final record document submittal with a transmittal letter in duplicate, containing:
1. Date
 2. Project title and number
 3. CONTRACTOR's name and address
 4. Title and number of each record document
 5. Certification that each document as submitted is complete and accurate
 6. Signature of CONTRACTOR
- D. Submission of the documents described above in Paragraph 1.05B and the letter described in Paragraph 1.05C is a condition of final acceptance of the Work by the OWNER.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION

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SECTION 01730
OPERATION AND MAINTENANCE
MANUALS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes procedural requirements for compiling and submitting operation and maintenance data required to complete the project.

1.02 RELATED WORK

- A. Submittals are included in Section 01300.
- B. Contract closeout is covered in Section 01700.
- C. Warranties and Bonds are covered in Section 01740.

1.03 OPERATING MANUALS

- A. Three complete sets of the final bound operation and maintenance instructions covering all equipment furnished under Divisions 11, 13, 15 and 16 shall be delivered directly to the ENGINEER. In addition, three digital copies of the manuals shall be provided in USB flash drive format, including drawings. One digital copy shall be a searchable PDF version, and one copy shall be an editable MS Word version of any site specific project information. Draft version of the operation and maintenance instructions covering all equipment furnished under Divisions 11, 13, 15 and 16 shall be delivered directly to the ENGINEER in digital format.
- B. The Operation and Maintenance Data for this project shall be contained in a manual consisting of one or more volumes specifically assembled for this project. Each volume of the Manual shall contain O&M data for one or more pieces of equipment. Each volume shall either be a 3-ring or 3 post binder no greater than 4-inches thick. Each volume shall be labeled on front cover and binding edge as follows:

OLIVENHAIN MUNICIPAL WATER DISTRICT
DAVID C. MCCOLLOM WATER TREATMENT PLANT – STAGE 4
UPGRADES OPERATION AND MAINTENANCE DATA
VOLUME NO. _____

SECTION _____ THROUGH _____

- C. Material:

1. Typed pages: Loose leaf on 20 pound bond minimum, white, punched paper
2. Holes reinforced with plastic cloth or metal
3. Page size, 8-1/2-in by 11-in

Drawings: Diagrams, illustrations, and attached foldouts as required, of original quality, reproduced by dry copy method. If drawings are larger than 11-in by 17-in, fold larger drawings to size of text pages and include in clear plastic pockets.

4. Provide indexed tabs for each product and piece of equipment.
5. Binding: Provide binders for all submittals to be of commercial quality post- or ring-type with durable, oil, moisture and wear resistant plastic covers.

D. Submittals to the ENGINEER:

1. Three preliminary copies of manuals shall be submitted to the Office of the consulting Engineer, Hazen and Sawyer, 11260 El Camino Real, Suite 100, San Diego 92130, no later than 30 days following approval of the shop drawings for each piece of equipment. Provide six final copies of complete manuals prior to testing.

1.04 CONTENTS, EACH VOLUME

- A. Table of Contents: Provide title of project, names, addresses and telephone numbers of ENGINEER, subconsultants and CONTRACTOR with name of responsible parties; schedule of products and systems, indexed to content of the volume.
- B. For each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers; including local source of supplies and replacement parts.
 1. The manual for each piece of equipment shall be a separate document with the following specific requirements:
 - a. Table of contents and index
 - b. Brief description of each system and components
 - c. Starting and stopping procedures
 - d. Special operating instructions
 - e. Routine maintenance procedures
 - f. Manufacturer's printed operating and maintenance instructions, parts list, illustrations and diagrams

- g. One copy of each wiring diagram
 - h. One copy of each approved shop drawing and each CONTRACTOR's coordination and layout drawing
 - i. List of spare parts, manufacturer's price, and recommended quantity
 - j. Name, address and telephone numbers of local service representatives
- C. Product Data/Equipment Numbers: Mark each sheet to clearly identify specific products and component parts and data applicable to installation along with the Equipment Number reference from the Contract Documents. Delete inapplicable information.
- D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- E. Type Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.
- F. Warranties and Bonds are as specified in Section 01740.
- G. All text shall be written in English and at a minimum, in units of foot-pound-seconds.
- H. If multiple binders are used, the data shall be correlated into related, logical groupings.

1.05 MANUAL FOR MATERIALS AND FINISHES

- A. Building Products, Applied Materials and Finishes: Include product data, with catalog number, size, composition and color and texture designations. Provide information for re- ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods and recommended schedule for cleaning and maintenance.
- C. Moisture Protection and Weather Exposed Products: Include product data listing, applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance and repair.
- D. Additional Requirements: As specified in individual product specification Sections.
- E. Provide a listing in Table of Contents for design data, if provided by CONTRACTOR, with tabbed fly sheet and space for insertion of data.

1.06 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. For each Item of Equipment and Each System provide the following:
1. Site Specific overview of system and description of unit or system and component parts. Identify function, normal operating characteristics and limiting conditions. Include performance curves, with engineering data and tests and complete nomenclature and commercial number of replaceable parts, and corresponding 11-in by 17-in Process and Instrumentation Diagram that allows the reader to follow the description.
 2. Panelboard Circuit Directories including electrical service characteristics, controls and communications and color coded wiring diagrams as installed.
 3. Site Specific Operating Procedures: Provide step-by-step operating procedures for the following:
 - a. Normal start-up, start-up following maintenance, start-up following emergency shutdown, break-in, and routine normal operating instructions and sequences.
 - b. Regulation, control, stopping, shut-down and emergency instructions.
 - c. Summer, winter and any special operating instructions.
 4. Maintenance Requirements:
 - a. Provide step-by-step maintenance procedures for the following: Routine procedures and guide for regular preventative maintenance activities; trouble-shooting; disassembly, repair and reassembly instructions; and alignment, adjusting, balancing and checking instructions.
 - b. Provide servicing and lubrication schedule and list of lubricants required, along with a list of all acceptable equivalents from at least one alternative major supplier.
 - c. Provide manufacturer's printed operation and maintenance instructions.
 - d. Provide sequence of operation by controls manufacturer.
 - e. Provide original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 5. Identify any health and safety considerations, including chemical safety data sheets and exposure or injury prevention precaution requirements.
 6. Control diagrams by controls manufacturer as installed.
 7. CONTRACTOR's coordination drawings, with color coded piping diagrams as installed.

8. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
 9. List of original manufacturer's spare parts, current prices, supplier's address and telephone number, authorized repair service's address and telephone number, and recommended quantities to be maintained in storage.
 10. Test and balancing reports as specified.
 11. Additional Requirements: As specified in individual product specification sections.
- B. Provide a listing in Table of Contents for design data, if provided by CONTRACTOR, with tabbed fly sheet and space for insertion of data.
- C. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01740
WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers' standard warranties on products and special warranties.

1.02 RELATED WORK

- A. Refer to the General Provisions for the general requirements relating to warranties and bonds.
- B. General closeout requirements are included in Section 01700 Contract Closeout.
- C. Specific requirements for warranties for the Work and products and installations that are specified to be warranted are included in the individual Sections of Division 2 through 16.

1.03 SUBMITTALS

- A. Submit written warranties to the OWNER prior to the date fixed by the ENGINEER for Notice of Completion (NOC). If the NOC designates a commencement date for warranties other than the date of NOC for the Work, or a designated portion of the Work, submit written warranties upon request of the OWNER.
- B. When a designated portion of the Work is completed and occupied or used by the OWNER, by separate agreement with the CONTRACTOR during the construction period, submit properly executed warranties to the OWNER within fifteen days of completion of that designed portion of the Work.
- C. When a special warranty is required to be executed by the CONTRACTOR, or the CONTRACTOR and a subcontract, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the OWNER for approval prior to final execution.
- D. Refer to individual Sections of Divisions 2 through 16 for specific content requirements, and particular requirements for submittal of special warranties.
- E. At Final Completion compile two copies of each required warranty and bond properly executed by the CONTRACTOR, or by the CONTRACTOR, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the Table of Contents of the Specifications.

- F. Bind warranties and bonds in heavy-bond, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8- 1/2-in by 11-in paper.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Specifications, with each item identified with the number and title of the specification Section in which specified, and the name of the product or work item.
- H. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer, supplier and manufacturer.
- I. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS," the Project title or name, and the name, address and telephone number of the responsible principal.
- J. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.04 WARRANTY REQUIREMENT

- A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding; reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The CONTRACTOR is responsible for the cost of replacing or rebuilding defective Work regardless of whether the OWNER has benefited from use of the Work through a portion of its anticipated useful service life.
- D. OWNER's Recourse: Written warranties made to the OWNER are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the OWNER can enforce such other duties, obligations, rights, or remedies.
- E. Rejection of Warranties: The OWNER reserves the right to reject warranties

and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

- F. The OWNER reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities to countersign such commitments are willing to do so.
- G. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the CONTRACTOR of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the CONTRACTOR.

1.05 MANUFACTURERS CERTIFICATIONS

- A. Where required, the CONTRACTOR shall supply evidence, satisfactory to the ENGINEER, that the CONTRACTOR can obtain manufacturers' certifications as to the CONTRACTOR's installation of equipment.

1.06 DEFINITIONS

- A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the OWNER.
- B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the OWNER.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 02050

DEMOLITION AND RENOVATION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, supervision, materials, equipment and incidentals required for demolition, renovation, removal and disposal work as shown on the Drawings and as specified herein.
- B. Included, but not limited to, are demolition and removals of existing materials, equipment, or work necessary to install the new work as shown on the Drawings and as specified herein. Demolition includes structural concrete, foundations, walls, doors, windows, structural steel, metals, roofs, masonry, attachments, appurtenances, piping, electrical and mechanical equipment, paving of all types, curbs, walks, fencing and other existing facilities.
- C. Demolitions and removals which may be specified under other Sections shall conform to the requirements of this Section.
- D. Where applicable, this Section calls attention to certain activities necessary to maintain and facilitate continuous operation of existing facilities during and immediately following construction, and does not necessarily cover all of the required activities. Exercise due concern for existing facilities operation and direct all activities toward maintaining continuous operation and minimization of operation inconvenience. Damage to existing facilities shall be repaired to original condition by the CONTRACTOR at no additional expense to the OWNER.

1.02 RELATED WORK

- A. Construction Sequence and Constraints are included in Section 01014.
- B. Cutting and Patching is included in Section 01045.
- C. Control of Work is included in Section 01046.
- D. Construction Scheduling is included in Section 01311.
- E. Temporary Facilities are included in Section 01500.
- F. Cleaning is included in Section 01710.
- G. Clearing, Grubbing, and Stripping are included in Section 02110.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, six copies of proposed schedule of intended operations for demolition of any existing facilities prior to the start of work. Include in the schedule the coordination of shutoff, capping and continuation of utility services as required.
- B. Submit for review and comment by the ENGINEER a detailed sequence of demolition and removal work to ensure the uninterrupted operation of the OWNER's facilities.

- C. Before the start of demolition work, all modifications necessary to bypass the affected structure will be completed. Actual work will not begin until the ENGINEER has inspected, reviewed and authorized the start of the demolition work, in writing.
- D. The above procedure must be followed for each individual demolition operation.

1.04 CONDITION OF STRUCTURES

- A. The OWNER and the ENGINEER assume no responsibility for the actual condition of any structures to be demolished or modified.
- B. Conditions existing at the time of inspection for bidding purposes will be maintained by the OWNER insofar as practicable. However, variations within a structure may occur prior to the start of demolition work.

1.05 RULES AND REGULATIONS

- A. Determine the applicability and file notifications to the appropriate agencies with regard to demolition work that requires clearances for asbestos containing materials (ACMs) handling or any other materials requiring special management. It should be noted that, in any demolition event, notifications must be filed in accordance with the National Emission Standards for Hazardous Air Pollutants (NESHAPS) as described in 40 CFR Part 61, Subpart M.
- B. No building or structure, or any part thereof, shall be demolished until an application has been filed with the appropriate building department and a permit issued. Any fee for this permit shall be the CONTRACTOR's responsibility.

1.06 DISPOSAL OF MATERIAL

- A. Where directed by the ENGINEER, salvageable material and equipment listed below shall become the property of the OWNER. Dismantle all such items to a size that can be readily handled, cleaned and stored on or adjacent to the site in a protected place specified by the ENGINEER or loaded onto trucks provided by the OWNER.
- B. All other material and items of equipment shall become the CONTRACTOR's property and must be removed from the site.
- C. Concrete, concrete block and excess bricks shall be disposed of as specified in PART 3.
- D. The storage or sale of removed items will not be allowed on the site.

1.07 TRAFFIC AND ACCESS

- A. Conduct demolition and the removal of equipment and debris to ensure minimum interference with occupied or used facilities.
- B. Special attention is directed towards maintaining safe and convenient access to any existing facilities by personnel and vehicles.
- C. Do not close or obstruct accesses to used facilities without permission from the ENGINEER. Furnish alternate routes around closed or obstructed access ways.

- D. Where demolition interferes with or obstructs access routes or roadways CONTRACTOR shall work with OWNER to provide evacuation directions and alternate exit routes to the satisfaction of governing fire officials. CONTRACTOR shall post temporary signage identifying alternate evacuation and exit routes.

1.08 PROTECTION

- A. Conduct operations to minimize damage by falling debris or other causes to adjacent facilities. Furnish interior and exterior shoring, bracing, or support to prevent the movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.
- B. Exercise precautions for fire prevention. Acceptable fire extinguishing apparatus shall be available at all times in areas where demolition work is being performed using burning torches. Burning of demolition debris shall not be permitted on or near the site.
- C. Construct and maintain shoring, bracing and supports as required. Ensure that structural elements are not overloaded. CONTRACTOR shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this Contract.

1.09 DAMAGE

- A. Promptly repair damage caused to adjacent facilities by demolition operations as directed by the ENGINEER and at no cost to the OWNER. Repairs shall be made to a condition equal or better than that which existed prior to construction.

1.10 UTILITIES

- A. Maintain existing utilities in service and protect against damage during demolition operations.
- B. Do not interrupt existing utilities serving occupied or used facilities, except when authorized by the ENGINEER. Furnish temporary services acceptable to the ENGINEER during interruptions to existing utilities.
- C. Assist the OWNER in shutting off utilities required for the performance of demolition operations.
- D. Be solely responsible for making all necessary arrangements and for performing any necessary work involved in connection with the discontinuance or interruption of all utilities or services under the jurisdiction of the public and private utility companies.
- E. All utilities being abandoned shall be disconnected and terminated at the service mains in conformance with the requirements of the utility companies or the municipality owning or controlling them.

1.11 DUST AND NOISE CONTROL

- A. Take all measures necessary to minimize the amount of dust and noise resulting from demolition activity.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All materials or items of equipment required for the performance of the work of this Section shall be suitable for the intended purpose and shall be equal, where applicable, to similar items and materials specified in other Sections of Divisions 2 through 16.

PART 3 EXECUTION

3.01 SEQUENCE OF WORK

- A. The sequence of demolition and, where applicable, modifications to existing facilities shall be in accordance with Section 01014 and the schedule submitted in accordance with Paragraph 1.03 above.

3.02 REMOVAL OF EXISTING PROCESS EQUIPMENT, PIPING AND APPURTENANCES

- A. Subject to the constraints of maintaining the existing facilities in operation and prior to demolition, existing process equipment, non-buried valving, piping and appurtenances not necessary for the operation of the new facilities shall be removed.
- B. All equipment, piping and appurtenances shall be cleaned, flushed and drained. Equipment to be retained by the OWNER, as previously specified, shall be dismantled sufficiently and thoroughly cleaned and drained. All valves shall be left open. All discontinued piping shall be capped and sleeves and openings remaining after removal of the existing equipment, piping and appurtenances shall be plugged and sealed as shown on the Drawings and as directed by the ENGINEER.

3.03 DEMOLITION

- A. Demolition shall be performed to the limits shown on the Drawings or, if no limits are shown, to a depth at least 2-ft below existing and proposed final grades, or 2-ft below any new foundation or pipe.
- B. Wet down work during demolition operations to prevent dust from arising. Furnish protection from inclement weather for materials, equipment and personnel located in partially dismantled structures.
- C. Existing, below grade slabs to be abandoned but not demolished shall have holes cut to allow for positive drainage and the prevention of flotation.
- D. Remove all existing work as indicated on the Drawings or as required and prepare adjoining areas for installation of the proposed work or for blocking up and filling in of existing openings.
- E. All demolition debris shall become the property of the CONTRACTOR and shall be removed from the site and disposed off the site in conformance with all applicable laws and regulations. Demolition debris shall not be used for fill or backfill.
- F. Blasting or the use of explosives will not be allowed for demolition work.

- G. Remove from the site all debris resulting from the demolition operations as it accumulates. Upon completion of the work, all materials, equipment, waste and debris of every sort shall be removed and the premises shall be left clean, neat and orderly.

3.04 CLEANUP

- A. Remove demolished materials from site as Work progresses.
- B. Leave areas of Work in clean condition. Maintain roads and staging areas in a clean condition.
- C. Do not burn or bury materials on site.
- D. Remove temporary Work.

3.05 ITEMS TO BE PROTECTED

- A. Protect areas and items indicated on Drawings and listed in this Section.
- B. Protect areas and items outside the project demolition boundary identified on the Drawings
- C. Fencing on perimeter of site as shown on Drawings.
- D. Utilities as indicated on Drawings and listed in this Section.
 - 1. Storm drain lines, catch basins, culverts, ditches, and other stormwater components unless otherwise indicated.
 - 2. Overhead electric lines, power poles, and service drops.
 - 3. Fire protection water service and sprinkler systems unless otherwise indicated.
 - 4. Telephone lines, poles, and service drops.
 - 5. Underground communication systems during Category 1 demolition and prior to completion on new communication systems.
- E. Active electrical systems in buildings to remain:
 - 1. Protect active electrical systems in buildings to remain.

3.06 SUBSURFACE REMOVALS (NOT APPLICABLE)

- A. Remove below ground portions of buildings to be demolished in their entirety. Reference drawings of existing facilities have been included to indicate approximate foundation elevations.
- B. Landscaping, trees, and other vegetation around buildings to be demolished, unless otherwise indicated. Remove roots to a depth of 5 feet below grade.

3.07 UTILITY AND PIPELINE REMOVAL

- A. Remove all utilities and pipelines within the demolition boundary unless otherwise indicated on Drawings.

1. Coordinate with ENGINEER to disconnect active utilities and terminate service at buildings to be demolished. Utilities will be deactivated and disconnected by others. Provide a minimum of 48-hours notice to ENGINEER to coordinate disconnection by others.
2. After disconnecting utilities, all underground pipes, conduits or other facilities to the structures shall be removed by the CONTRACTOR to the perimeter of the demolition boundary or to the point of disconnect unless otherwise specified.
3. All electrical wiring, telephone cables, and other wiring shall be removed from all duct banks or conduits from the point of the disconnect to the structure to be demolished.
4. Remove all pipes within the Demolition Boundary.

B. Sanitary sewer systems:

1. Protect sanitary sewer systems in buildings to be demolished until ready for demolition. Maintain and protect roof drain systems until roof demolition is performed to prevent flooding of roofs.
2. Provide a minimum of 48-hours notice to ENGINEER prior to disconnecting Sanitary sewer systems from buildings to be demolished.

C. Active electrical services:

1. Electrical power to the facilities shall remain active throughout equipment modifications except for limited, planned outages necessary to install new components in the existing MCC 5 at the RHB. No other 480V electrical distribution facilities will be taken out of service under this Contract.
2. The Contractor shall coordinate with OMWD prior to executing any electrical outages.

3.08 SCADA CONTROL SYSTEM EQUIPMENT

- A. SCADA equipment for the treatment facilities shall remain in operation during demolition.
- B. The SCADA network media including fiber optic and copper cabling and associated network switches and communications equipment, shall be protected and remain in place and active during demolition.

3.09 REFERENCE DRAWINGS

- A. Construction drawings for existing structures and utilities are available for review from this District. The drawings do not necessarily represent as-built conditions and are included for information only.

END OF SECTION

SECTION 02222

PROTECTING EXISTING UNDERGROUND UTILITIES

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials and procedures for protecting existing underground utilities.

PART 2 MATERIALS

2.01 REPLACEMENT IN KIND

- A. Except as indicated or as specifically authorized by the District's Representative, reconstruct utilities with new material of the same size, type, and quality as that removed.

2.02 CONTRACTOR SUPPLIED TEMPORARY MATERIALS

- A. CONTRACTOR shall supply all materials, including but not limited to, steel beams and bracing, support straps, sheeting and shoring, timbers, and all other items necessary to protect existing underground utilities.

PART 3 EXECUTION

3.01 GENERAL

- A. Replace in kind street improvements, such as curbs and gutters; fences; signs; paved surfaces; etcetera, that are cut, removed, damaged, or otherwise disturbed by the construction.
- B. Where utilities are parallel to or cross the pipeline trench but do not conflict with the permanent work to be constructed, follow the procedures given below and as indicated on the Drawings. Notify the utility owner 48 hours in advance of the crossing construction and coordinate the construction schedule with the utility owner's requirements. For utility crossings not shown on the Drawings, refer to the instructions of the District's Representative for guidance.
- C. Determine the true location and depth of utilities and service connections which may be affected by or affect the work. Determine the type, material, and condition of these utilities. In order to provide sufficient lead time to resolve unforeseen conflicts, order materials and take appropriate measures to ensure that there is no delay in work. Expose utilities in advance of the pipeline construction by potholing a minimum of 250 feet ahead of pipe laying.

3.02 PROCEDURES

- A. Protect in Place: Protect utilities in place, unless abandoned, and maintain the utility in service, unless otherwise specified.

- B. Cut and Plug Ends: Cut abandoned utility lines and plug the ends with concrete plug. Pour a concrete lug completely around the plugged end of the abandoned utility line such that the line is encapsulated with a minimum of 6 inches of concrete on all sides. Dispose of the cut pipe as unsuitable material.
- C. Remove and Reconstruct: Where necessary or as required by the District's Representative, remove the utility and, after passage, reconstruct it with new materials. Provide temporary service for the disconnected utility.

3.03 COMPACTION

- A. Utilities Protected in Place: Backfill and compact under and around the utility so that no voids are left. Where utilities are concrete encased, use the alternative construction method (sand slurry) for backfill around the utility.
- B. Alternative Construction -Sand Slurry: Sand slurry consisting of one sack (94 pounds) of portland cement per cubic yard of sand and sufficient moisture for workability may be required for backfill to aid in reducing compaction difficulties. Submit specific methods and procedures for the review of the District's Representative prior to construction.

3.04 ADJACENT PARALLEL UTILITIES

- A. Protect existing parallel utilities from any disturbances and repair the lines and associated appurtenances if they are damaged in any way. All costs incurred for protection of utilities or any costs incurred due to the presence of the lines, whether or not they lie within the new construction, shall be borne in full by the CONTRACTOR.

END OF SECTION

SECTION 03250
CONCRETE ACCESSORIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor and equipment required to provide all concrete accessories including waterstops, expansion joint material, joint sealants, expansion joint seals, crack inducing joint inserts, epoxy bonding agent, and neoprene bearing pads.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03300 – Cast-in-Place Concrete
- B. Section 07900 – Joint Fillers, Sealants, and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ASTM C881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - 2. ASTM D412 – Standard Tests for Rubber Properties in Tension
 - 3. ASTM D 624 – Standard Test method for Rubber Property - Tear Resistance
 - 4. ASTM D 638 – Standard Test Method for Tensile Properties of Plastics
 - 5. ASTM D1751 – Standard Specifications for Preformed Expansion Joint fillers for Concrete Paving and Structural Construction (non-extruding and resilient bituminous types)
 - 6. ASTM D 1752 – Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
 - 7. ASTM D 1171 – Standard Test Method for Ozone Resistance at 500 pphm
 - 8. ASTM D 471 – Standard Test Method for Rubber Properties
 - 9. ASTM D 2240 – Standard Test for Rubber Property – Durometer Hardness

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittal Procedures.
 - 1. Manufacturer's literature on all products specified herein including material certifications.
 - 2. Samples of products if requested by the Engineer.

PART 2 – PRODUCTS

2.01 JOINT SEALANTS

- A. Joint sealants shall comply with Section 07900 – Joint Fillers, Sealants, and Caulking.

2.02 EXPANSION JOINT MATERIAL

- A. Preformed expansion joint material shall be non-extruding, and shall be of the following types:
 - 1. Type I – Sponge rubber, conforming to ASTM D1752, Type I.
 - 2. Type II – Cork, conforming to ASTM D1752, Type II.
 - 3. Type III – Self-expanding cork, conforming to ASTM D1752, Type III.
 - 4. Type IV – Bituminous fiber, conforming to ASTM Designation D1751.

2.03 EPOXY BONDING AGENT

- A. Epoxy bonding agent shall conform to ASTM C881 and shall be Sikadur 32 Hi-Mod, Sika Corporation, Lyndhurst, N.J.; Euco #452 Epoxy System, Euclid Chemical Company, Cleveland, OH, MasterEmaco ADH Series by Master Builders Solutions.

2.04 EPOXY RESIN BINDER

- A. Epoxy resin binder shall conform to the requirements of ASTM C-881, Type III, Grade 3, Class B and C for epoxy resin binder and shall be Sikadur 23, Low-Mod-Gel, manufactured by the Sika Corporation, Lyndhurst, N.J., Flexocrete Gel manufactured by DuraJoint Concrete Accessories or Euco #352 Gel, Euclid Chemical Company, MasterEmaco ADH 327 or 327 RS by Master Builders Solutions.

2.05 BEARING PADS

- A. Neoprene bearing pads shall conform to requirements of A4-F3-T.063-B2, Grade 2, Method B, in accordance with the RMA Rubber Handbook. Pads shall be nonlaminated pads having a nominal Shore A durometer hardness of 70 in accordance with ASTM D2240. Adhesive for use with neoprene pads shall be an epoxy-resin compound compatible with the neoprene having a

sufficient shear strength to prevent slippage between pads and adjacent bearing surfaces. Adhesive shall be 20+F Contact Cement by Miracle Adhesives Corporation, Neoprene Adhesive 77-198 by IGI Adhesives, Sikadur 31, Hi-Mod Gel by Sika Corporation, or DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

PART 3 – EXECUTION

3.01 INSTALLATION OF EXPANSION JOINT MATERIAL AND SEALANTS

- A. Type I, II, or III shall be used in all expansion joints in structures and concrete pavements unless specifically shown otherwise on the Drawings. Type IV shall be used in sidewalk and curbing and other locations specifically shown on the Drawings.
- B. All expansion joints exposed in the finish work, exterior and interior, shall be sealed with the specified joint sealant. Expansion joint material and sealants shall be installed in accordance with manufacturer's recommended procedures and as shown on the Drawings.
- C. Expansion joint material that will be exposed after removal of forms shall be cut and trimmed to ensure a neat appearance and shall completely fill the joint except for the space required for the sealant. The material shall be held securely in place and no concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.
- D. A bond breaker shall be used between expansion joint material and sealant. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surfaces shall present a clean and even appearance.
- E. Type 1 joint sealant shall be used in all expansion and crack inducing joints in concrete, except where other specific types are required as stated below, and wherever else specified or shown on the Drawings. Sealant shall be furnished in pour grade or gun grade depending on installation requirements. Primers shall be used as required by the manufacturer. The sealant shall be furnished in colors as directed by the Engineer.
- F. Type 8 joint sealant shall be used in all concrete pavements and floors subject to heavy traffic and wherever else specified or shown on the Drawings.
- G. Type 7 joint sealant shall be used for all joints in chlorine contact tanks and wherever specified or shown on the Drawings.

3.02 EXPANSION JOINT SEAL

- A. The expansion joint seal system shall be installed as shown on the Drawings in strict accordance with the manufacturer's recommendations.

3.03 EPOXY BONDING AGENT

- A. The Contractor shall use an epoxy bonding agent for bonding fresh concrete to existing concrete as shown on the Drawings.
- B. Bonding surface shall be clean, sound, and free of all dust, laitance, grease, form release agents, curing compounds, and any other foreign particles.
- C. Application of bonding agent shall be in strict accordance with manufacturer's recommendations.
- D. Fresh concrete shall not be placed against existing concrete if epoxy bonding agent has lost its tackiness.

3.04 EPOXY RESIN BINDER

- A. Epoxy resin binder shall be used to seal all existing rebar cut and burned off during demolition operations. Exposed rebar shall be burned back 1/2-inch minimum into existing concrete and the resulting void filled with epoxy resin binder.

3.05 BEARING PADS

- A. Care shall be taken in fabricating pads and related metal parts so effects detrimental to the proper performance of the pads, such as uneven bearing and excessive bulging, will not occur.

END OF SECTION

SECTION 03300 CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Section includes cast-in-place concrete work including slabs on grade, small vaults, and site-cast bases for precast units.
- B. Provide all labor, equipment, materials, and services necessary for all cast-in-place concrete work, including the composition, transportation, and placement of the concrete mix, and for all formwork, reinforcement, finishing and curing of all plain and reinforced concrete work, as shown on the Drawings.
- C. The requirements in this section shall apply to the following types of concrete:
 - 1. Class A2 Concrete: Normal weight structural concrete in all structures other than environmental concrete structures as described above, and for all sidewalks and pavement.
 - 2. Class B Concrete: Normal weight structural concrete used for duct bank encasements, catch basins, fence and guard post embedment, concrete fill, and other areas where specifically noted on Contract Drawings.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. California Building Code
 - 2. ACI 117 – Specification for Tolerances for Concrete Construction and Materials and Commentary
 - 3. ACI 214 – Guide to Evaluation of Strength Test Results of Concrete
 - 4. ACI 301 – Specifications for Structural Concrete
 - 5. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete
 - 6. ACI 305.1 – Specification for Hot Weather Concreting
 - 7. ACI 306.1 – Standard Specification for Cold Weather Concreting
 - 8. ACI 308.1 – Specification for Curing Concrete

9. ACI 309 – Guide for Consolidation of Concrete
10. ACI 315 - Details and Detailing of Concrete Reinforcing
11. ACI 318 – Building Code Requirements for Structural Concrete and Commentary
12. ACI 347 – Recommended Practice for Concrete Formwork
13. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures
14. ACI SP66 - ACI Detailing Manual
15. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcing
16. ASTM C 31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field
17. ASTM C 33 – Standard Specification for Concrete Aggregates
18. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
19. ASTM C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
20. ASTM C 94 – Standard Specification for Ready-Mixed Concrete
21. ASTM C 114 – Standard Test Method for Chemical Analysis of Hydraulic Cement
22. ASTM C 138 – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
23. ASTM C 143 – Standard Test Method for Slump of Hydraulic Cement Concrete
24. ASTM C 150 – Standard Specification for Portland Cement
25. ASTM C 171 – Standard Specifications for Sheet Materials for Curing Concrete
26. ASTM C 172 – Standard Practice for Sampling Freshly Mixed Concrete
27. ASTM C 192 – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
28. ASTM C 231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
29. ASTM C 260 – Standard Specification for Air-Entraining Admixtures for Concrete

30. ASTM C 309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
31. ASTM C 457 – Standard Test Method for Microscopical Determination of the Air-Void System in Hardened Concrete
32. ASTM C 494 – Standard Specification for Chemical Admixtures for Concrete
33. ASTM C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
34. ASTM C 989 – Standard Specification for Slag Cement for Use in Concrete and Mortars
35. ASTM C 1077 – Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
36. ASTM C 1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
37. ASTM C 1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
38. ASTM C 1778 – Standard Guide for Reducing the Risk of Deleterious Alkali – Aggregate Reaction in Concrete
39. CRSI - Concrete Reinforcing Institute Manual of Standard Practice
40. U.S. Product Standard for Concrete Forms, Class I, PS 1

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01300 – Submittal Procedures.

1. Concrete mix design for each class of concrete.
2. Trial mix data for each class of concrete.
3. Sources of all materials and certifications of compliance with specifications for all materials.
4. Certified current (less than 1 year old) chemical analysis of the Portland Cement and fly ash or slag cement to be used.
5. Manufacturer's data on all admixtures stating compliance with required standards.
6. Manufacturer's mill certificates for reinforcing steel.

7. Detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66), for all concrete reinforcing. These drawings shall be made to such a scale as to clearly show the arrangement, spacing and splicing of the bars. These drawings shall include proposed bar supports, bar schedules, stirrup spacing, splice lengths, diagrams of bent bars, arrangements, and assemblies, as required for fabrication and placing concrete reinforcing.
8. Manufacturer's data on proposed formwork system, form release agent and form ties.
9. Proposed procedures for protection and curing of concrete under normal conditions, wet weather placement conditions, hot weather conditions, and cold weather conditions. Including proposed method of measuring concrete surface temperature changes.

1.04 QUALITY ASSURANCE

- A. Field quality control tests, as specified in Article 3.08, unless otherwise stated, will be performed by a materials testing consultant employed by the Owner. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. Any individual who samples and tests concrete to determine if the concrete is being produced in accordance with this Specification shall be certified as a Concrete Field-Testing Technician, Grade I, in accordance with ACI CP-2. Testing laboratory shall conform to requirements of ASTM C-1077.

PART 2 – PRODUCTS

2.01 FORMS AND FALSEWORK

- A. All forms shall be smooth surface forms and conform to the requirements of ACI 347.
- B. The Contractor shall furnish all labor and materials for all forms required for the construction of the Work.
- C. Either metal or wood forms may be used.
- D. All forms shall be true to the required shape, clean, of sufficient strength, and well braced so that they shall maintain their proper position during the placing and vibrating of the concrete

2.02 STEEL REINFORCEMENT

- A. Steel reinforcement shall be detailed, fabricated, and placed in conformance with all applicable requirements of ACI 318, and the CRSI Manual of Standard Practice.
- B. Steel reinforcing bars shall conform to ASTM A615, Grade 60, unless otherwise specified.
- C. Welded wire fabric shall conform to ASTM A185.
- D. Steel wire shall conform to ASTM A82.

- E. All metal accessories for setting and fastening of reinforcement shall conform to CRSI Manual of Standard Practice.

2.03 HYDRAULIC CEMENT

A. Portland Cement

1. Portland Cement shall be Type II conforming to ASTM C 150. Type I cement may be used provided either fly ash or slag cement is also included in the mix in accordance with Articles 2.04 or 2.05, respectively.
2. The proposed Portland Cement shall not contain more than 8% tricalcium aluminate and more than 12% tetracalcium aluminoferrite.

2.04 FLY ASH

- A. Fly ash shall meet the requirements of ASTM C 618 for Class F, except that the loss on ignition shall not exceed 4%. Fly ash shall also meet the optional physical requirements for uniformity as shown in Table 3 of ASTM C 618. Fly ash shall be considered as a supplemental cementitious material.
- B. Where fly ash is used, the minimum fly ash content shall be 15%.

2.05 SLAG CEMENT

- A. Slag cement shall meet the requirements of ASTM C 989 including tests for effectiveness of slag in preventing excessive expansion due to alkali-aggregate reactivity as described in Appendix X-3 of ASTM C 989.
- B. Where Slag Cement is used, the minimum Slag Cement content shall be 30%, and the maximum Slag Cement content shall be 40%.

2.06 WATER

- A. Water used for mixing concrete shall be clear, potable, and free from deleterious substances such as objectionable quantities of silty organic matter, alkali, salts, and other impurities.
- B. Water shall meet requirements of ASTM C 1602.

2.07 AGGREGATES

- A. All aggregates used in normal weight concrete shall conform to ASTM C 33.
- B. Fine Aggregate (Sand) in the various concrete mixes shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the limits of ASTM C 33.

- C. Coarse aggregates shall consist of hard, clean, durable gravel, crushed gravel, or crushed rock. Coarse aggregate shall be size #57 or #67 as graded within the limits given in ASTM C 33 unless otherwise specified.
- D. All aggregates shall be non-reactive according to ASTM C 1778.
- E. All aggregates shall be sourced from a Caltrans approved producer.

2.08 ADMIXTURES

- A. Admixtures containing calcium chloride, thiocyanates or more than 0.05% chloride ions are not permitted. The addition of admixtures to prevent freezing is not permitted.
- B. All admixtures shall be compatible and made by the same manufacturer.
- C. Air entraining admixture shall be added to all concrete unless noted otherwise. The air entraining admixture shall conform to ASTM C 260.
- D. Water reducing admixture shall conform to ASTM C 494, Type A.
- E. High-range water reducing admixture shall conform to ASTM C 494, Type F or G. The high range water reducer shall be added to the concrete at the batch plant and may be used in conjunction with a water reducing admixture.
- F. A non-chloride, non-corrosive accelerating admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C 494, Type C or E.
- G. A retarding admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C494, Type B or D.
- H. Workability Retaining Admixture shall conform to ASTM C 494, Type S.
- I. The Contractor shall submit manufacturer's data including the chloride ion content of each admixture and certification from the admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned prior to mix design review.

2.09 CONCRETE MIX DESIGN

- A. The proportions of cement, aggregates, admixtures, and water used in the concrete mixes shall be based on the results of laboratory trial mixes in conformance with ACI 301.
- B. Structural concrete shall conform to the following requirements. Cementitious materials refer to the total combined weight of all cement, fly ash, and slag cement contained in the mix.
 - 1. Compressive Strength (28-Day)

Concrete Class A2	4,000 psi (minimum)
Concrete Class B	3,000 psi (minimum)

2. Water/cementitious materials ratio, by weight

	Maximum	Minimum
Concrete Class A2	0.45	0.39
Concrete Class B	0.50	0.39

3. Slump range

- a. 4" nominal unless high range water reducing admixture is used
- b. 8" max if high range water reducing admixture is used.

4. Air Content

Concrete Class A2	3% \pm 1.5%
Concrete Class B	3% Max (non-air-entrained)

2.10 CURING COMPOUND

- A. Clear curing and sealing compound shall be a clear styrene acrylate type complying with ASTM C 1315, Type 1, Class A with a minimum solids content of 30%. Moisture loss shall not be greater than 0.40 kg/m² when applied at manufacturer's recommended volume for square feet of area. Manufacturer's certification is required. Acceptable products are Super Diamond Clear VOX by the Euclid Chemical Company.
- B. Where specifically approved by Engineer, on slabs to receive subsequent applied finishes, compound shall conform to ASTM C 309. Acceptable products are "Kurez DR VOX" or "Kurez W VOX" by the Euclid Chemical Company. Install in strict accordance with manufacturer's requirements.

PART 3 – EXECUTION

3.01 FORMS AND FALSEWORK

- A. Forms and falsework shall be designed for total dead load, plus all construction live load as outlined in ACI 347. Design and engineering of formwork and safety considerations during construction shall be the responsibility of the Contractor.
- B. Design, erect, shore, brace and maintain formwork according to ACI 301.

- C. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- D. Forms shall be smooth and free from surface irregularities. Adjacent edges shall be held tightly together for accurate alignment. Forms shall be true to line and grade and shall be sufficiently rigid to prevent displacement and sagging between supports.
- E. All vertical surfaces of concrete members shall be formed, unless specifically noted otherwise.
- F. All forms shall be constructed in such a manner that they can be removed without hammering or prying against the concrete.
- G. Suitable moldings shall be placed to bevel or round all exposed corners and edges of beams, columns, walls, slabs, and equipment pads. Chamfers shall be 3/4 inch unless otherwise noted.
- H. Forms for concrete surfaces that will not be subsequently waterproofed shall be coated with a form release agent. Form release agent shall be applied on formwork in accordance with manufacturer's recommendations.
- I. The inner faces of all forms shall be thoroughly cleaned prior to concreting. 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. Unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.
- J. Forms shall not be disturbed until the concrete has attained sufficient strength. Sufficient strength shall be demonstrated by structural analysis considering proposed loads, strength of forming and shoring system, and concrete strength data. Formwork shall remain in place for 7 days minimum after concrete placement, or as approved by the Engineer.

3.02 REINFORCING STEEL

- A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318.
- B. No fabrication shall commence until approval of Shop Drawings has been obtained.
- C. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports. Reinforcing steel shall be stored above ground on platforms or other supports and shall always be protected from the weather by suitable covering
- D. The surfaces of all reinforcing 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.
- E. Reinforcing steel placement shall comply with CRSI's "Manual of Standard Practice".

- F. Reinforcing steel shall be accurately positioned as shown on the Drawings and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic or plastic protected (CRSI Class 1) metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the reinforcing bars without settlement. In no case shall concrete block supports be continuous.
- G. Reinforcing placing, spacing, and protection tolerances shall be within the limits specified in ACI 318 except where in conflict with the Building Code, unless otherwise specified.
- H. Tie wires shall be bent away from the forms to provide the specified concrete coverage.
- I. Reinforcing bar splices shall only be used at locations shown on the Drawings or where approved by the Engineer. The length of lap slices for reinforcing bars, unless otherwise shown on the Drawings, shall be in accordance with ACI 318 for a class B splice.
- J. The Contractor shall advise the Engineer of intentions to place concrete and shall allow adequate time to inspect all reinforcing steel before concrete is placed.

3.03 PRODUCTION OF CONCRETE

- A. All concrete shall be machine mixed. Hand mixing of concrete will not be permitted.
- B. Ready-Mixed Concrete
 - 1. Ready-mixed concrete shall meet the requirements for materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.
 - 2. Truck mixers shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
 - 3. Each batch of concrete shall be mixed in a truck mixer for not less than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment.
 - 4. Ready-mixed concrete shall be delivered to the site for the work and discharge shall be completed within the time requirements of this Section.
 - 5. Every concrete delivery shall be accompanied by a delivery ticket containing at least the following information:
 - a. Date and truck number
 - b. Ticket number

- c. Mix designation of concrete
 - d. Cubic yards of concrete
 - e. Cement brand, type, and weight in pounds
 - f. Weight in pounds of fine aggregate (sand)
 - g. Weight in pounds of coarse aggregate (stone)
 - h. Air entraining agent, brand, and weight in pounds and ounces
 - i. Other admixtures, brand, and weight in pounds and ounces
 - j. Water, in gallons, stored in attached tank
 - k. Water, in gallons, maximum that can be added without exceeding design water/cementitious materials ratio
 - l. Water, in gallons, used (by truck driver)
 - m. Time of loading
 - n. Time of delivery to job (by truck driver)
6. Any truck delivering concrete to the job site, which is not accompanied by a delivery ticket showing the above information will be rejected and such truck shall immediately depart from the job site.
7. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to inspection at the batching plant by the Engineer.

3.04 CONCRETE PLACEMENT

- A. No concrete shall be placed prior to approval of the concrete mix design. Concrete placement shall conform to the recommendations of ACI 304.
- B. Prior to concrete placement, all reinforcement shall be securely and properly fastened in its correct position. Formwork shall be clean, oiled and form ties at construction joints shall be retightened. All bucks, sleeves, castings, hangers, pipe, conduits, bolts, anchors, wire, and any other fixtures required to be embedded therein shall be in place. Forms for openings to be left in the concrete shall be in place and anchored by the Contractor. All loose debris in bottoms of forms or in keyways shall be removed and all debris, water, snow, ice, and foreign matter shall be removed from the space to be occupied by the concrete. The Contractor shall notify the Engineer in advance of placement, allowing sufficient time for a concurrent inspection and for any corrective measures required.

- C. All concrete shall be placed during the daylight hours except with the consent of the Engineer. If special permission is obtained to carry on work during the night, adequate lighting must be provided.
- D. When concrete arrives at the project with slump below that suitable for placing, as indicated by the Specifications, water may be added to bring the concrete within the specified slump range provided the design water-cementitious materials ratio is not exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. Water may be added only to full trucks. On-site tempering shall not relieve the Contractor from furnishing a concrete mix meeting all specified requirements.
- E. Concrete shall be conveyed as rapidly as practical to the point of deposit by methods which prevent the separation or loss of the ingredients. The concrete shall be deposited so that additional handling will be unnecessary. Discharge of the concrete to its point of deposit shall be completed within 90 minutes after the addition of the cement to the aggregates unless workability-retaining admixtures are included and approved by the Engineer. In hot weather (air temperature greater than 85 degrees F), or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed 60 minutes.
- F. Where concrete is conveyed to position by chutes, a continuous flow in the chute shall be maintained. The angle and discharge arrangement of the chute shall be such to prevent segregation of the concrete ingredients. The delivery end of the chute shall be as close as possible to the point of deposit and in no case shall the free pour from the delivery end of the chute exceed five feet, unless approved otherwise.
- G. Placing of concrete shall be regulated so the pressure caused by the wet concrete shall not exceed that used in the design of the forms.
- H. Concrete shall be placed to thoroughly embed all reinforcement, inserts, and fixtures.
- I. When forms are removed, surfaces shall be even and dense, free from aggregate pockets or honeycomb. Concrete shall be consolidated using mechanical vibration, supplemented by forking and spading by hand in the corners and angle of forms and along form surfaces while the concrete is plastic under the vibratory action. Consolidation shall conform to ACI 309.
- J. Mechanical vibration shall be applied directly to the concrete, unless otherwise approved by the Engineer. The bottom of vibrators used on floor slabs must not be permitted to ride the form supporting the slab. Vibration shall be applied at the point of deposit and in freshly placed concrete by a vertical penetration of the vibrator. Vibrators shall not be used to move concrete laterally within the forms.
- K. The intensity of vibration shall be sufficient to cause settlement of the concrete into place and to produce monolithic joining with the preceding layer. Vibration shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures with a vibrator transmitting not less than 7,500 impulses per minute. Since the duration of vibration per

square foot of surface is dependent on the frequency (impulses per minute), size of vibrator, and slump of concrete, the length of time must therefore be determined in the field. Vibration shall not be continued in any one location to the extent that pools of grout are formed.

- L. Care shall be taken to prevent cold joints when placing concrete in any portion of the work. The concrete placing rate shall ensure that each layer is placed while the previous layer is soft or plastic, so the two layers can be made monolithic by penetration of the vibrators. Maximum thickness of concrete layers shall be 18 inches. The surface of the concrete shall be level whenever a run of concrete is stopped.
- M. Concrete shall not be placed during rains sufficiently heavy or prolonged to prevent washing of mortar from coarse aggregate on the forward slopes of the placement. Once placement of concrete has commenced in a block, placement shall not be interrupted by diverting the placing equipment to other uses.
- N. Cold weather concreting procedures shall conform to the requirements of ACI 301 and ACI 306.1.
- O. Hot weather concreting procedures shall conform to the requirements of ACI 301 and ACI 305.1.

3.05 PLACING FLOOR SLABS ON GROUND

- A. The subgrade for slabs on ground shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required by the specifications. No foundation, slab, or pavement concrete shall be placed until the depth and character of the foundation soils have been inspected and approved by the materials testing consultant.
- B. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing, the temperature shall be raised and maintained above 50° long enough to remove all frost from the subgrade.
- C. The subgrade shall be moist at the time of concreting. If necessary, the subgrade shall be dampened with water in advance of concreting, but no free water shall remain standing on the subgrade nor any muddy or soft spots when the concrete is placed.
- D. Thirty-pound felt-paper shall be provided between edges of slabs-on-ground and vertical and horizontal concrete surfaces, unless otherwise indicated on the Drawings.
- E. Contraction joints shall be provided in slabs-on-ground at locations indicated on the Drawings.
- F. Floor slabs shall be screeded level or pitched to drain as indicated on the Drawings.

3.06 FINISHING

- A. Finishes on Formed Concrete Surfaces

1. Rough Finish

- a. Rough finish shall be provided only for concrete surfaces not exposed to view.
- b. Rough finish is defined as as-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Honeycombs shall be chipped back to solid concrete and repaired as directed by the Engineer. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

2. Grout Cleaned Finish

- a. Grout cleaned finish shall be provided for concrete surfaces exposed to view.
- b. Grout cleaned finish shall be applied after completion of a rough finish. After the concrete has been pre-dampened over an extended amount of time to reach the condition of saturated surface dry (SSD), a slurry consisting of one part cement (including an appropriate quantity of white cement to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 16 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats. Any surplus shall be removed by scraping and then rubbing with clean burlap.

3. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated

B. Finishes on Floors and Slabs

- 1. General: Comply with ACI 302.1R recommendations for screeding, and finishing operations for concrete surfaces. Do not wet concrete surfaces. All edges shall be edged with a 1/8-inch tool as directed by the Engineer.
- 2. Float Finish
 - a. Float finish shall be applied to floors of process basins, wetwells, and flow channels.
 - b. Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes until surface is left with a uniform, smooth, granular texture.
- 3. Trowel Finish
 - a. Trowel finish shall be applied to equipment pads and interior finish floors which are not continuously or intermittently wet or floors that are to receive tile, flooring, or carpeting.

- b. Trowel finish shall be applied after the completion of a float finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete troweling operations. Continue troweling passes until surface is free of trowel marks and uniform in texture and appearance.

4. Broom Finish

- a. Broom finish shall be applied to all pedestrian surfaces exposed to weather and all interior finish floors which are continuously or intermittently wet.
- b. Broom finish shall be applied after completing a trowel finish. This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a trowel finish.

3.07 CURING

- A. General: Concrete curing procedures shall be in accordance with ACI 308.1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.
- B. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provisions shall be made for maintaining the concrete in a moist condition for at least a 7-day period thereafter. Horizontal surfaces shall be kept covered, and intermittent, and localized drying will not be permitted.
- C. Walls that will be exposed on one side with either fluid or earth backfill on the opposite side shall be continuously wet cured for a minimum of seven days. Use of a curing compound will not be acceptable for applications of this type.
- D. The Contractor shall use one of the following methods to ensure that the concrete remains in a moist condition for the minimum period stated above.
 - 1. Ponding or continuous fogging or sprinkling.
 - 2. Application of mats or fabric kept continuously wet.
 - 3. Continuous application of steam (under 150°F).
 - 4. Application of sheet materials conforming to ASTM C171.
 - 5. If approved by the Engineer, application of a curing compound.
- E. The Contractor shall keep absorbent wood forms wet until they are removed. After form removal, the concrete shall be cured by one of the specified methods.

- F. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.08 QUALITY CONTROL

A. Testing of Concrete

1. The Contractor shall coordinate with the Engineer's project representative the on-site scheduling of the materials testing consultant personnel as required for concrete testing.
2. Concrete for testing shall be supplied by the Contractor at no additional cost to the Owner, and the Contractor shall assist the materials testing consultant in obtaining samples. The Contractor shall dispose of and clean up all excess material.
3. Testing of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements.
 - a. Testing Frequency
 - 1) In general, one sampling shall be taken for each placement greater than five (5) cubic yards, with a minimum of one (1) sampling for each day of concrete placement operations, or for each one hundred (100) cubic yards of concrete, whichever is greater.
 - b. Slump shall be tested in accordance with ASTM C143, with one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - c. Air Content shall be tested in accordance with ASTM C231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - d. Concrete Temperature shall be tested in accordance with ASTM C1064, with one test hourly when air temperature is 40 degrees F and below and when 80 degrees F and above, and one test for each composite sample.
 - e. Unit Weight: Perform one test for each composite sample.
 - f. Compression Test Specimens shall be tested in accordance with ASTM C31. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - g. Compressive-Strength Tests shall be performed in accordance with ASTM C39, with test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

- 1) Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
- 2) A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

B. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 214, ACI 318, and ACI 350.
2. The strength level of concrete will be considered satisfactory if the following conditions are satisfied.
 - a. Every arithmetic average of any three consecutive strength tests equals or exceeds the minimum specified 28-day compressive strength for the mix.
 - b. No individual compressive strength test result falls below the minimum specified strength by more than 500 psi.
3. If any of the conditions listed above are not met, the mix proportions shall be corrected for the next concrete placing operation.
4. If condition 2B is not met, additional tests shall be performed.
5. All concrete which fails to meet the ACI requirements, and these specifications is subject to removal and replacement at no additional cost to the Owner.
6. When non-compliant concrete is identified, test reports shall be sent immediately to the Engineer for review.

C. Additional Tests

1. When ordered by the Engineer, additional tests on in-place concrete shall be provided and paid for by the Contractor.
2. If the 28-day test cylinders fail to meet the minimum strength requirements, the Contractor shall have concrete core specimens obtained and tested in accordance with ASTM C 42, or by other methods as directed by the Engineer.
3. If the concrete placed by the Contractor is suspected of not having proper air content, the Contractor shall engage a materials testing consultant approved by the Engineer, to obtain and test samples for air content in accordance with ASTM Specification C 457.

3.09 CARE AND REPAIR OF CONCRETE

- A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Care shall be exercised to avoid jarring forms or placing any strain on the ends of projecting reinforcing bars. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired, or removed and replaced with acceptable concrete at no additional cost to the Owner.
- B. Areas of honeycomb shall be chipped back to sound concrete and repaired as directed.
- C. Concrete formwork blowouts or unacceptable deviations in tolerances for formed surfaces due to improperly constructed or misaligned formwork shall be repaired as directed. Bulging or protruding areas, which result from slipping or deflecting forms shall be ground flush or chipped out and redressed as directed.
- D. Areas of concrete in which cracking, spalling, or other signs of deterioration develop prior to final acceptance shall be removed and replaced or repaired as directed. This stipulation includes concrete that has experienced cracking due to drying or thermal shrinkage of the concrete. Structural cracks shall be repaired using an approved epoxy injection system. Non-structural cracks shall be repaired using an approved hydrophilic resin pressure injected grout system unless other means of repair are deemed necessary and approved. All repair work shall be performed at no additional cost to the Owner.

END OF SECTION

SECTION 03600

GROUT

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all grout used in concrete work and as bearing surfaces for base plates, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Requirements of related work are included in Division 01 and Division 02 of these Specifications.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. CRD-C 621 – Corps of Engineers Specification for Non-shrink Grout
 - 2. ASTM C 33 – Standard Specification for Concrete Aggregates
 - 3. ASTM C 109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cube Specimens)
 - 4. ASTM C 531 – Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing
 - 5. ASTM C 579 – Test Method for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacing
 - 6. ASTM C 827 – Standard Test Method for Early Volume Change of Cementitious Mixtures
 - 7. ASTM C 1107 – Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittal Procedures.
 - 1. Certified test results verifying the compressive strength and shrinkage and expansion requirements specified herein.
 - 2. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of grout used in the work.

1.05 QUALITY ASSURANCE

A. Field Tests

1. 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 ensure continued compliance with these Specifications. The specimens will be made by the Engineer or its representative.
 - a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days, and any additional times as appropriate.
 - b. 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 Engineer. A set of three specimens will be made for testing at seven days and any other time as appropriate.
2. The cost of all laboratory tests on grout will be borne by the OWNER, but the CONTRACTOR shall assist the Engineer in obtaining specimens for testing. 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, at no additional cost to the OWNER.
3. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the OWNER.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Cement Grout

1. Cement grout shall be composed of Portland Cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated, cement grout shall consist of one-part Portland Cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland Cement shall be mixed with the Portland Cement as required to match color of adjacent concrete.
2. The minimum compressive strength at 28 days shall be 4000 psi.
3. For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These

applications shall use a plain cement grout without coarse aggregate regardless of bed thickness. Cement grout used for surfaces swept in by a mechanism shall also contain micro-synthetic fibers in accordance with Section 03300.

4. Sand shall conform to the requirements of ASTM C33.

B. Non-Shrink Grout

1. Non-shrink grout shall conform to CRD-C 621 and ASTM C 1107, Grade B or C when tested at a max. fluid consistency of 30 seconds per CDC 611/ASTM C939 at temperature extremes of 45°F and 90°F and an extended working time of 15 minutes. Grout shall have a min. 28-day strength of 7,000 psi. Non-shrink grout shall be, "Euco N-S" by the Euclid Chemical Company, "SikagROUT 212" by Sika Corporation, "Conspec 100 Non-Shrink Non-Metallic Grout" by Conspec, "MasterFlow 928" by Master Builders Solutions.

C. Epoxy Grout

1. Epoxy grout shall be "Sikadur 32 Hi-Mod" by Sika Corporation, "Duralcrete LV" by Tamms Industries, or "Euco #452 Series" by Euclid Chemical, "MasterEmaco ADH 1090 RS" by Master Builders Solutions.
2. Epoxy grout shall be modified as required for each application with aggregate per manufacturer's instructions.

D. Epoxy Base Plate Grout

1. Epoxy base plate grout shall be "Sikadur 42, Grout-Pak" by Sika Corporation, or "MasterFlow 648" by Master Builders Solutions.

2.02 CURING MATERIALS

- A. Curing materials shall be as specified in Section 03300 – Cast-In-Place Concrete for cement grout and as recommended by the manufacturer for prepackaged grouts.

PART 3 – EXECUTION

3.01 GENERAL

- A. The different types of grout shall be used for the applications stated below unless noted otherwise in the Contract Documents. Where grout is called for in the Contract Documents which does not fall under any of the applications stated below, non-shrink grout shall be used unless another type is specifically referenced.
 1. Cement grout shall be used for grout toppings and for patching of fresh concrete, when approved by the ENGINEER. Grout toppings swept in by equipment mechanisms shall contain micro-synthetic fibers as specified in Section 03300.

2. Non-shrink grout shall be used for grouting beneath base plates of structural metal framing.
 3. Epoxy grout shall be used for bonding new concrete to hardened concrete.
 4. Epoxy base plate grout shall be used for precision seating of base plates including base plates for all equipment such as engines, mixers, pumps, vibratory and heavy impact machinery, etc.
- B. New concrete surfaces to receive cement grout shall be as specified in Section 03300 – Cast-in-Place Concrete, and shall be cleaned of all dirt, grease, and oil-like films. Existing concrete surfaces shall likewise be cleaned of all similar contamination and debris, including chipping, or roughening the surface if a laitance or poor concrete is evident. The finish of the grout surface shall match that of the adjacent concrete. Curing and protection of cement grout shall be as specified in Section 03300 – Cast-in-Place Concrete.
- C. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- D. The CONTRACTOR, through the manufacturer of a non-shrink grout and epoxy grout, shall provide on-site technical assistance upon request, at no additional cost to the OWNER.

3.02 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the application. Dry pack consistency is such that the grout is plastic and moldable but will not flow.

3.03 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

3.04 GROUT INSTALLATION

- A. Grout shall be placed quickly and continuously, shall completely fill the space to be grouted and be thoroughly compacted and free of air pockets. The grout may be poured in place, pressure grouted by gravity, or pumped. The use of pneumatic pressure or dry-packed grouting requires approval of the ENGINEER. For grouting beneath base plates, grout shall be placed from one side only and allowed to flow across to the open side to avoid air-entrapment.

END OF SECTION

SECTION 03732 CONCRETE REPAIRS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish all materials, labor, equipment, tools, etc., required for the repair, renovation, and replacement of concrete and/or reinforcing steel as indicated on the Drawings, specified herein, and determined by field survey.
- B. The CONTRACTOR, in conjunction with the ENGINEER, shall determine the extent of cracked or deteriorated concrete to be rehabilitated and/or resurfaced. A summary of the work to be performed shall be submitted to the ENGINEER for review, and such summary shall be approved by the ENGINEER prior to commencement of the Work.
- C. Concrete repairs include the following:
 - 1. Repair of concrete surface as necessary following demolition of existing concrete pads.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 01 – General Requirements
- B. Division 03 – Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. ICRI CSP – International Concrete Repair Institute Concrete Surface Profile.

1.04 SUBCONTRACTOR/APPLICATOR QUALIFICATIONS

- A. The CONTRACTOR shall furnish the name of all subcontractors/applicators which he/she proposes to use for this work, including necessary evidence and/or experience records to ascertain their qualifications in the application of epoxy, urethane, and polymer-modified repair materials.
- B. Approved applicator qualifications shall include a minimum of 5 years of experience in applying epoxy, urethane, and polymer-modified and cement-based repair materials like those materials specified in this Section.
- C. A letter from the manufacturer of the specified materials, on the manufacturer's letterhead, signed by an officer of the company, stating that the subcontractor/applicator has been trained in the proper techniques for applying the product, including surface preparation and mixing, placing, curing, and caring for the manufacturer's products shall be submitted. This letter shall further state that the subcontractor/applicator is on the manufacturer's approved list of CONTRACTORS.

1.05 SUBMITTALS

- A. Material certifications and technical data sheets on all grouts, mortars, epoxy resins, aggregates and repair products specified in this Section.
- B. Subcontractor/Applicator qualifications as specified in Section 1.04.
- C. Shop Drawings detailing any planned deviation from the proposed construction sequence and/or method of repair.
- D. The CONTRACTOR, based on their experience in their profession, and/or recommendation from product manufacturers, may submit to the ENGINEER for approval, alternative materials and/or methods of work to assure the durability and watertight integrity of the repair work performed.
- E. Detailed repair procedures for each repair type.
- F. Letter from repair material manufacturer(s) certifying that all repair materials to be used to create single repairs are compatible for use together

1.06 ADDITIONAL GUARANTEE

- A. The CONTRACTOR shall guarantee all repair work performed under this Contract against defects in workmanship resulting in leakage and/or failure of concrete bond for a period of three (3) years from the date of the Certificate of Substantial Completion.

PART 2 – MATERIALS

2.01 GENERAL

- A. All concrete repair materials shall conform to NSF Standards for contact with potable water supplies.
- B. All concrete repair materials, when used in combination to create a single repair, shall be compatible.

2.02 WATER

- A. The water used for mixing concrete repair products shall be clear, potable, and free of deleterious substances.

2.03 AGGREGATE

- A. All aggregate shall conform to ASTM C-33. The aggregate supplier shall submit to the ENGINEER documentation that the proposed aggregates comply with ASTM C-33 and the requirements listed below:

- B. Pea Gravel - Pea gravel shall meet the gradation and material requirements of Standard Size 14 as defined by ASTM C-33. Pea gravel shall be clean and free from deleterious matter and shall contain no limestone.

2.04 EPOXY BONDING AGENT

- A. Epoxy bonding agent shall conform to ASTM C-881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives, depending on the application. The class of epoxy bonding agent shall be suitable for all ambient and substrate temperatures. The epoxy resin shall be "Sikadur Hi-Mod Series" as manufactured by the Sika Corp, Lyndhurst, NJ, "Duralbond" as manufactured by Euclid Chemical Company, Cleveland, OH, "Euco #452 Series" by the Euclid Chemical Company, or "MasterEmaco ADH series" by Master Builders Solutions.

2.05 TYPE I CRACK REPAIR - CEMENTITIOUS SURFACE SEAL

- A. Type I Crack Repair - Cementitious Surface Seal shall be a one- or two-component, polymer-modified or silica fume enhanced trowel grade cementitious mortar and shall conform to EPA/USPHS standards for surface contact with potable water supplies. Type I Crack Repair material shall be "Sikatop 123 Plus" manufactured by Sika Corp., Lyndhurst, NJ, "Verticoat" or "Verticoat Supreme" by Euclid Chemical Company; or "Emaco S88 CI" or by Master Builders Solutions.

2.06 SPALL REPAIR PATCHING MATERIAL

- A. All spall repairs not requiring formwork shall be repaired using a two-component, polymer-modified cementitious mortar and shall have a minimum 28-day compressive strength of 7,000 psi. Spall repair mortar for use in horizontal applications shall be "Sikatop 122 Plus" manufactured by Sika Corp., Lyndhurst, NJ, "Eucocrete Supreme" or "Duraltop Flowable Mortar" by the Euclid Chemical Company, or "MasterEmaco T-302" or "MasterEmaco T310CI" by Master Builders Solutions. Spall repair mortar for use in vertical and overhead applications shall be "Sikatop 123 Plus" manufactured by Sika Corp., Lyndhurst, NJ, "Verticoat or Verticoat Supreme" by the Euclid Chemical Company, or "MasterEmaco N 425" or "MasterEmaco N 400" by Master Builders Solutions.
- B. All spall repairs requiring formwork shall be repaired using a two-component, polymer-modified cementitious mortar/pea gravel mixture and shall have a minimum 28-day compressive strength of 7,000 psi. Spall repair mortar shall be "SikaTop 111 PLUS" manufactured by Sika Corp., Lyndhurst, NJ, "Eucocrete Supreme" manufactured by Euclid Chemical Company, Cleveland, OH, or "MasterEmaco T 310 CI" by Master Builders Solutions.

2.07 STORAGE OF MATERIALS

- A. The CONTRACTOR shall provide an area for repair material storage free from exposure to moisture in any form, before, during, and after delivery to the site. Manufactured materials shall be delivered in unbroken containers labeled with the manufacturer's name and product type. All mortar products shall be stored on raised platforms. Materials susceptible to damage by freezing

shall be stored in a dry, heated, insulated area. Any material that has hardened, partially set, become caked and/or has been contaminated or deteriorated shall be rejected. All aggregates shall be stored in clean bins, scows or platforms.

PART 3 – INSTALLATION

3.01 GENERAL REQUIREMENTS

- A. No repair work shall be undertaken when ambient temperatures are below manufacturer's safe recommendations. No admixtures, except those required by the manufacturer, shall be used in the repairs specified herein.
- B. All products shall be applied in strict accordance with manufacturer's recommendations. The CONTRACTOR shall furnish and install safe scaffolding and ladders for the ENGINEER's prework inspection, the repair work activities, and the ENGINEER's final inspection.
- C. Sandblast or waterblast (3000-5000 psi waterjet) or use low impact hand chipping tools to clean deteriorated areas to remove all loose concrete, existing coatings, unsound material, debris, and laitance. All surfaces shall be clean, free of dirt, grease, loose particles, and deleterious substances and shall be prepared according to manufacturer's requirements.

3.02 EPOXY BONDING AGENT

- A. An epoxy bonding agent shall be used when applying fresh concrete to previously placed concrete unless otherwise recommended by the manufacturer.
- B. Existing concrete surfaces shall be roughened (1/16" or CSP 5 minimum profile) unless otherwise recommended by the manufacturer prior to application of bonding agent. Concrete surface shall be clean and sound, free of all foreign particles and laitance. Repair material shall be placed while bonding agent is still tacky. If bonding agent cures prior to placement of repair material, bonding agent shall be reapplied.
- C. Repairing concrete with epoxy mortars shall conform to all the requirements of ACI 503.4 "Standard Specification for Repairing Concrete with Epoxy Mortars" (latest edition), except as modified herein.

3.03 TYPE I CRACK REPAIR – CEMENTITIOUS SURFACE SEAL

- A. Where indicated on the Drawings, or as directed by the ENGINEER, existing nonstructural cracks 1/16" and wider in vertical and overhead surfaces or existing cracks between 1/16" and 1/4" wide in horizontal surfaces shall be repaired with Type I Crack Repair Material. Rout crack to 3/4" wide by 3/4" deep V-notch to expose sound concrete. Provide a 3/8" high vertical shoulder at the top of notch on each side. Where rebar has deteriorated, or where deteriorated concrete extends below the top of rebar, crack shall be routed to expose 3/4" all around rebar. The

resulting void in concrete shall be patched flush with the existing concrete surface using Type I Crack Repair material.

3.04 SPALL REPAIR PATCHING MATERIAL

- A. All voids or spalled areas to be repaired shall be chipped back to sound concrete a minimum 1/8" deep, with a minimum surface profile of CSP-5, cleaned and repaired with spall repair patching material according to manufacturer's recommendations. All patching shall provide a final finished surface which is flat, level and even with the existing concrete surface. Repair mortar shall not be feathered to meet existing concrete surface. Prior to commencing repair surface preparation, saw cut or grind a 1/2" deep groove around the perimeter around the repair area, perpendicular to the finished concrete surface to provide a square shoulder to the repair area. Repair areas shall be formed using clean, straight rectangular edges where possible. Final patching on horizontal surfaces shall receive a broom finish consistent with the finish on the existing structure.

3.05 CURING

- A. All repair products shall be cured in strict accordance with manufacturer recommendations. Wet curing is preferred where possible.

3.06 WORK IN CONFINED SPACES

- A. The CONTRACTOR shall provide and maintain safe working conditions for all employees and subcontractors. Fresh air shall be supplied continuously to confined spaces through the combined use of existing openings, forced-draft fans and temporary ducts to the outside, or by direct air supply to individual workers. Fumes shall be exhausted to the outside from the lowest level of the confined space. Electrical fan motors shall be explosion-proof if in contact with fumes. No smoking or open fires shall be permitted in or near areas where volatile fumes may accumulate.

END OF SECTION

SECTION 05010 METAL MATERIALS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Metal materials not otherwise specified shall conform to the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Materials for fasteners are included in Section 05050 – Metal Fastening.
- B. Requirements for specific products made from the materials specified herein are included in other sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. ASTM A36 – Standard Specification for Structural Steel
- B. ASTM A47 – Standard Specification for Malleable Iron Castings
- C. ASTM A48 – Standard Specification for Gray Iron Castings
- D. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- E. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- F. ASTM A276 – Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
- G. ASTM A307 – Standard Specification for Carbon Steel Externally Threaded Standard Fasteners
- H. ASTM A446 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) quality
- I. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- J. ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
- K. ASTM A529 – Standard Specification for Structural Steel with 42 000 psi (290 Mpa) Minimum Yield Point (1/2 in. (12.7 mm) Maximum Thickness)
- L. ASTM A536 – Standard Specification for Ductile Iron Castings

- M. ASTM A570 – Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
- N. ASTM A572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
- O. ASTM A992 – Standard Specification for Structural Steel Shapes
- P. ASTM A666 – Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications
- Q. ASTM A1085 – Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
- R. ASTM B26 – Standard Specification for Aluminum-Alloy Sand Castings
- S. ASTM B85 – Standard Specification for Aluminum-Alloy Die Castings
- T. ASTM B108 – Standard Specification for Aluminum-Alloy Permanent Mold Castings
- U. ASTM B138 – Standard Specification for Manganese Bronze Rod, Bar, and Shapes
- V. ASTM B209 – Standard Specification for Aluminum-Alloy Sheet and Plate
- W. ASTM B221 – Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
- X. ASTM B308 – Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded
- Y. ASTM B574 – Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod
- Z. ASTM F468 - Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
- AA. ASTM F593 – Standard Specification for Stainless Steel Fasteners

1.04 SUBMITTALS

- A. Material certifications shall be submitted along with any shop drawings for metal products and fabrications required by other sections of the Specifications.

1.05 QUALITY ASSURANCE

- A. OWNER may engage the services of a testing agency to test any metal materials for conformance with the material requirements herein. If the material is found to be in conformance with Specifications the cost of testing will be borne by the OWNER. If the material does not conform to the Specifications, the cost of testing shall be paid by the CONTRACTOR and all materials not

in conformance as determined by the ENGINEER shall be replaced by the CONTRACTOR at no additional cost to the OWNER. In lieu of replacing materials, the CONTRACTOR may request further testing to determine conformance, but any such testing shall be paid for by the CONTRACTOR regardless of outcome of such testing.

PART 2 – PRODUCTS

2.01 CARBON AND LOW ALLOY STEEL

- A. Material types and ASTM designations shall be as listed below:

Steel W, C, and MC Shapes	A992
Steel HP Shapes	A572 Grade 50
Steel M and S shapes and Angles, Bars, and Plates	A36
Rods	F 1554 Grade 36
Pipe - Structural Use	A53 Grade B
Hollow Structural Sections	A500 Grade C or A1085 Grade A
Cold-Formed Steel Framing	A 653

2.02 STAINLESS STEEL

- A. All stainless steel fabrications shall be Type 316, unless noted otherwise.
- B. Material types and ASTM designations are listed below:

Plates and Sheets	ASTM A167 or A666 Grade A
Structural Shapes	ASTM A276
Fasteners (Bolts, etc.)	ASTM F593

2.03 ALUMINUM

- A. All aluminum shall be alloy 6061-T6, unless otherwise noted or specified herein.
- B. Material types and ASTM designations are listed below:

Structural Shapes	ASTM B308
Castings	ASTM B26, B85, or B108
Extruded Bars	ASTM B221 - Alloy 6061

Extruded Rods, Shapes and Tubes	ASTM B221 - Alloy 6063
Plates	ASTM B209 - Alloy 6061
Sheets	ASTM B221 - Alloy 3003

- C. All aluminum shall be provided with mill finish unless otherwise noted.
- D. Where bolted connections are indicated, aluminum shall be fastened with stainless steel bolts.

2.04 DISSIMILAR METALS

- A. Dielectric isolation shall be installed wherever dissimilar metals are connected according to the following table.

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Zinc			•	•	•	•	•	•	•
Galvanized Steel			•	•	•	•	•	•	•
Aluminum	•	•		•	•	•	•	•	•
Cast Iron	•	•	•				•	•	•
Ductile Iron	•	•	•				•	•	•
Mild Steel/ Carbon Steel	•	•	•				•	•	•
Copper	•	•	•	•	•	•			•
Brass	•	•	•	•	•	•			•
Stainless Steel	•	•	•	•	•	•	•	•	

1. "•" signifies dielectric isolation is required between the two materials noted.
2. Consult ENGINEER for items not listed in table.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 05035

GALVANIZING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Where galvanizing is called for in the Contract Documents, the galvanizing shall be performed in accordance with the provisions of this Section unless otherwise noted.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Further requirements for galvanizing specific items may be included in other Sections of the Specifications. See section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. California Building Code
 - 2. ASTM A123 – Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
 - 3. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 4. ASTM A653 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized), or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 5. ASTM A924 – Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
 - 6. ASTM A780 – Standard Practice of Repair of Damaged Hot-Dip Galvanized Coatings
 - 7. ASTM F2329 – Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittal Procedures.

1. Certification that the item(s) are galvanized in accordance with the applicable ASTM standards specified herein. This certification may be included as part of any material certification that may be required by other Sections of the Specifications.

PART 2 – PRODUCTS

2.01 GALVANIC COATING

- A. Material composition of the galvanic coating shall be in accordance with the applicable ASTM standards specified herein.

PART 3 – EXECUTION

3.01 FABRICATED PRODUCTS

- A. Products fabricated from rolled, pressed, and forged steel shapes, plates, bars, and strips, 1/8 inch thick and heavier which are to be galvanized shall be galvanized in accordance with ASTM A123. Products shall be fabricated into the largest unit which is practicable to galvanize before the galvanizing is done. Fabrication shall include all operations necessary to complete the unit such as shearing, cutting, punching, forming, drilling, milling, bending, and welding. Components of bolted or riveted assemblies shall be galvanized separately before assembly. When it is necessary to straighten any sections after galvanizing, such work shall be performed without damage to the zinc coating. The galvanizer shall be a member of American Galvanizers Association.
- B. Components with partial surface finishes shall be commercial blast cleaned prior to pickling.
- C. Sampling and testing of each lot shall be performed prior to shipment from the galvanizer's facility per ASTM A123.

3.02 HARDWARE

- A. Iron and steel hardware which is to be galvanized shall be galvanized in accordance with ASTM A153 and ASTM F2329.

3.03 ASSEMBLED PRODUCTS

- A. Assembled steel products which are to be galvanized shall be galvanized in accordance with ASTM A123. All edges of tightly contacting surfaces shall be completely sealed by welding before galvanizing.
- B. Assemblies shall be provided with vent and drain holes as required by the fabricator. Vent and drain hole sizes and locations shall be included in the structural steel shop drawings required in Section 05120 – Structural Steel for approval. All vent and drain holes shall be plugged and finished to be flush with and blend in with the surrounding surface. Where water intrusion can

occur, the plug shall be carefully melted into the surrounding zinc coating using an appropriate fluxing agent.

3.04 REPAIR OF GALVANIZING

- A. Galvanized surfaces that are abraded or damaged at any time after the application of zinc coating shall be repaired by thoroughly wire brushing the damaged areas and removing all loose and cracked coating, after which the cleaned areas shall be painted with 2 coats of zinc rich paint meeting the requirements of Federal Specification DOD-P-21035A and shall be thoroughly mixed prior to application. Zinc rich paint shall not be tinted. The total thickness of the 2 coats shall not be less than 6 mils. In lieu of repairing by painting with zinc rich paint, other methods of repairing galvanized surfaces in accordance with ASTM A780 may be used provided the proposed method is acceptable to the ENGINEER.

END OF SECTION

SECTION 05050
METAL FASTENING

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 – Metal Materials
- B. Section 05035 – Galvanizing
- C. Section 05061 – Stainless Steel
- D. Section 05120 – Structural Steel

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. California Building Code
 - 2. AC 193 – Acceptance Criteria for Mechanical Anchors in Concrete Elements
 - 3. AC 308 – Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements
 - 4. ACI 318 – Building Code Requirements for Structural Concrete
 - 5. ACI 355.2 – Qualifications of Post-Installed Mechanical Anchors in Concrete
 - 6. ACI 355.4 – Qualifications of Post-Installed Adhesive Anchors in Concrete
 - 7. AISC – RCSC Specification for Structural Joints Using High Strength Bolts
 - 8. AISC – Code of Standard Practice
 - 9. AWS D1.1 – Structural Welding Code – Steel
 - 10. AWS D1.2 – Structural Welding Code – Aluminum
 - 11. AWS D1.6 – Structural Welding Code – Stainless Steel

12. Aluminum Association – Specifications for Aluminum Structures
13. ASTM A572/A572M-94C – Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50
14. ASTM A36 – Standard Specification for Carbon Structural Steel
15. ASTM A489 – Standard Specification for Eyebolts
16. ASTM A563 – Standard Specifications for Carbon and Alloy Steel Nuts
17. ASTM D1785 – Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe
18. ASTM E3121 – Standard Test Methods for Field Testing of Anchors in Concrete or Masonry
19. ASTM F436 – Standard Specification for Hardened Steel Washers
20. ASTM F467 – Standard Specification for Nonferrous Nuts for General Use
21. ASTM F593 – Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs
22. ASTM F594 – Standard Specification for Stainless Steel Nuts
23. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
24. ASTM F3125 – Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch and Metric Dimension

1.4 SUBMITTALS

A. Submit the following in accordance with Section 01300 – Submittal Procedures.

1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.
2. Anchor design calculations sealed by a Professional Engineer currently registered in the State of California. Only required if design not shown on Contract Drawings.
3. A current Evaluation Report shall be submitted for all anchors that will be considered for use on this project.
4. Manufacturer's installation instructions.
5. Copy of valid certification for each person who is to perform field welding.
6. Certified weld inspection reports, when required.

7. Welding procedures.
8. Installer qualifications.
9. Certification of Installer Training.
10. Inspection Reports.
11. Results of Anchor Proof Testing.
12. Manufacturer's Literature for Resistance of Adhesive to Appropriate Chemical Exposure, where deemed necessary.

1.5 QUALITY ASSURANCE

- A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.
- B. Evaluation Report: A current Evaluation Report from an independent testing and evaluation agency (ITEA) shall be submitted for all anchors that will be used on this project. The ITEA producing the evaluation report shall be accredited in accordance with the requirements for ITEA's in ACI 355.2 (for mechanical anchors) or 355.4 (for adhesive anchors). Acceptable ITEA's include but are not necessarily limited to the International Code Council Evaluation Service (ICC-ES) and the International Association of Plumbing and Mechanical Officials Uniform Evaluation Service (IAPMO-UES).
- C. Installer Qualifications: All concrete anchors shall be installed by an Installer with at least three years of experience performing similar installations. Concrete adhesive anchor installers for anchor installations in horizontal to vertically overhead applications shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.
- D. Installer Training: For concrete anchors, conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process to include but not be limited to the following:
 1. Hole drilling procedure.
 2. Hole preparation and cleaning technique.
 3. Adhesive injection technique and dispenser training/maintenance.
 4. Concrete adhesive anchor preparation and installation.
 5. Proof loading/torquing.

6. Provide a list of names of all installers who are trained by the Manufacturer's Field Representative on this jobsite prior to installation of products. Record must include the installer name, date of training, products included in the training and trainer name and contact information.
 7. Provide a copy of the current ACI/CRSI "Adhesive Anchor Installer" certification cards for all installers who will be installing adhesive anchors in the horizontal to vertically overhead orientation.
- E. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless-steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.
- F. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.
- G. The OWNER may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the ENGINEER and/or an acceptable independent testing laboratory, at no additional cost to the OWNER.
- H. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.
- I. Special inspections for concrete adhesive anchors shall be conducted in accordance with the manufacturer's instructions and Section 01 45 33 – Special Inspections. Downward installations require periodic inspection and horizontal and overhead installations require continuous inspection.

PART 2 – PRODUCTS

2.1 ANCHOR RODS

- A. Anchor rods shall conform to ASTM F1554 Grade 55 except where stainless steel or other approved anchor rods are shown on the Drawings or stated herein. Anchor rods shall have hexagonal heads and shall be supplied with hexagonal nuts meeting the requirements of ASTM A563 Grade A. Washers shall meet the requirements of ASTM A436.
- B. All anchors into concrete shall be cast-in-place anchors unless specifically referenced otherwise on Drawings.
- C. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot dipped galvanized in accordance with ASTM F1554.

- D. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 40 PVC plastic piping meeting the requirements of ASTM D1785.

2.2 HIGH STRENGTH BOLTS

- A. High strength bolts and associated nuts and washers shall be in accordance with ASTM F3125, Grade A325 Type 1 or Grade F1852 Type 1. Bolts, nuts, and washers shall meet the requirements of RCSC “Specification for Structural Joints Using High Strength Bolts”.
- B. Where high strength bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot dipped galvanized in accordance with ASTM A325.

2.3 STAINLESS STEEL BOLTS

- A. Stainless steel bolts shall conform to ASTM F-593 for alloy groups 1 and 2, Condition CW1, or ASTM F-3125. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless-steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.
- B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts, washers, and lock washers shall be of the same alloy as the bolts.

2.4 CONCRETE ANCHORS

A. General

- 1. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used; except, where one of the types listed below is specifically called for on the Drawings, only that type shall be used. If no specific type is indicated on the Drawings, the concrete anchor shall be a cast-in-place anchor. The determination of anchors equivalent to those listed below shall be based on test data performed by an approved independent testing laboratory. Two types of anchors shall be used:
 - a. Mechanical anchors include any of the following anchors:
 - 1) Expansion anchors shall be mechanical anchors of the wedge, sleeve, or drop-in type that are set by expanding against the sides of the drilled hole.
 - 2) Screw anchors are mechanical anchors that derive tensile holding strength by the mechanical interlock provided by threads cutting into the concrete during installation. Screw anchors shall be one-piece, heavy duty screw anchors with a finished head.
 - b. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete. Adhesive anchors shall be two-part injection type

using the manufacturer's static mixing nozzle and shall be supplied as an entire system.

2. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC 308. Mechanical anchors shall conform to the requirements of ACI 355.2 or alternately to AC 193. Anchors in Seismic Design Categories C through F shall conform to the International Building Code and ACI 318 Chapter 17 requirements as applicable, including seismic test requirements.
3. Fire Resistance: All anchors installed within fire resistant construction shall either be enclosed in a fire-resistant envelope, be protected by approved fire-resistive materials, be used to resist wind and earthquake loads only, or anchor non-structural elements.
4. ENGINEER's approval is required for use of concrete anchors in locations other than those shown on the Drawings.

B. Wedge Anchors:

- a. Do not use when subjected to vibration.
- b. Do not use in exterior locations or locations subjected to freezing.
- c. Do not use in submerged, intermittently submerged, or buried locations.
- d. Suitable for use in overhead applications.

C. Screw Anchors:

- a. Do not use when subjected to vibration.
- b. Do not use in exterior locations or locations subjected to freezing.
- c. Do not use in submerged, intermittently submerged, or buried locations.
- d. Do not use in overhead applications.

D. Sleeve Anchors:

- a. Do not use when subjected to vibration.
- b. Do not use in exterior locations or locations subjected to freezing.
- c. Do not use in submerged, intermittently submerged, or buried locations.
- d. Suitable for use in overhead applications.

E. Undercut Anchors:

- a. Suitable for use where subjected to vibration.

- b. Do not use in exterior locations or locations subjected to freezing.
- c. Do not use in submerged, intermittently submerged, or buried locations.
- d. Suitable for use in overhead applications.

F. Adhesive Anchors in Concrete:

- a. Suitable for use where subjected to vibration.
- b. Suitable for use in exterior locations or locations subjected to freezing.
- c. Suitable for use in submerged, intermittently submerged, or buried locations.
- d. Do not use in overhead applications, unless otherwise shown or approved by ENGINEER.
- e. Suitable for use in chemical areas provided manufacturer's literature confirms appropriate chemical resistance.
- f. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.

G. Concrete Anchor Design:

1. Basis of design shall include the following design parameters:
 - a. Actual compressive strength of concrete.
 - b. Cracked concrete conditions.
 - c. Dry or water saturated installation conditions.
 - d. Base material temperature between 40- and 104-degrees Fahrenheit.
 - e. Installation with hammer drill or hollow-drill bit system drilling methods.
 - f. Installation not prior to 21-day minimum age of concrete.
2. An anchor design consists of specifying anchor size, quantity, spacing, edge distance and embedment to resist all applicable loads. Where an anchor design is indicated on the Drawings, the anchors shall be installed to the prescribed size, spacing, embedment depth, and edge distance. If all parts of an anchor design are provided on the Drawings except embedment depth, the CONTRACTOR shall provide the embedment depth as indicated in Paragraph B.3 unless otherwise directed by the ENGINEER. Where an anchor design is not indicated on the Drawings, the CONTRACTOR shall provide the anchor design per the requirements listed below.
 - a. The CONTRACTOR shall submit design with signed and sealed calculations and drawings performed by an ENGINEER currently registered in the State of

California. Anchors shall be of a type recommended by the anchor manufacturer for use in cracked concrete and shall be designed by the CONTRACTOR in accordance with ACI 318 Chapter 17.

b. Embedment Depth

- 1) Minimum anchor embedment shall be as indicated on the Drawings unless anchor design is stipulated to be by CONTRACTOR or equipment provider. The provider of equipment including pumps, blowers, etc. shall provide anchor design including size of anchors, pattern, and embedment depth. If the equipment provider is unable to provide design of embedment depth, the design shall be provided by the CONTRACTOR using the loads furnished by the equipment provider. Although all manufacturers listed are permitted, the embedment depth indicated on the Drawings is based on “Set 3G by Simpson” ESR 4057 issued 4/2022. If the CONTRACTOR submits one of the other concrete adhesive anchors listed, the ENGINEER shall evaluate the required embedment and the CONTRACTOR shall provide the required embedment depth stipulated by the ENGINEER specific to the approved dowel adhesive.
- 2) Where the embedment depth is not shown on the Drawings, concrete anchors shall be embedded no less than the manufacturer’s standard embedment (expansion or mechanical anchors) or to provide a minimum allowable bond strength equal to the allowable yield capacity of the rod according to the manufacturer (adhesive anchors).
- 3) The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long-term temperature of 110 degrees F, and maximum short-term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum or more than the maximum stated in the manufacturer’s literature.

H. Anchors:

1. Mechanical Anchors:

- a. Wedge Anchors: Wedge anchors shall be “Kwik Bolt TZ” by Hilti, Inc., “Strong-Bolt 2” by Simpson Strong-Tie Co. or “Power-Stud+SD1” or “Power-Stud+ SD-2” by DeWalt.
- b. Screw Anchors: Screw anchors shall be “KWIK HUS-EZ”, “KWIK HUS-EZ-I”, or “KWIK HUS-EZ CRC” by Hilti, Inc., “Titen HD” or “Stainless Steel Titen HD” by Simpson Strong-Tie Co., or “Screw-Bolt+” by DeWalt.
- c. Sleeve Anchors: Sleeve anchors shall be “HSL-3 Heavy Duty Sleeve Anchor” by Hilti, Inc. or “Power-Bolt +” by DeWalt.

- d. Shallow Embedment Internally Threaded Insert (3/4" max embedment): "Mini-Undercut +Anchor" by DeWalt, "HDI-P-TZ" by Hilti, Inc. or approved equal.
 - e. Concrete Undercut Anchors: Concrete undercut anchors shall be "HDA Undercut Anchors" by Hilti, Inc, "DUC Ductile Undercut Anchor", by USP Structural Connectors, or approved equal.
 - f. Mechanical anchor systems shall comply with ACI 355.2 or alternatively the latest revision of AC 193 and shall have a valid evaluation report in accordance with the applicable building code.
2. Adhesive Anchors:
- a. Adhesive anchors shall be "HIT HY-200 Adhesive Anchoring System" by Hilti, Inc., "SET-3G Epoxy Adhesive Anchors" by Simpson Strong-Tie Co., or "Pure 110+ Epoxy Adhesive Anchor System" by DeWalt.
 - b. Adhesive anchor systems shall be IBC compliant and capable of resisting short term wind and seismic loads (Seismic Design Categories A through F) as well as long term and short term sustained static loads in both cracked and uncracked concrete in all Seismic Design Categories. Adhesive anchor systems shall comply with ACI 355.4 or alternatively the latest revision of AC308 and shall have a valid evaluation report in accordance with the applicable building code. **No or equal products will be considered unless prequalified and approved by the ENGINEER and OWNER.**
- I. Concrete Anchor Materials:
- 1. Concrete anchors used to anchor structural steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.
 - 2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be manufactured from stainless steel unless noted otherwise. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless-steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.
 - 3. Nuts, washers, lock washers and other hardware shall be of a material to match the anchors.

2.5 WELDS

- A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).
- B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.
- C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

2.6 WELDED STUD CONNECTORS

- A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

2.7 EYEBOLTS

- A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.8 HASTELLOY FASTENERS

- A. Hastelloy fasteners and nuts shall be constructed of Hastelloy C-276. Hastelloy fasteners shall be used for fasteners located in chemical areas containing Hydrochloric Acid (Muriatic Acid), Hydrofluosilicic Acid (Fluoride), or Sulfuric Acid.

2.9 ANTISEIZE LUBRICANT

- A. Antiseize lubricant shall be C5-A Anti-Seize by Loctite Corporation, Molykote P-37 Anti-Seize Paste by Dow Corning, 3M Anti-Seize by 3M, or equal.

PART 3 – EXECUTION

3.1 MEASUREMENTS

- A. The CONTRACTOR shall verify all dimensions and review the Drawings and shall report any discrepancies to the ENGINEER for clarification prior to starting fabrication.

3.2 FASTENER INSTALLATION

- A. Anchor Rods, Concrete Anchors, and Masonry Anchors
 - 1. Anchor rods shall be installed in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template. Overhead adhesive anchors, and base plates or elements they are anchoring, shall be shored as required and securely held in place during anchor setting to prevent movement during anchor installation. Movement of anchors during curing is prohibited.

2. The CONTRACTOR shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.
3. Concrete anchors shall not be used in place of anchor rods without ENGINEER's approval.
4. All stainless-steel threads shall be coated with anti-seize lubricant.

B. High Strength Bolts

1. All bolted connections for structural steel shall use high strength bolts. High strength bolts shall be installed in accordance with RCSC "Specification for Structural Joints Using High Strength Bolts". All bolted joints shall be Type N, snug-tight, bearing connections in accordance with AISC Specifications unless noted otherwise on the Drawings.

C. Stainless Steel Bolts

1. Where connections indicate the use of stainless-steel bolts, the bolts shall be installed to the snug tight condition. Connections shall include stainless steel washers under both the bolt head and the nut head. Lock washers shall be utilized for all connections and shall be placed under the nut head.

D. Concrete Anchors

1. Concrete at time of anchor installation shall be a minimum age of 21 days, have a minimum compressive strength of 2500 psi, and ambient temperature at time of installation shall be at least 50 degrees F.
2. Concrete Anchor Testing:
 - a. At all locations, at least 10 percent of all concrete anchors installed shall be proof tested to 80% of the yield strength of the anchor rod, with a minimum of one tested anchor per anchor group.
 - b. CONTRACTOR shall submit a plan and schedule indicating locations of anchors to be proof tested, load test values and proposed anchor testing procedure (including a diagram of the testing equipment proposed for use) to the ENGINEER for review prior to conducting any testing. Proof testing of anchors shall be in accordance with ASTM E3121 for the static tension test. If additional tests are required, inclusion of these tests shall be as stipulated on Contract Drawings.
 - c. Where Contract Documents indicate anchor design to be the CONTRACTOR's responsibility, the CONTRACTOR shall submit a plan and schedule indicating locations of anchors to be proof tested and load test values, sealed by a Professional Engineer currently registered in the State of California. Documentation shall also be submitted indicating the CONTRACTOR's proof testing procedures have been reviewed and the proposed procedures are acceptable. Proof testing procedures shall be in accordance with ASTM E3121.

- d. Concrete Anchors shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure. Anchors exhibiting damage shall be removed and replaced. If more than 5 percent of tested anchors fail, then 100 percent of anchors shall be proof tested.
 - e. Proof testing of concrete anchors shall be performed by an independent testing laboratory hired directly by the CONTRACTOR and approved by the ENGINEER. The CONTRACTOR shall be responsible for costs of all proof testing, including additional testing required due to previously failed tests.
3. All concrete anchors shall be installed in strict conformance with the manufacturer's printed installation instructions. A representative of the manufacturer shall be on site when required by the ENGINEER.
 4. All holes shall be drilled in accordance with the manufacturer's instructions except that cored holes shall not be allowed unless specifically approved by the ENGINEER. If cored holes are allowed, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with the manufacturer's instructions prior to installation of adhesive and threaded rod unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the ENGINEER. Injection of adhesive into the hole shall be performed to minimize the formation of air pockets in accordance with the manufacturer's instructions. Wipe rod free from oil that may be present from shipping or handling.
 5. All adhesive anchor installations in the horizontal to vertically overhead orientation shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CSRI per ACI 318-14 17.8.2.2. Current AAI Certificate must be submitted to the ENGINEER of Record prior to commencement of any adhesive anchor installations.

E. Other Bolts

1. All dissimilar metal shall be connected with appropriate fasteners and shall be isolated via an approved dielectric.
2. All stainless-steel bolts shall be coated with anti-seize lubricant.

3.3 WELDING

- A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.
- B. Welded stud connectors shall be installed in accordance with AWS D1.1.

- C. Welds shown on the Drawings with a field weld symbol shall be field welded. All other welds shall be shop welded unless specifically approved by the ENGINEER.

3.4 INSPECTION

- A. High strength bolting will be visually inspected in accordance with RCSC “Specification for Structural Joints Using High Strength Bolts”. Rejected bolts shall be either replaced or retightened as required.
- B. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.
- C. Post-installed concrete anchors shall be inspected as required by ACI 318.

3.5 CUTTING OF EMBEDDED REBAR

- A. The CONTRACTOR shall not cut embedded rebar cast into structural concrete during installation of post-installed fasteners without prior approval of the ENGINEER.

END OF SECTION

SECTION 05120
STRUCTURAL STEEL

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all equipment, labor, materials, and services required to provide all structural steel work in accordance with the Contract Documents. The term "structural steel" shall include items as defined in the AISC "Code of Standard Practice".

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 – Metal Materials
- B. Section 05035 – Galvanizing
- C. Section 05050 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents.
 - 1. California Building Code
 - 2. AISC – "Code of Standard Practice"
 - 3. AISC – "Specification for Structural Steel Buildings"
 - 4. AISC – RCSC "Specification for Structural Joints Using High Strength Bolts"
 - 5. AWS – "Structural Welding Code"
 - 6. ASTM A786 – Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittal Procedures.
 - 1. Certified Mill Test Reports
 - 2. Affidavit of Compliance with grade specified
 - 3. Shop Drawings which include the following:

- a. Layout drawings indicating all structural shapes, sizes, and dimensions.
- b. Beam and column schedules.
- c. Detailed drawings indicating jointing, anchoring and connection details and vent and drain holes where required.

1.05 QUALITY ASSURANCE

- A. Shop inspection may be required by the OWNER at his own expense. The CONTRACTOR shall give ample notice to the ENGINEER prior to the beginning of any fabrication work so that inspection may be provided. The CONTRACTOR shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the CONTRACTOR from his responsibility for furnishing proper materials or workmanship under this Specification.
- B. The structural steel erector shall be a qualified installer who participates in the AISC Certification program and is designated an AISC Certified Erector.
- C. The structural steel fabricator shall be a qualified fabricator who participates in the AISC Certification program and is designated an AISC Certified Building Fabricator.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Structural Steel
 1. Structural steel for W, C, and MC shapes shall conform to ASTM A992 unless otherwise indicated.
 2. Structural steel for HP shapes shall conform to ASTM A572 Grade 50 unless otherwise indicated.
 3. Structural steel for S and M shapes and angles and plates shall conform to ASTM A36 unless otherwise indicated.
 4. Steel pipe shall be ASTM A53, Grade B.
 5. HSS shall be ASTM A500, Grade C or ASTM A1085. All members shall be furnished full length without splices unless otherwise noted or accepted by the ENGINEER.
 6. All unidentified steel will be rejected and shall be removed from the site and replaced by the CONTRACTOR, all at the expense of the CONTRACTOR.

7. Fasteners for structural steel shall be in accordance with Section 05050 – Metal Fastening.

B. Welds

1. Electrodes for welding shall be in accordance with Section 05050 – Metal Fastening.

PART 3 – EXECUTION

3.01 MEASUREMENT

- A. The CONTRACTOR shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The CONTRACTOR shall review the Drawings and any discrepancies shall be reported to the ENGINEER for clarification prior to starting fabrication.

3.02 FABRICATION

- A. Fabrication shall be in accordance with the AISC "Specification for Structural Steel Buildings and AISC "Code of Standard Practice". Fabrication shall begin only after Shop Drawing approval.
- B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.
- C. All holes in structural steel members required for anchors, anchor rods, bolts, sag rods, vent and drain holes or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.
- D. All materials shall be properly worked and match-marked for field assembly.
- E. Where galvanizing of structural steel is required, galvanizing shall be done in accordance with Section 05035 – Galvanizing.
- F. Checkered floor plate shall meet the requirements of ASTM A786.

3.03 DELIVERY, STORAGE AND HANDLING

- A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.
- B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The CONTRACTOR shall repair or replace damaged materials or structures as directed.

3.04 ERECTION

- A. The erection of all structural steel shall conform to the applicable requirements of the AISC "Specification for Structural Steel Buildings" and AISC "Code of Standard Practice". All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the CONTRACTOR.
- B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanently fastened. A licensed land surveyor shall survey the structural steel during erection and shall provide a final survey indicating elevations and locations of all major members. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed.
- C. No cutting of structural steel members in the field will be allowed except by the written approval of the ENGINEER.
- D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.
- E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the ENGINEER. All field welding shall comply with Section 05050 – Metal Fastening.
- F. All bolted connections shall use high strength bolts in accordance with Section 05050 – Metal Fastening. High strength bolts shall be installed in accordance with RCSC "Specification for Structural Joints Using High Strength Bolts". Bolts specified or noted on the Drawings to be a tension or slip critical "SC" type connection shall be fully pretensioned with proper preparation of the faying surfaces. All other bolts shall be snug tightened unless otherwise noted on the Drawings.
- G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.
- H. Misfits at Bolted Connections
 - 1. Where misfits in erection bolting are encountered, the ENGINEER shall be immediately notified. The CONTRACTOR shall submit a method to remedy the misfit for review by the ENGINEER. The ENGINEER will determine whether the remedy is acceptable or if the member must be refabricated.
 - 2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The CONTRACTOR shall notify the ENGINEER immediately and shall submit a proposed method of remedy for review by the ENGINEER.

3. Where misalignment between anchor rods and rod holes in steel members are encountered, the ENGINEER shall be immediately notified. The CONTRACTOR shall submit a method to remedy the misalignment for review by the ENGINEER.

I. Grouting of Base Plates and Bearing Plates

1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.
2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.
3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03600 – Grout.
4. Anchor rods shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.

- J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.05 PAINTING

- A. Painting shall be performed according to Section 09900 – Painting and Coating and the following additional requirements.

1. Concrete Encased Steel: Steel members which will be encased in concrete shall be cleaned but not painted prior to encasement.
2. Contact Surfaces: Contact surfaces such as at field connections, shall be cleaned and primed but not painted.
3. Finished Surfaces: Machine finished surfaces shall be protected against corrosion by a rust-inhibiting coating which is easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.
4. Surfaces Adjacent to Field Welds: Surfaces within 2 inches of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

END OF SECTION

SECTION 05500
METAL FABRICATIONS

PART 1 – GENERAL

1.01 REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all metal fabrications not specifically included in other Sections, complete and in accordance with the requirements of the Contract Documents.
- B. Work shall include but may not be limited to platform modifications, guard rail modifications, and waste bin guide rails.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 – Metal Materials
- B. Section 05035 – Galvanizing
- C. Section 05050 – Metal Fastening
- D. Certain specific items are included in other Sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. California Building Code
 - 2. AISC – Specification for Structural Steel Buildings
 - 3. AISI – Specifications for the Design of Cold-Formed Steel Structural Members
 - 4. Aluminum Association Specifications for Aluminum Structures

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittal Procedures.
 - 1. Complete fabrication and erection drawings of all metalwork specified herein.
 - 2. Other submittals as required in accordance with Section 05010 – Metal Materials and Section 05050 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

- A. Metal materials used in metal fabrications shall conform to Section 05010 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

- A. All welds and fasteners used in metal fabrication shall conform to Section 05050 – Metal Fastening, unless noted otherwise.

PART 3 – EXECUTION

3.01 FABRICATION

- A. All measurements and dimensions shall be based on field conditions and shall be verified by the CONTRACTOR prior to fabrication. Such verification shall include coordination with adjoining work.
- B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.
- C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.
- D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.
- E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.
- F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050 – Metal Fastening. All fastenings shall be concealed where practicable.
- G. Fabricated items shall be shop painted when specified in Section 09900 – Painting and Coating.

3.02 INSTALLATION

- A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.
- B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

- C. Metal work shall be field painted when as specified in accordance with Section 09900 – Painting and Coating.

END OF SECTION

SECTION 05520
GUARDS AND RAILINGS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all metal removable guards and railings in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 – Metal Materials
- B. Section 05050 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. California Building Code
 - 2. Aluminum Association Specifications for Aluminum Structures
 - 3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittal Procedures.
 - 1. Complete fabrication and erection drawings of all metal work specified herein, sealed by a Professional Engineer currently licensed in the State of California.
 - 2. Other submittals as required in accordance with Section 05010 – Metal Materials and Section 05050 – Metal Fastening.
 - 3. Structural calculations on guard and handrail system sealed by a Professional Engineer currently licensed in the State of California.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

- A. Metal materials used for guards and railings shall conform to Section 05010 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

- A. All welds and fasteners used in guards and railings shall conform to Section 05050 – Metal Fastening, unless noted otherwise.

2.03 GUARDS AND RAILINGS

- A. General - Guard systems shall consist of all railings, posts, toeboards, baseplates, anchors, and accessories required for a complete and rigid installation of removable guards.
 - 1. All guard systems shall be fabricated from extruded aluminum alloy 6061-T6 or 6105-T5, with finish to match existing railing system or Aluminum Association M12C22A41 finish.
 - 2. Metal railings shall be fabricated from 1-1/2 inch Schedule 40 minimum pipe. Metal railing support posts shall be fabricated from 1-1/2 inch Schedule 80 minimum pipe.
 - 3. The top of the upper guard rail shall be 42 inches above the walking surface for level guards. For stair guards, the top of the upper guard rail shall be 42 inches above the leading edge of the tread nosing. The top of stair handrail shall be 34 inches above the leading edge of the tread nosing.
 - 4. Posts
 - a. Maximum horizontal spacing between posts for level rail shall be six feet.
 - b. Maximum horizontal spacing between posts for stair rail shall be five feet.
 - 5. All rail joints shall be finished flush and shall occur only at supports. Posts shall not interrupt the continuation of the top rail at any point along the railing, including corners and end terminations. The top surface of the top railing shall be smooth and shall not be interrupted by projecting fittings.
 - 6. Toeboards
 - a. Toeboards shall project 4-inches above the walking surface and shall not infringe on the minimum required walkway width.
 - b. Aluminum toeboards shall be extruded from aluminum alloy 6063-T6 unless otherwise noted.

- c. Toeboards shall have a minimum thickness of 1/8" at any point. Geometry of toeboard shall closely resemble geometry shown on Drawings.
 - 7. Expansion joint splices shall be provided at 30 foot maximum spacing and at all expansion joints in the structure supporting the guards.
 - 8. The guard system shall be designed to resist the design loads specified by both OSHA and the California Building Code.
 - 9. Provide handrail extensions at top and bottom of stairs and ramps in accordance with the California Building Code.
- B. The CONTRACTOR shall have the option of providing a guard system of either an all welded type construction or a component type construction.
- 1. With both the all welded or component type construction, the baseplates and toeboards shall be furnished as shown on the Drawings.
 - 2. Component Type System
 - a. All fittings and brackets shall be designed for stainless steel concealed set screws with internal tyne type connectors.
 - b. Exposed fittings shall be cast or extruded aluminum, or stainless steel to match guard material, except where corrosion-resistant steel is employed as a standard fabricator's item for use.
 - c. Component type guards shall be as manufactured by Thompson Fabricating Company, Inc., or Hollaender Manufacturing Company, Inc.
 - 3. Welded guards may be field assembled using component type fittings as described herein.
- C. Guards shall be Type I guards as shown on the Drawings.
- 1. Type I guards shall be a three-rail system as shown on the Drawings.
 - a. The intermediate rails shall be spaced 13 inches maximum from the top rail.
 - b. The centerline of the lower intermediate rail shall be 15 inches above the walking surface.
- D. Where removable guard rails are required as shown on the Drawings, posts shall be removable from side mounts. Length of removable sections shall be as shown on the Drawings.

PART 3 – EXECUTION

3.01 FABRICATION

- A. All measurements and dimensions shall be based on field conditions and shall be verified by the CONTRACTOR prior to fabrication. Such verification shall include coordination with all adjoining work.
- B. All fabricated work shall be shop fitted together as much as practical, and delivered to the field, complete and ready for erection.
- C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.
- D. Finished members shall conform to the lines, angles, and curves shown on the drawings and shall be free from distortions of any kind.
- E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.
- F. Concrete anchors and bolts for attachment of guard baseplates to supporting members shall conform to Section 05050 – Metal Fastening.
- G. All fabricated items shall be shop painted, anodized in accordance with Section 09900 – Painting.

3.02 INSTALLATION

- A. Assembly and installation of guards and railings shall be performed in strict accordance with manufacturer's recommendations.
- B. All guards and railings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

END OF SECTION

SECTION 05531
GRATINGS, CHECKERED FLOOR PLATES, AND ACCESS DOORS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all gratings, floor plates, and access doors in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 – Metal Materials
- B. Section 05035 – Galvanizing
- C. Section 05050 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. California Building Code
 - 2. Aluminum Association Specifications for Aluminum Structures
 - 3. Occupational Safety and Health Administration (OSHA) Regulations
 - 4. ANSI/NAAMM MBG 531 – NAAMM Metal Bar Grating Manual
 - 5. ASTM C1802 – Design, Testing, Manufacture, Selection, and Installation of Fabricated Metal Access Hatches for Utility, Water, and Wastewater Structures

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittal Procedures.
 - 1. Complete fabrication and erection Drawings of all gratings, floor plates, and access doors specified herein.
 - 2. For checkered floor plates, structural calculations signed and sealed by a currently registered Professional Engineer in the State of California verifying the proposed floor plate meets the minimum load and deflection requirements stipulated herein.

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3. For access doors provided by a manufacturer not specifically named herein, structural calculations signed and sealed by a Professional Engineer currently registered in the State of California verifying the proposed access door meets the minimum load and deflection requirements stipulated herein. For access doors provided by a named manufacturer, sealed calculations are not required provided the applicable ASTM C1802 load rating is clearly indicated in the submittal for each proposed product.
4. Other submittals as required in accordance with Section 05010 – Metal Materials and Section 05050 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

- A. Metal materials used for gratings, floor plates, and access doors shall conform to Section 05010 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

- A. All welds and fasteners used for gratings, floor plates, and access doors shall conform to Section 05050 – Metal Fastening, unless noted otherwise.

2.03 GRATING

- A. General - Grating, including support frames, fastenings, and all necessary appurtenances for a complete installation, shall be furnished as indicated on the Drawings.
 1. All exposed bearing ends of grating shall be enclosed in a perimeter band of the same dimensions and material as the main bars, including ends at all cutouts.
 2. Grating shall be fabricated into easily removable sections and shall be fastened at each corner and as required with fasteners provided by the grating manufacturer. No fasteners shall be permitted to project above the walking surface.
 3. Grating shall be designed for a loading of 150 psf unless otherwise required by the Drawings. Grating deflection shall not exceed 1/4 inch under a uniform load of 100 psf. Minimum grating depth shall be 1-1/2 inches, unless structural requirements based on clear span require more depth.
 4. Grating installed in cast-in-place concrete shall be provided with embedded support frames on all perimeter and bearing edges. Support frames shall be extruded frames with continuous means of anchoring frames to concrete around entire perimeter of frame. Support frames shall be fabricated from the same material as the grating.
- B. Aluminum Grating

1. Aluminum grating shall be of I-bar type and shall consist of extruded bearing bars positioned and locked by crossbars. All supports, cross members, etc. shall be aluminum. Plank clips for grating attachment to frames and any other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.
2. Grating shall be "IB" by Harsco Industrial IKG, "I-Bar 19SGI4", by Ohio Grating Inc., or "I-Bar" by Thompson Fabricating LLC.

C. Heavy Duty Steel Grating

1. Heavy duty steel grating shall be galvanized according to Section 05035 – Galvanizing.
2. Main bearing bars shall conform to ASTM A36. Cross bars shall be flush with the top of the grating. Provide embedded galvanized steel support frames for cast-in-place concrete installations.
3. Grating span shall be 36 inches maximum and shall satisfy AASHTO loading for HS-20 truck.
4. Grating shall be manufactured by Harsco Industrial IKG and Ohio Gratings, Inc.

2.04 CHECKERED FLOOR PLATES

- A. Floor plates shall meet the requirements of ASTM C1802 for Load Level 1 – Light Pedestrian Load, minimum, unless otherwise indicated on the Drawings.
- B. Floor plates shall be aluminum unless noted otherwise.
- C. All floor plates shall be checkered plate with an approved raised pattern, non-skid surface.
- D. Openings greater than 42 inches in either direction shall require two plates opening via hinges in opposite directions.
- E. Floor plates shall be designed to carry a minimum service level live load of 150 psf, or a concentrated load of 300 pounds applied over a 5.50 inch by 5.50 inch area, whichever produces the greatest stress, unless indicated otherwise on the Drawings. Loading shall be positioned to produce the greatest stresses, both due to maximum moment and maximum shear load conditions.
- F. All components of checkered floor plates shall have a minimum tensile yield strength of 23,000 psi and a minimum compressive yield strength of 21,000 psi. Yield strengths shall be indicated on both the structural calculations and the fabrication drawings.
- G. Live load deflection shall be limited to $L/200$ of the span, but no greater than $3/16$ inch.
- H. All checkered floor plates shall be fabricated from $1/4$ " plate, minimum and shall be stiffened as required to maintain allowable stress and deflection requirements specified herein.

- I. Stiffeners shall consist of angles or bars welded to the bottom of the plate.
- J. Checkered floor plate hinges shall be either stainless steel or aluminum with stainless steel pins and fasteners.
- K. All checkered floor plates shall be provided with recessed handles. Handle material shall be as shown on the Contract Drawings.
- L. Air-tight and water-tight checkered floor plates shall be provided with a 1/8-inch-thick neoprene gasket between the checkered plate and the support frame. Gasket material shall be bonded to the support frame and checkered floor plates shall be bolted to the structural support frame with countersunk stainless-steel flathead screws.
- M. All floor plates shall be clearly marked with the information listed below. Markings shall be indicated on metal or plastic tags permanently attached to the floor plate or frame or shall be permanently painted or printed.
 - 1. The manufacturer's name or trademark, location, and telephone contact number.
 - 2. The manufacturer's model number and ASTM designation.
 - 3. The design load level as indicated in ASTM C1802. If the design requires deviation from the Load Level requirements specified in ASTM C1802, a description of the modifications shall be included.
 - 4. Date of manufacture and/or serial number.

PART 3 – EXECUTION

3.01 FABRICATION

- A. All measurements and dimensions shall be based on field conditions and shall be verified by the CONTRACTOR prior to fabrication. Such verification shall include coordination with adjoining work.
- B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.
- C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.
- D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

- E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.
- F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050 – Metal Fastening. All fastenings shall be concealed where practicable.

3.02 INSTALLATION

- A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.
- B. All gratings, checkered floor plates, and access doors shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions. Embedded support frames shall be set level and square.
- C. Where access doors utilize leveling bolts, or are placed on irregular surfaces, and are not to be embedded in concrete, the area beneath the frames shall be fully grouted with non-shrink grout to create a uniformly loaded bearing surface.
- D. Grating shall not be field cut or modified unless approved by ENGINEER.
- E. Grating shall not be used for equipment support or anchorage.

END OF SECTION

SECTION 07900
JOINT FILLERS, SEALANTS AND CAULKING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for the complete execution of Work shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03250 – Concrete Accessories

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM C-920 – Elastomeric Joint Sealants
2. ASTM D-1056 – Flexible Cellular Materials – Sponge or Expanded Rubber
3. SWRI – Sealant and Caulking Guide Specification

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittal Procedures, submit the following:
 1. Manufacturers literature and installation instructions. Label each product submitted with Type as indicated in paragraph 2.01 A.
 2. Color samples of each type of sealant.

1.05 QUALITY ASSURANCE

- A. Applicator shall be a company specializing in the installation of sealants with a minimum of five years of experience.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in unopened labeled packages.
- B. Store materials in location protected from freezing or damages.

- C. Reject and remove from the site materials within broken or damaged packaging.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Sealants

1. Type 1: Multi-component, non-sag, low-modulus polyurethane rubber sealant meeting ASTM C-920, Type M, Grade NS, Class 25, use NT, M, A, and O. Capable of withstanding 50% in extension or compression such as Sikaflex-2C NS/SL, Sika Corporation, or Sonolastic NP-2, Sonneborn, or DynaTrol II by Pecora Corporation.
2. Type 2: Single component polyurethane sealant meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, A, and O. Capable of withstanding 25% in extension or compression such as Sikaflex 1A by Sika Corporation, DynaTrol 1-XL by Pecora Corporation, or Sonolastic NP-1 by Master Builders Solutions.
3. Type 3: Single component, low-modulus moisture curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Capable of withstanding 50% extension and compression. Pecora 890 by Pecora Corporation, Sonolastic Omni Seal by Master Builders Solutions.
4. Type 6: High grade butyl sealant meeting Federal Specification TT-S-00-1657. BC-158 by Pecora Corporation or equal.
5. Type 7: Multi-component chemical resistant polysulfide sealant conforming to ASTM C-920, Type M, Grade NS, Class 25 such as Deck-O-Seal by W.R. Meadows, Tammsflex by DuraJoint Concrete Accessories, or Synthacalk GC2+ by Pecora Corporation.

- B. Primer: Non-staining primer recommended by sealant manufacturer for the substrates on this project.
- C. Backer Rod: Closed cell foam, nonreactive with caulking materials, non-oily, and approved by the sealant manufacturer. Minimum density shall be 2.00 pounds per cubic foot. Use no asphalt or bitumen-impregnated fiber with sealants.
- D. Joint Cleaner: Recommended by sealant or caulking compound manufacturer.
- E. Bond breaker: Either polyethylene film or plastic tape as recommended by the sealant manufacturer.
- F. Color: Where manufacturer's standard colors do not closely match materials being sealed, provide a custom color.

PART 3 – EXECUTION

3.01 QUALITY CONTROL

- A. Coordinate work with details shown on approved shop drawings prepared by other trades.
- B. Verify conditions in the field.
- C. Schedule work to follow closely the installation of other trades.
- D. Apply sealants and related items in temperatures and dry conditions recommended by the manufacturers.
- E. Do not paint sealant, unless recommended by sealant and paint manufacturer.

3.02 PREPARATION

- A. Protect finished surfaces adjoining by using masking tape or other suitable materials.
- B. Clean and prime joints before starting any caulking or sealing work.
- C. Thoroughly clean joints and spaces of mortar and other foreign materials. Cleaning agent shall be Xylol or similar non-contaminating solvent to remove any film from metal surfaces. Masonry or concrete surfaces shall be brushed or air jet cleaned.
- D. Joint Requirements
 - 1. All joints and spaces to be sealed in exterior work shall be less than 1/2-inch deep and not less than 1/4 inch wide. If joints in masonry are less than that specified herein, the mortar shall be cut out to the required width and depth. All joints and spaces to receive sealant shall be completely prepared and thoroughly dry before installation of sealant.
 - 2. Unless otherwise specified, joints and spaces which are open to a depth of 1/2 inch or greater shall be solidly filled with back-up material to within 1/4 inch of the surface. Back-up material shall be packed tightly and made continuous throughout the length of the joints. Bond breaker shall be applied as required. If joints are less than 1/4-inch deep, the back-up material may be omitted, a bond breaker substituted and the joint completely filled with sealant. The back-up material shall not project beyond the 1/4-inch depth of the open space in any joint. The following width-to-depth ratio table shall be adhered to, unless otherwise recommended by manufacturer.

Joint Width	Sealant Depth	
	Minimum	Maximum
1/4 inch	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width

Over 1/2 inch to 1 inch	1/2 inch	Equal to width
Over 1 inch to 2 inches	1/2 inch	1/2 of width

3.03 APPLICATION

- A. Exercise care before, during, and after installation so as not to damage any material by tearing or puncturing. All finished work shall be approved before covering with any other material or construction.
- B. Apply sealant by an approved type of gun except where the use of a gun is not practicable, suitable hand tools shall be used. Avoid applying the compound to any surface outside of the joints or spaces to be sealed. Mask areas where required to prevent overlapping of sealant.
- C. All joints shall be waterproof and weathertight.
- D. Point sealed joints to make a slightly concave joint, the edges of which are flush with the surrounding surfaces. Exposed joints in the interior side of the door and other frames shall be neatly pointed flush or to match adjacent jointing work.
- E. Adjacent materials which have been soiled shall be cleaned immediately and the work left in neat and clean condition.
- F. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

3.04 ADJUSTMENT AND CLEANING

- A. Remove misplaced sealant compounds promptly using methods and materials recommended by the manufacturer, as the work progresses.
- B. Allow sealants to cure and remove protective edging, of doors, louvers, saddles windows etc. as directed by the Engineer.

3.05 SCHEDULE

Schedule of Sealants

Application	Sealant	Color
Vertical and horizontal expansion and construction joints in concrete structures unless noted otherwise herein or on Drawings.	Type 1	To closely match adjacent surfaces or mortar and as selected by the Owner.
Vertical and horizontal joints bordered on both sides by painted metals, anodized aluminum, mill finished aluminum, PVC, glass or other non-porous building material.	Type 3	To closely match adjacent surfaces and as selected by the Owner.

Schedule of Sealants

Application	Sealant	Color
Perimeter sealing of doors, windows, louvers, piping, ducts, and electrical conduit. ²	Type 2 OR Type 3	To closely match adjacent surfaces and as selected by the Owner.
Below thresholds.	Type 6	Manufacturer's standard
Submerged in liquids. ^{1,2}	Type 1	Manufacturer's standard
Submerged in liquids with high concentration of chlorine (> 2 ppm) or wastewater.	Type 7	Manufacturer's standard

¹ Sealants which will come in contact with potable water shall meet the requirements of NSF 61.

² Where sealant will be immersed in liquid chemicals verify compatibility prior to installation of sealant.

END OF SECTION

SECTION 09900
PAINTING AND COATING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and Specified herein.
- B. Section Includes:
 - 1. Paint Materials
 - 2. Shop Painting
 - 3. Field Painting
 - a. Surface Preparation
 - b. Piping and Equipment Identification
 - c. Schedule of Colors
 - d. Work in Confined Spaces
 - e. OSHA Safety Colors

1.02 RELATED SECTIONS

- A. Section 09902 – Field Painting
- B. Section 07900 – Joint Fillers, Sealants, and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of these specifications, the Work shall conform to the applicable requirements of the following documents:
 - 1. SSPC – The Society for Protective Coatings Standards
 - a. SSPC-Vis 1 – Pictorial Surface Preparation Standards for Painting Steel Structures
 - b. SSPC-SP2 – Hand Tool Cleaning
 - c. SSPC-SP3 – Power Tool Cleaning

- d. SSPC-SP5/NACE 1 – White Metal Blast Cleaning
 - e. SSPC-SP6/NACE 3 – Commercial Blast Cleaning
 - f. SSPC-SP7/NACE 4 – Brush-off Blast Cleaning
 - g. SSPC-SP10/NACE 2 – Near-White Metal Blast
 - h. SSPC-SP11 – Power Tool Cleaning to Bare Metal
 - i. SSPC-SP13/NACE6 – Surface Preparation of Concrete
- 2. ICRI – International Concrete Repair Institute
 - 3. NACE – National Association of Corrosion Engineers
 - 4. NAFP – The National Association of Pipe Fabricators
 - 5. ASTM D1737 – Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus
 - 6. ASTM B117 – Method of Salt Spray (Fog) Testing
 - 7. ASTM D4060 – Test Method for Abrasion Resistance of Organic Coating by the Taber Abraser
 - 8. ASTM D3359 – Method for Measuring Adhesion by Tape Test

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittal Procedures, submit the following:
 - 1. Manufacturer's literature and Material Safety Data Sheets for each product.
 - 2. Painting schedule identifying surface preparation and paint systems proposed. Cross reference with Tables 1 and 2. Provide the name of the paint manufacturer, and name, address, and telephone number of manufacturer's representative who will inspect the work. Submit schedule for approval as soon as possible following the Award of Contract, so approved schedule may be used to identify colors and specify shop paint systems for fabricated items. Manufacturer shall substitute paint system with equal performance where required for VOC compliance.
 - 3. Contractor shall submit Q.C. Inspection plan describing all tests and inspections task to be performed. Include copy of daily log showing environmental conditions measurements and frequency. Copy of completed log shall be provided at completion of work.

1.05 SYSTEM DESCRIPTION

- A. Work shall include surface preparation, paint application, inspection of painted surfaces and corrective action required, protection of adjacent surfaces, cleanup and appurtenant work required for the proper painting of all surfaces to be painted. Surfaces to be painted are designated within the Painting Schedule and may include new and existing piping, miscellaneous metals, equipment, buildings, exterior fiberglass, exposed electrical conduit and appurtenances.
- B. Perform Work in strict accordance with manufacturer's published recommendations and instructions, unless the Engineer stipulates that deviations will be for the benefit of the project.
- C. Paint surfaces which are customarily painted, whether indicated to be painted or not, with painting system applied to similar surfaces, areas and environments, and as approved by Engineer.

1.06 QUALITY ASSURANCE

- A. Painting operations shall be accomplished by skilled craftsman and licensed by the state/commonwealth to perform painting work.
- B. Provide a letter indicating that the painting applicator has five years of experience, and 5 references which show previously successful application of the specified or comparable painting systems. Include the name, address, and the telephone number for the Owner of each installation for which the painting applicator provided services.
- C. Contractor shall coordinate Q.C Inspections.
- D. Notify Owner and Engineer at completion of surface preparation, priming application and final cure to allow inspection by Owner and Engineer or their Third-Party Inspector.

1.07 STORAGE AND DELIVERY

- A. Bring materials to the job site in the original sealed and labeled containers.
- B. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

PART 2 – MATERIALS

2.01 GENERAL INFORMATION

- A. The term "paint" is defined as both paints and coatings including emulsions, enamels, stains, varnishes, sealers, and other coatings whether organic or inorganic and whether used as prime, intermediate, or finish coats.
- B. Purchase paint from an approved manufacturer. Manufacturer shall assign a representative to inspect application of their product both in the shop and field. The manufacturer's representative shall submit a report to the Engineer at the completion the Work identifying products used and verifying that surfaces were properly prepared, products were properly applied, and the paint systems were proper for the exposure and service.
- C. Provide primers and intermediate coats produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and only within manufacturer's recommended limits.
- D. Ensure compatibility of total paint system for each substrate. Test shop primed equipment delivered to the site for compatibility with final paint system. Provide an acceptable barrier coat or totally remove shop applied paint system when incompatible with system specified, and repaint with specified paint system.
- E. Use painting materials suitable for the intended use and recommended by paint manufacturer for the intended use.
- F. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of each product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.

2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:
 - 1. Tnemec Company Inc.
 - 2. PPG
 - 3. CARBOLINE
 - 4. Sherwin-Williams
 - 5. International Paints (Akzo Nobel)

PART 3 – EXECUTION

3.01 SHOP PAINTING

- A. Shop prime fabricated steel and equipment with at least one shop coat of prime paint compatible with finish paint system specified. Prepare surface to be shop painted in strict accordance with paint manufacturer's recommendations and as specified. Finish coats may be shop applied, if approved by the Engineer. Package, store and protect shop painted items until they are incorporated into Work. Repair painted surfaces damaged during handling, transporting, storage, or installation to provide a painting system equal to the original painting received at the shop.
- B. Identify surface preparation and shop paints on Shop Drawings. Verify compatibility with field applied paints.
- C. Coordinate shop painting and field coating to ensure item is delivered and field coating occurs within recoat window of shop painted system requirements.

3.02 SURFACE PREPARATION

- A. General
 - 1. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale, and foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless approved by the Engineer.
 - 2. Protect or remove, during painting operations, hardware, accessories, machined surfaces, nameplates, lighting fixtures, and similar items not intended to be painted prior to cleaning and painting. Reposition items removed upon completion of painting operations.
 - 3. Examine surfaces to be coated to determine that surfaces are suitable for specified surface preparation and painting. Report to Engineer surfaces found to be unsuitable in writing. Do not start surface preparation until unsuitable surfaces have been corrected. Starting surface preparation precludes subsequent claim that such surfaces were unsuitable for the specified surface preparation or painting.
 - 4. Surface preparation shall be in accordance with specifications and manufacturer's recommendations. Provide additional surface preparation, and fill coats where manufacturer recommends additional surface preparation, in addition to requirements of specification.
 - 5. Touch-up shop or field applied coatings damaged by surface preparation or any other activity, with the same shop or field applied coating; even to the extent of applying an entire coat when required to correct damage prior to application of the next coating. Touchup coats are in addition to the specified applied systems, and not considered a field coat.
 - 6. Protect motors and other equipment during blasting operation to ensure blasting material is not blown into motors or other equipment. Inspect motors and other equipment after

blasting operations and certify that no damage occurred, or where damage occurred, the proper remedial action was taken.

7. Field paint shop painted equipment in compliance with Color Coding and as approved by Engineer.

B. Metal Surface Preparation

1. Prepare all welds to a minimum NACE weld preparation level "C" per NACE Standard SP0178. Provide additional weld preparation where required by the coating manufacturer. Contractor shall provide NACE SP0178 weld mold visual aids on site for evaluation of all weld preparation.
2. Conform to current The Society for Protective Coatings Standards (SSPC) Specifications for metal surface preparation. Use SSPC-Vis-1 pictorial standards or NACE visual standards TM-01-70 or TM-01-75 to determine cleanliness of abrasive blast cleaned steel.
3. Perform blast cleaning operations for metal when following conditions exist:
 - a. Moisture is not present on the surface.
 - b. Relative humidity is below 80%.
 - c. Ambient and surface temperatures are 5°F or greater than the dew point temperature.
 - d. Painting or drying of paint is not being performed in the area.
 - e. Equipment is in good operating condition.
 - f. Proper ventilation, illumination, and other safety procedures and equipment are being provided and followed.
4. Abrasive blast ferrous metals to be shop primed, or component mechanical equipment in accordance with SSPC-SP5, White Metal Blast.
5. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP10, Near White Metal Blast, where metal is to be submerged, in a corrosive environment, or in severe service. Provide a 3.0 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.
6. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP6 Commercial Blast, where metal is to be used in mild or moderate service, or non-corrosive environment or weathering exposure. Provide a 1.5 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.
7. Clean nonferrous metals, copper, or galvanized metal surfaces in accordance to SSPC-SP1, Solvent Cleaning, or give one coat of metal passivator or metal conditioner compatible with the complete paint system. Galvanized metal shall be prepared in accordance with

SSPC SP-16. Abrasive blast clean to increase mechanical adhesion in accordance with ASTM D6386, Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting when required by coating manufacturer. Provide a 1.5 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.

8. Abrasive blast clean internal and external ductile iron pipe surfaces prior to coating in accordance with NAPF 500-03-04, Surface Preparations Standard for Abrasive Blast Cleaning of Ductile Iron Pipe. Abrasive blast clean internal and external cast ductile iron and cast-iron fitting surfaces in accordance with NAPF-03-05.
9. Prime cleaned metals immediately after cleaning to prevent rusting.
10. Clean rusted metals down to bright metal by abrasive blasting and immediately field primed.

C. Concrete Surface Preparation

1. Cure concrete a minimum of 28 days at 75° F before surface preparation, and painting begins. Allow more time at lower temperatures if specified by paint manufacturer.
2. Test concrete for pH and salts using test methods recommended by the paint manufacturer. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer. Do not begin surface preparation, or painting until acceptable to manufacturer.
3. Moisture content of concrete and masonry surfaces shall conform to manufacturer's recommended limits, and as listed in SSPC-SP13/NACE 6 Section 6 Acceptance Criteria Table 1. Floor surfaces to be coated shall be tested in accordance with ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride or as required by the coating manufacturer. Moisture vapor transmission shall not exceed three pounds per 1,000 square feet in a 24-hour period or less if specified by Coating Manufacturer. Vertical and horizontal overhead surfaces shall be tested in accordance with ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete using in situ Probes (relative humidity shall not exceed 80% or as required by the coating manufacturer) or with ASTM D4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Test Method (test results shall be no moisture present). Engineer or Coating Manufacturer Representative shall specify all test locations. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer.
4. Prepare concrete surfaces to receive coatings in accordance with NACE 6/SSPC-13 – Joint Surface Preparation Standards and ICRI Technical Guidelines. Remove contaminants, open bugholes, surface voids, air pockets, and other subsurface irregularities using abrasive blasting, shot blasting, water jetting or mechanical abrading. Use dry, oil-free air for blasting operations. Surface texture after blasting shall achieve profile as required by manufacturer or where not defined by manufacturer, profile shall be a minimum ICRI-CSP

5 surface profile. Remove residual abrasives, dust, and loose particles by vacuuming or other approved method.

5. Surface defects, such as hollow areas, bugholes, honeycombs, and voids shall be filled with polymeric or waterborne epoxy cementitious filler compatible with painting system. Complete fill coats may be used in addition to specified painting system and as approved by the Engineer. Fins, form marks, and all protrusions or rough edges shall be removed.
6. Repair existing concrete surfaces which are deteriorated to the point that surface preparation exposes aggregate with fill coats or patching mortar as recommended by paint manufacturer and as directed by the Engineer.
7. Clean concrete of all dust, form oils, curing compounds, oil, tar, laitance, efflorescence, loose mortar, and other foreign materials before paints are applied.
8. To ease coating around outside corners, provide $\frac{3}{4}$ -inch chamfered edges on all new concrete outside corners and grind existing concrete outside corners to a minimum radius of $\frac{3}{4}$ -inch.
9. Unless recommended otherwise by the coating manufacturer, provide $\frac{1}{4}$ " deep by $\frac{1}{4}$ " wide tool cut terminations at 1-inch maximum from all coating edges for anchorage. Provide terminations around all equipment, piping, openings, gates, top and bottom of walls, stop locations of each day's work and overlap onto previously completed work. Transition coating 3-inches onto interior lining of piping except where coating compatibility concerns are noted by coating manufacturer.
10. Apply epoxy or polymeric filler compatible with painting system to all inside corners of areas to be coated with a margin trowel to form a continuous 45-degree cant cove across corners with a minimum dimension of 1.5-inch. Roughen or prepare cured filler as recommended by coating manufacturer for proper coating adhesion.
11. All equipment grouting shall be installed and cured prior to starting coating work. Coating shall be applied over grout up to the edges of all equipment, gates and uninterrupted piping unless specifically noted otherwise.

D. Wood

1. Clean wood surfaces free of all foreign matter, with cracks and nail holes and other defects properly filled and smoothed. Remove sap and resin by scraping and wipe clean with rags dampened with mineral spirits.
2. Saturate end grain, cut wood, knots, and pitch pockets with an appropriate sealer before priming.
3. Prime and backprime wood trim before setting in place.
4. After prime coat has dried, fill nailholes, cracks, open joints, and other small holes with approved spackling putty. Lightly sand wood trim prior to applying second coat of paint.

E. Castings

1. Prepare castings for painting by applying a brush or a knife-applied filler. Fillers are not to be used to conceal cracks, gasholes, or excessive porosity.
2. Apply one coat of primer with a minimum thickness of 1.2 mils in addition to coats specified. Allow sufficient drying time before further handling.

F. Masonry

1. Cure for a minimum of 30 days prior to paint application.
2. Clean masonry surfaces free from all dust, dirt, oil, grease, loose mortar, chalky deposits, efflorescence, and other foreign materials.
3. Test masonry for moisture content. Use test method recommended by paint manufacturer. Do not begin painting until moisture content is acceptable to manufacturer.

G. Gypsum Drywall

1. Sand joint compound with sandpaper to provide a smooth flat surface. Avoid sanding of adjacent drywall paper.
2. Remove dust, dirt, and other contaminants.

H. Previously-Painted Surfaces

1. Totally remove existing paint when: surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.
2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.
3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.
4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.
5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

3.03 APPLICATION OF PAINT

- A. Apply paint by experienced painters with brushes or other applicators approved by the Engineer, and paint manufacturer.
- B. Apply paint without runs, sags, thin spots, or unacceptable marks.
- C. Apply at rate specified by the manufacturer to achieve at least the minimum dry mil thickness specified. Apply additional coats, if necessary, to obtain thickness.
- D. Special attention shall be given to nuts, bolts, edges, angles, flanges, welds, etc., where insufficient film thicknesses are likely. Stripe paint outside corners and edges in accordance with SSPC PA Guide 11. Stripe painting shall be in addition to coats specified.
- E. Perform thinning in strict accordance with the manufacturer's instructions, and with the full knowledge and approval of the Engineer and paint manufacturer.
- F. Allow paint to dry a minimum of twenty-four hours between application of any two coats of paint on a particular surface, unless shorter time periods are a requirement by the manufacturer. Longer drying times may be required for abnormal conditions as defined by the Engineer and paint manufacturer. Do not exceed manufacturer's recommended drying time between coats.
- G. Suspend painting when any of the following conditions exist:
 - 1. Rainy or excessively damp weather.
 - 2. Relative humidity exceeds 85%.
 - 3. General air temperature cannot be maintained at 50°F or above through the drying period, except on approval by the Engineer and paint manufacturer.
 - 4. Relative humidity will exceed 85% or air temperature will drop below 40°F within 18 hours after application of paint.
 - 5. Surface temperature of item is within 5 degrees of dewpoint.
 - 6. Dew or moisture condensation are anticipated.
 - 7. Surface temperature exceeds the manufacturer's recommendations.
- H. Where application of coating across concrete control joints or expansion joints has the potential to crack, turn coating into joints and caulk joints with a sealant compatible with coating rated for the intended service per Section 07900 – Joint Fillers, Sealants, Caulking.

3.04 INSPECTION

- A. Each field coat of paint will be inspected and approved by the Engineer or his authorized representative before succeeding coat is applied. Tint successive coats so that no two coats for a

given surface are exactly the same color. Tick-mark surfaces to receive black paint in white between coats.

- B. Use magnetic dry film thickness gauges and wet film thickness gauges for quality control. Furnish magnetic dry film thickness gauge for use by the Engineer.
- C. Coatings shall pass a holiday detector test.
- D. Determination of Film Thickness: Randomly selected areas, each of at least 107.5 contiguous square feet, totaling at least 5% of the entire control area shall be tested. Within this area, at least 5 squares, each of 7.75 square inches, shall be randomly selected. Three readings shall be taken in each square, from which the mean film thickness shall be calculated. No more than 20 percent of the mean film thickness measurements shall be below the specified thickness. No single measurement shall be below 80 percent of the specified film thickness. Total dry film thickness greater than twice the specified film thickness shall not be acceptable. Areas where the measured dry film thickness exceeds twice that specified shall be completely redone unless otherwise approved by the Engineer. When measured dry film thickness is less than that specified additional coats shall be applied as required.
- E. Holiday Testing: Holiday test painted ferrous metal surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Mark areas which contain holidays. Repair or repaint in accordance with paint manufacturer's printed instructions and retest.
 - 1. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
 - 2. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog, shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flow, shall be added to the water prior to wetting the detector sponge.
- F. Paint manufacturer's NACE certified representative shall provide their services as required by the ENGINEER. Services shall include, but not be limited to, inspecting existing paint, determination of best means of surface preparation, inspection of completed work, and final inspection of painted work 23 months after the job is completed.

3.05 PROTECTION OF ADJACENT PAINT AND FINISHED SURFACES

- A. Use covers, masking tape, other method when protection is necessary, or requested by Owner or Engineer. Remove unwanted paint carefully without damage to finished paint or surface. If damage does occur, repair the entire surface adjacent to and including the damaged area without visible lapmarks and without additional cost to the Owner.

- B. Take all necessary precautions to contain dispersion of abrasive blasting debris and paint to the limits of the work. Take into account the effect of wind and other factors which may cause dispersion of the abrasive blasting debris and paint. Suspend painting operations when abrasive blasting debris or paint cannot be properly confined. Assume all responsibilities and cost associated with damage to adjacent structures, vehicles, or surfaces caused by the surface preparation and painting operations.

3.06 PIPING AND EQUIPMENT IDENTIFICATION

- A. Piping and equipment identification shall be in accordance with Section 09902 – Field Painting.

3.07 SCHEDULE OF COLORS

- A. Match colors indicated. Piping and equipment colors are indicated in Section 09902 – Field Painting. Colors which are not indicated shall be selected from the manufacturer's full range of colors by the Engineer. No variation shall be made in colors without the Engineer's approval. Color names and numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

3.08 WORK IN CONFINED SPACES

- A. Provide and maintain safe working conditions for all employees. Supply fresh air continuously to confined spaces through the combined use of existing openings, forceddraft fans and temporary ducts to the outside, or direct air supply to individual workers. Exhaust paint fumes to the outside from the lowest level in the contained space. Provide explosionproof electrical fans, if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done. Follow OSHA, state/commonwealth, and local regulations at all times.

3.09 OSHA SAFETY COLORS

- A. Paint wall around wall-mounted breathing or fire apparatus with the appropriate safety red color; area not to exceed 2 feet wide by 3 feet high, unless apparatus covers the area. Fire apparatus include fire hoses, extinguisher, and hydrants.
- B. Paint hazardous areas and objects in accordance with OSHA regulations.

3.10 VOC REGULATIONS

- A. Provide paint systems in accordance with local, state, and federal regulations. Where paint systems shown in schedule do not comply, substitute equal products with VOC limits which comply with local, state, and federal regulations.

Table 1: Painting Schedule

Surface	Application	Painting System and No. of Coats	Product Reference (Table 2)	Total Min. Dry Film Thickness (Mils)
Concrete and Masonry				
Interior masonry and concrete walls and ceilings	All new structures	1 coat sealer 2 coats acrylic epoxy	101 116	75-85 sq.ft./gal. 4-6/coat
Interior masonry and concrete walls in chemical rooms		1 coat sealer 2 coats epoxy polyamide	117 102	60-80 sq.ft./gal. 4-6/coat
Submerged water	Water retaining side of new wall surfaces where opposite side of wall is interior and dry and where indicated "epoxy waterproofing" on drawing	2 coats NSF approved epoxy polyamide Provide filler as required and recommended by manufacturer	105	4-6/coat
Submerged wastewater		2 coats high solids epoxy Provide filler as required and recommended by manufacturer	119	6-10/coat
Containment Liner ¹	Interior and exterior secondary containment floors, tank supports and walls	2 coats high solids epoxy coating	119	6-10/coat
Metals				
Interior and exterior nonsubmerged (gloss)	All new blowers, pumps, motors and mechanical equipment, piping, etc.	1 coat epoxy polyamide primer 1 coat epoxy polyamide 1 coat aliphatic polyurethane	104 102 115	4-6 4-6 3-5
Interior insulated		1 coat acrylic latex	103	4
Submerged water	All metal piping, and mechanical equipment, etc.	2 coats NSF approved epoxy polyamide	105	4-6/coat
Submerged Wastewater		2 coats high solids epoxy	119	8-10/coat
Steel doors, windows and door frames, steel stairs, monorails, structural steel, misc. metals (steel), galvanized lintels,		1 coat epoxy polyamide 1 coat aliphatic polyurethane	102 115	5-8 3-4
Aluminum surfaces in contact with concrete		2 coats coal tar	107	26
Shop Primed Structural Steel	Pre-Engineered Buildings, Polymer Day Tank Platform	1 tie coat 1 coat epoxy 1 coat epoxy	113 114 120	2-3 3-4 3-4

¹ Painting manufacturer shall verify compatibility of containment liner and chemical to be contained. Where incompatible substitute a compatible coating system.

~~Olivenhain Municipal Water District~~

David C. McCollom Water Treatment Plant Stage 4 Upgrades

Ref.	System	Purpose	For Construction Product			
			Tnemec Series	PPG/AMERON	CARBOLINE	Sherwin-Williams
101	Acrylic filler	Primer-sealer	130-6601	BLOXFIL 4000	Sanitile 100	Cement-Plex 875
102	Epoxy polyamide	Finish coat semi-gloss or gloss	N69	AMERLOCK 2	Carboguard 890	Macropoxy 646
103	Acrylic latex	Sealer	1028/1029	PITT TECH PLUS	Carbocrylic 3359DTM	DTM Acrylic Primer/Finish
104	Epoxy Polyamide – metal	Primer	66	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
105	Epoxy polyamide	Primer/Finish	N140	AMERLOCK 2	Carboguard 61/891VOC	Macropoxy 646 PW
106	Coal tar epoxy	Finish high-coat build	46H-413	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
107	Coal tar	Sealer	46-465	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
108	Alkyd-medium oil	Finish coat	2H	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
109	Alkyd-long oil	Finish coat	1029	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
110	Epoxy polyamide	Primer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
112	Epoxy polyamide	Sealer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 920 Pre-Prime
113	Urethane	Barrier coat	530	AMERLOCK SEALER	Rustbond	-
114	Polyamine Epoxy	Intermediate coat	27	AMERLOCK 385	Carboguard 893SG	-
115	Aliphatic Polyurethane	Finish coat	1094 or 1095	AMERCOAT 450 HS	Carbothane 134HG	Acrolon 218HS
116	Acrylic epoxy	Finish coat	113 or 114	AQUAPON WB	Sanitile 255	Water-Based Catalyzed Epoxy
117	Epoxy block filler	Sealer	1254	AMERLOCK 114	Sanitile 500	Kem Cati-Coat HS Epoxy Filler
118	Catalyzed epoxy	Finish coat	84	AMERLOCK 2/400	Carboguard 890	Macropoxy 646
119	High solids epoxy	Finish coat	104	AMERLOCK 400	Carboguard 890	Dura-Plate 235
120	Epoxy	Top coat	N69	AMERLOCK 2/400	Carboguard 890	-

Table 2: Product Listing

END OF SECTION

SECTION 09902

FIELD PAINTING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all materials, labor, equipment and incidentals required and perform all the painting necessary to complete this Contract in its entirety as indicated on the Drawings and specified herein.
- B. It is the intent of this Section to paint all exposed structural and miscellaneous steel; steel doors; steel frames for door and glazed openings, door closers and surface sound/weather seals; chemical tanks and systems; mechanical and electrical equipment; operators and posts; conveying systems, pipe, fittings and valves; electrical conduit and appurtenances; concrete and metal deck ceilings; ducts where scheduled; all as specified in the attached painting schedules and all other work obviously required to be painted unless otherwise specified. Minor items not mentioned in the schedule of work shall be included in the work of this Section where they come within the general intent of this Section as stated herein.
- C. Aluminum paint only where noted (as is specified). Paint items so noted in Paragraph 1.01B and in accordance with the Paint Color Schedule. Provide vinyl film letters and numbers for markings as specified. Items noted in Paint Color Schedule as having factory finish and other factory finished items obviously are not field painted. The CONTRACTOR is responsible for having damaged factory finish painted items repaired or, if so ordered, for replacing items. The various Sections are responsible, as stated in each, for preparation and field touch-up of abrasions, welds and damaged primed areas of primed or galvanized components after erection.
- D. The work will be performed at an existing operating facility. It will be necessary that contaminants, including dust from abrasive blasting, solvents, thinners, paints, etc., shall be kept from the treatment process and from the existing operating equipment, motors, valves, etc. The CONTRACTOR shall take whatever precautions are necessary to prevent contamination of the water supply at all times during this contract.
- E. The work includes surface preparation and repainting the components of existing buildings indicated on the Drawings and specified herein. Such components include, but are not limited to: all piping, doors and frames, louvers and frames, roof fans, CMU and GWB wall assemblies.
 - 1. Prior to bidding, the CONTRACTOR shall field survey the existing conditions to identify full scale and scope of repainting work. Existing paint/coatings are present and all surfaces must be appropriately prepared as recommended by the Manufacturer for proper adhesion and performance of the new paint systems.
- F. The following items will not be painted:
 - 1. Concrete (unless otherwise specified in the painting or finish schedules), seamless flooring and tile work.
 - 2. Exterior masonry.
 - 3. Finish hardware unless specifically noted otherwise.

4. Acoustical treatment and fireproofing.
5. Portland cement plaster work.
6. Stainless steel and non-ferrous metals, unless specifically noted otherwise.
7. Factory prefinished architectural components.
8. Packing glands and other adjustable parts and name plates of mechanical equipment.
9. Parts of buildings not exposed to sight, unless specifically noted otherwise.
10. Furniture and casework.
11. Maintenance equipment.
12. Plumbing fixtures.
13. Fencing
14. Copper tubing, red brass piping and PVC piping except where such piping occurs in rooms where the walls are painted, or required for color coding.
15. Electrical fixtures except for factory coatings.
16. Buried pipe unless specifically required in the piping specifications.
17. Cement mortar coated pipe and fittings
18. Fiberglass items.
19. Aluminum handrails, stairs and grating, unless in contact with concrete.
20. Mechanical and electrical equipment which has been finished painted in the factory as specified in Divisions 11, 13, 15 and 16.

1.02 RELATED WORK

- A. Shop priming and surface preparation of equipment and piping (except copper piping) are specified in Section 09901 and included in the respective Section with the item to be primed.

1.03 SUBMITTALS

- A. Submit to the ENGINEER, in accordance with Section 01300, the following:
 1. Color cards for initial color selections.
 2. Three sets of 8-inch by 8-inch samples, on 1/4-inch hardboard, of all colors required for all types of paint. Include special colors as required. Resubmit until approved.

1.04 REFERENCE STANDARDS

- A. Steel Structures Painting Council (SSPC)
 - 1. SSPC SP-1 - Surface Preparation Specification No. 1 Solvent Cleaning
 - 2. SSPC SP-2 - Surface Preparation Specification No. 2 Hand Tool Cleaning
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 MANUFACTURER REPRESENTATIVE

- A. The CONTRACTOR shall require the protective coating manufacturer to furnish a qualified technical representative to visit the project site for technical support as required and ordered and as may be necessary to resolve field problems attributable to or associated with the Manufacturer's products furnished under this Contract or the application thereof.

1.06 PRE-PAINTING CONFERENCE

- A. Well in advance of commencement of painting operations, but after major equipment has been delivered, a pre-painting conference shall be held. All parties with an interest in the painting work shall attend, including the CONTRACTOR, the Manufacturer, the OWNER, the ENGINEER and the paint subcontractor. The CONTRACTOR shall contact each party and arrange the meeting.
- B. The conference shall include an inspection of the areas to be painted by all parties and discussion of the conformance of each area with the specifications. Important issues such as environmental conditions, climate control systems, original primer, dry film thickness and monitoring the number of coats that have been field applied shall be discussed and problems shall be resolved.
- C. A written record of the meeting shall be submitted to the ENGINEER.

1.07 WARRANTY INSPECTION

- A. A warranty inspection may be conducted during the twenty third month following completion of all coating and painting work. The CONTRACTOR, painting subcontractor and a representative of the coating material manufacturer shall attend this inspection with the OWNER.
- B. All defective work shall be repaired in accordance with these specifications and to the satisfaction of the OWNER. The OWNER may, by written notice to the CONTRACTOR, reschedule the warranty inspection to another date within the two year correction period or may cancel the warranty inspection altogether. If a warranty inspection is not held, the CONTRACTOR is not relieved of his responsibilities under the Contract Documents.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All painting materials shall be by the Tnemec Company, Inc.; equals by and, where scheduled, NSF Standard 61 certified equals by Ameron (VyGuard); DuPont or equal. The painting schedule has been prepared on the basis of Tnemec products (unless otherwise noted) and

Tnemec recommendations for application. No brand other than those named will be considered for approval unless the brand and type of paint proposed for each item in the following schedule together with sufficient data substantiated by certified tests conducted at no expense to the OWNER, to demonstrate its equality to the paint(s) named is submitted to the ENGINEER in writing for approval within 30 days after given the Notice to Proceed. The type and number of tests performed shall be subject to the ENGINEER's approval.

- B. All painting materials shall be delivered to the mixing room in unbroken packages, bearing the manufacturer's brand and name. They shall be used without adulteration and mixed, thinned and applied in strict accordance with manufacturer's directions for the applicable materials and surface and with the ENGINEER's approval before using.
- C. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touchup painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.
- D. Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with the finish paints to be used. Refer to Section 09900 for special primers.
- E. No paint containing lead will be allowed.
- F. Work areas for the storage and mixing of all painting materials shall be designated by the ENGINEER and approved by the OWNER.
 - 1. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations.
 - 2. CONTRACTOR shall provide the trailer and containers necessary to store and mix the paint away from the Sludge Dewatering Facility. Separate trash containers shall be provided for the proper disposal of unused painting related materials.
 - 3. Proper containers outside of the buildings shall be provided and used for painting wastes and no plumbing fixture shall be used for this purpose.

2.02 COLOR CODING FOR PIPES AND EQUIPMENT

- A. The Color Schedule establishes, defines and assigns a definite color for each category of pipe.
- B. Banding for pipes shall be as specified in the Color Schedule. Bands shall be minimum 2-inches wide and spaced at ten feet on center.
- C. All exposed conduits, trough items and pipelines for the transport of gases, liquid and semi-liquids including all accessories such as valves, insulated pipe coverings, fittings, junction boxes, bus bars, connectors and all operating accessories which are integral to the whole functional mechanical pipe and electrical conduit system shall be painted with the colors and/or combination of colors as noted in the Color Schedule.
- D. All hangars and pipe support floor stands shall be painted the same color and with the same paint as the pipe it supports. The system shall be painted up to the flanges attached to the mechanical

equipment. Do not paint the flexible conduit connected to electrical motors. When more than one pipe system is supported on the same bracket, the bracket shall be painted the same color as the adjacent wall or ceiling. Colors shall be as noted in the Color Schedule.

- E. All systems which are an integral part of the equipment, that is originating from the equipment and returning to the same piece of equipment, shall be painted between and up to the fixed flanges or connections on the equipment.
- F. General Notes and Guidelines
1. All color numbers and names herein refer to master color card. Colors of specified equal Manufacturers may be substituted with approval of the ENGINEER.
 2. Pipe lines, equipment, or other items which are not listed here, shall be assigned a color by the ENGINEER and shall be treated as an integral part of the Contract.
 3. The colors of the Color Schedule shall be interpreted as follows:

<u>Colors</u>	<u>Tnemec #</u>
White	AA90
Orange	SC03
Yellow	BW56 [SC02]
Dark Yellow	BX36
Green	SC07
Light Green	AM52
Dark Brown	AF12
Dark Green	---
Tan	23BR
Ivory	AF82
Light Grey	BG62
Medium Grey	2047
Dark Grey	BK33
Red	SC09
Blue	SC06
Dark Blue	2042
Medium Blue	2041
Light Blue	26BL
Aqua	AX42
International Orange	SC04
Dark Bronze	BM07
Tank Blue	BB42
Blue Green	AX22
Magenta	BP14

4. All moving parts, drive assemblies and covers for moving parts, which are potential hazards, shall be Safety Orange #CA26.
5. All safety equipment shall be painted in accordance with OSHA standards.
6. All inline equipment and appurtenances not assigned another color, including pumps and motors, shall be painted the same base color as the piping. The pipe system shall be

painted with the pipe color up to the flanges attached to pumps and mechanical equipment assigned another color. Tanks shall be painted the color of the piping system that they serve, unless the tank is fiberglass and levels are monitored through the tank.

2.03 COLOR SCHEDULE

- A. Color selection for the following items are to be selected by the ENGINEER and reviewed by the OWNER at the time of shop drawing review. The color coding, banding and lettering schedule shall conform to the most current standards of the Boonsboro Advanced Wastewater Treatment Facility. The CONTRACTOR shall submit color charts for color selections to be approved by the OWNER.

<u>Piping and Legend</u>	<u>Pipe/Band Color</u>	<u>Letters</u>
Compressed Air	Light Green	Black
Low Pressure Air (air wash supply)	Light Green	Black
Instrument Air	Light Green/Dark Green	Black
High Purity Air	Light Green/Dark Green	White
Combustion Air	Dark Green	White
Blower Air	Green/Orange	Black
Filtrate	Dark Grey/Red	White
Drains	Dark Grey	White
Acid Drains	Black/Yellow	White
Plant Influent [water]	Medium Blue	
Plant Effluent [water]	Blue	
Foam Spray Water	Light Grey/Orange	Black
Aeration Basin Influent	Light Grey/Red	Black
Plant Water	Blue/Light Grey	White
Protected Water	Blue/Green	
Potable Cold Water	Light Blue	Black
Potable Hot Water	Light Blue	Black
Nonpotable Water (lines downstream from backflow preventers)	Dark Blue/White	Red
Seal Water (lines downstream from an air gap repump system)	Dark Blue/Red	White
Softened Water	Blue/White	
Heating Water	Medium Blue/Red	
Drain	Dark Grey	White
Odor Control	Dark Green/Light Brown	White
Recycle or Raw Water	Light Blue/Red	Black
Distilled Water	Light Blue/White	Black
Sprinkler (fire protection water)	Red	Black
Fuel Oil	Black	White
Hydraulic Oil	Black/White	White

<u>Piping and Legend</u>	<u>Pipe/Band Color</u>	<u>Letters</u>
Gas	Red/Black	White
LP Gas	Red/Black	White
Hydrocarbons	Black	White
Process Sample	Light Grey/Green	Black
Residuals	Light Brown	White
Filtrate	Dark Grey/Red	White
Laboratory Vacuum	Dark Green/Light Green	Red
Vacuum Pump Discharge	Aluminum	Black
Steam	International Orange/Red	
Acid	Dark Yellow/Red	Black
Hydro-Fluorosilicic Acid	Yellow/Blue	Black
Sodium Hydroxide	Orange/Grey	Black
Aluminum Sulfate	Tank Blue/Orange	
Potassium Permanganate	Orange/White	Black
Zinc Orthophosphate	Magenta/Yellow	
Sodium Hypochlorite	Yellow/Dark Yellow	
Aqua Ammonia	Yellow/Brown	Black
Ammonia Vapor	Yellow/Brown	Black
Acetelyene	Red/Blue	Black
Chlorine (gas, liquid or vent)	Yellow	Black
Sulfur Dioxide Gas	Yellow/Blue	
Chlorine Solution	Yellow/Red	Black
Sulfur Dioxide Solution	Yellow/Blue	
Ferric Chloride	Orange/Blue	
Ferric Sulfate	Orange	
Polymer	Light Brown/Red	White
Polyphosphate	Light Brown/Grey	White
Potassium Permanganate	Orange/White	Black
Lime Slurry	Light Green	
Soda Ash Solution	Dark Grey/Green	White
Oxygen	Red/Green	Black
Carbon Dioxide	Tank Blue/Yellow	
Hydrogen	Red/White	Black
Liquid Alum	Yellow/Orange	Black
Helium	Red/Orange	Black
Argon	Red/Brown	Black
Nitrogen	Red/Yellow	Black
Nitrous Oxide	Red/Grey	Black
Electrical Conduit	Light Green	

Piping and Legend

Conduit Connections
Mounting Backstops
Centrate
Sludge
Polymer

Pipe/Band Color

Light Green
Light Green
Light Blue
Tan
White

Building and Architectural Components

Colors shall be as indicated in the Finish Schedule, selected by the ENGINEER and approved by the OWNER.

2.04 LETTERING OF TITLES

- A. The name of the materials in each pipeline and alongside this an arrow indicating the direction of flow of fluids, shall be indicated on each pipe system. Titles shall not be located more than 26 linear feet apart and shall also appear directly adjacent to each side of any wall the pipeline breaches, adjacent to each side of the valve regulator, flowcheck, strainer cleanout and all pieces of equipment.
- B. Titles shall identify the contents by complete name at least once in each space through which it passes and thereafter by generally recognized abbreviations, letters or numerals as approved. Identification title locations shall be determined by the ENGINEER but in general they shall be placed where the view is unobstructed and on the two lower quarters of pipe or covering where they are overhead. Title should be clearly visible from operating positions especially those adjacent to control valves.
- C. Numbers and letters shall be die-cut from 3.5 mil vinyl film and prespaced on carrier tape. Adhesive and finish surface shall be protected with one piece removable liners. Color shall be white or black as approved depending on substrate color.
- D. Letter size shall be as indicated in the following table:

<u>OUTSIDE DIAMETER OF PIPE OR COVERING</u>	<u>SIZE OF LEGEND LETTERS</u>
3/4-in to 1-1/4-in	1/2-in
1-1/2-in to 2-in	3/4-in
2-1/2-in to 6-in	1-1/2-in
8-in to 10-in	2-1/2-in
Over 10-in	3-in

- E. The system for preparation and application of letters shall be Type B a.s.i/2 by ASI Sign Systems; Architectural Graphics Inc. or equal. Letter type shall be Optima Bold, upper case. Grid 2 spacing shall be employed. Arrow shall match as approved, letter type and size. The instructions of the manufacturer shall be followed in respect to storage, surface preparation and applications of letters.
- F. Bands of color, where scheduled, shall be 6-inches wide and spaced along pipe at 5-feet intervals.

2.05 TITLES FOR EQUIPMENT

- A. Titles indicated in attached schedules shall be provided in vinyl film as specified above on all equipment using 1-inch high Optima Bold upper case, Grid 2 spacing, white or black in color as approved depending on substrate. Titles shall be mounted at eye level on machines where possible or at the upper most broad vertical surface of low equipment. Where more than one piece of the equipment item to be titled exists, the items shall be numbered consecutively as indicated on the mechanical drawings or as directed by the ENGINEER; for example Pump No. 1, Pump No. 2, etc. Titles shall be composed in more than one line if required and justified on the left hand side as approved.

2.06 EXTRA PAINT

- A. Furnish one unopened gallon can for each type and each color of paint used.

2.07 TESTING EQUIPMENT

- A. Furnish to the ENGINEER for use on the Project for paint inspection, wet and dry film thickness gauges, digital temperature reading device and all other equipment required by the ENGINEER for inspection. All testing equipment shall become the property of the OWNER once construction has been completed.

PART 3 EXECUTION

3.01 PREPARATION OF SURFACES

- A. All surfaces to be painted shall be prepared as specified herein and shall be dry and clean before painting. Special care shall be given to thoroughly clean interior concrete and CMU surfaces to receive polyamide cured epoxy paint of all marks before application of finish.
- B. Remove oil and grease from metal surfaces in accordance with SSPC-SP 1. Use clean cloths and cleaning solvents and wipe dry with clean cloths. Do not leave a film or greasy residue on the cleaned surfaces before sandblasting.
- C. All metal welds, blisters, etc, shall be ground and sanded smooth. All pits and dents shall be filled and all imperfections shall be corrected so as to provide a smooth surface for painting. All rust, loose scale, oil, tar and asphalt bearing coatings, grease and dirt shall be removed by use of approved solvents, wire brushing, grinding or sanding.
- D. Remove weld spatter and weld slag from metal surfaces and grind smoothly rough welds, beads, peaked corners, and sharp edges in accordance with SSPC SP-2 and SSPC SP- 3. Grind 0.02 inch (minimum) off the weld caps on pipe weld seams. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of ¼ inch.
- E. Neutralize welds with a chemical solvent that is compatible with the specified coating materials. Use clean cloths and chemical solvent. Wipe dry with clean cloths. Do not leave a residue on the cleaned surfaces.
- F. Do not abrasive blast or prepare more surface area than can be coated in one day. Remove all sharp edges, burrs, and weld spatter. Do not abrasive blast PVC, CPVC, or FRP piping or equipment. Do not abrasive blast epoxy, enamel coated, or fusion-bonded epoxy pipe that has already been factory coated, except to repair scratched or damaged coatings. Concrete surfaces shall have been finished as specified in Section 03350. Report unsatisfactory surfaces to the ENGINEER. Concrete shall be left for one month minimum before painting and shall be free of dust, oil, curing compounds and other foreign matter.

- G. Concrete masonry unit surfaces shall be smooth and cleaned of all dust, loose mortar, excess joint compound and other foreign matter.
- H. Submerged concrete surfaces and those subject to splashing, scheduled to be painted and for tank coating system and chemical fill station containment, shall be brush sandblasted to open void spaces and bug holes with resultant finish being a uniform profile equal to 80 grit sandpaper.
- I. All PVC pipe and other plastic matrix surfaces to be painted shall be lightly sanded and cleaned of residue before painting.
- J. Wood surfaces shall be dry. All encrustations shall be removed. Sand wood to obtain a smooth surface.
- K. Galvanized (except metal deck surfaces), aluminum, and copper surfaces shall have all oxidation and foreign material removed before painting by SSPC SP-1, using an approved V.O.C. compliant method. Galvanized and, when ordered, the other metal surfaces specified above shall be hand tool cleaned to SSPC SP-2 standards to provide a uniform 1 mil surface profile.
- L. Galvanized steel deck below mezzanine floor shall have oxidation, oils and foreign materials removed and surfaces given a uniform profile without compromising the galvanized coatings. Use SSPC SP1 and SP7 methods as submitted and approved.

3.02 PAINTING SCHEDULE

- A. All colors will be selected by the ENGINEER based on the Color Schedule herein.
- B. The following types of paints by Tnemec Co. have been used as a basis for the paint schedule:
 - 1. Hi-build Epoxoline (Series 66) - polyamide cured epoxy.
 - 2. Potapox (Series 20) (FC - fast cure where scheduled) - polyamide cured epoxy (NSF Standard 61 certified for contact with water being treated).
 - 3. Envirofil (No. 130-6602 off-white color) - waterborne cementitious acrylic.
 - 4. Endura-Shield III - semi-gloss (Series 73) - high-build acrylic polyurethane enamel.
 - 5. Silicone Aluminum (No. 39-661) - high heat silicone aluminum (to 600 degrees F).
 - 6. PVA Sealer (No. 51-792) - vinyl acrylic primer.
 - 7. FC Typoxy (Series N27) - tie coat, low VOC, polyamide epoxy.
 - 8. Vinester (Series 120) - vinyl ester.
 - 9. Tneme-Cryl (Series 6) - acrylic latex emulsion, eggshell finish.
 - 10. PPG Industries Rez Polyurethane Satin Clear Plastic Interior Varnish 77-89 - Urethane - alkyd, clear, satin sheen with approved Rez alkyd-oil stain under.

- C. The following surfaces shall have the types of paint scheduled below applied at the dry film thickness (DFT) in mils per coat noted:
1. Exterior non submerged ferrous metals.
1 coat Series 66-1211 on properly prepared unprimed metal or for touch-up (2.0-3.0 DFT)
1 coat Series 66 (4.0 DFT), 1 coat Series 73 (3.0 DFT)
 2. Interior non-submerged concrete scheduled for painting.
2 coats Series 66 (5.0 DFT)
 3. Interior concrete masonry units
1 coat No. 130-6602 (80 sq ft/gal minimum scrub-in to fill voids as approved)
2 coats Series 66 (5.0 DFT)
 4. Interior non-submerged ferrous metals
1 coat Series 66-1211 on properly prepared, unprimed metal or for touch-up (2.0-3.0 DFT)
2 coats Series 66 (3.0 DFT)
 5. Submerged ferrous metals and ferrous metals subject to submersion or splashing. Surface shall be lightly sanded or abraded before application of first field coat.
1 coat Series 20 on properly prepared, unprimed metal or for touch-up (2.0-3.0 DFT)
2 coats Series 20 (6.0 DFT)
 6. Plastic piping and, where scheduled to be painted, plastic components
2 coats Series 66 (3.0 DFT)
 7. Galvanized deck requiring painting and galvanized metals.

Interior
2 coats Series 66 (3.0 DFT)

Exterior
1 coat Series 66 (4.0 DFT), 1 coat Series 73 (3.0 DFT)
 8. Pipe insulation
1 coat No. 51-792 (Vinyl-Acrylic Sealer - 1.0 DFT), 2 coats Series 66 (3.0 DFT)
(Plastic or metal sheathed insulation-paint as scheduled for appropriate substrate)
 9. Aluminum designated to be painted.

Interior
2 coats Series 66 (3.0 DFT)

Exterior
1 coat Series 66 (4.0 DFT), 1 coat Series 73 (3.0 DFT)
 10. Copper piping
2 coats Series 66 (3.0 DFT)
 11. Hot ferrous metal surfaces
2 coats Series 39-661 (1.5 DFT)

12. Gypsum work
1 coat 51-792 (1.0 DFT)
2 coats Series 6 (3.0 DFT)
13. Wood doors and wood paneling and components - clear finish. Stain to approved color before finish application.
3 coats approved polyurethane varnish, non-gloss satin finish - sand between coats
14. Service Door - factory polyester finish coated. Sand with 150 grit aluminum oxide paper.
1 coat Series 66 (2.0 DFT), 1 coat Series 73 (1.5 DFT)
15. Chemical Resistant Coating on Concrete
Whip blast concrete to a medium sandpaper texture, opening all surface air holes and defects and remove all residue from blasting, all as approved.

1 prime coat Series 120 (12-15 DFT)
2 coats Series 120 (15-18 DFT)

Provide silicone carbide, slip resistant aggregate broadcast in and adhered to top coat - floor surface.
16. Hollow metal-pressed metal work - First coat on substrates prepared as approved and replacing first coat of above-specified systems for ferrous metals. Complete painting with remainder of specified system for substrate.

First coat - Series N27 (5.0 DFT)

D. The following paint colors shall be provided and installed for Architectural work throughout the Administration Building:

1. Paint Color A – Pittsburgh Paints, Number 314-3, Sand Fossil: Main Field Color for Interior Walls (Gypsum Wall Board and CMU)
2. Paint Color B – Pittsburgh Paints, Number 515-4, Moth Gray: Color for Doors only at Interior Door Openings (Hollow Metal and Aluminum)
3. Paint Color C – Pittsburgh Paints, Number 515-6, Patches: Color for Frames only at Interior Door Openings (Hollow Metal and Aluminum)

3.03 WORKMANSHIP

A. General

1. At the request of the ENGINEER, sample areas of the finished work prepared in strict accordance with this Section shall be furnished and all painting shall be equal in quality to the approved sample areas. Finished areas shall be adequate for the purpose of determining the quality of workmanship. Experimentation with factory or paint manufacturer's warehouse mixed colors shall be furnished to the satisfaction of the ENGINEER where standard chart colors are not satisfactory.

2. Protection of furniture and other movable objects, equipment, fittings and accessories shall be provided throughout the painting operation. Canopies of lighting fixtures shall be loosened and removed from contact with surface, covered and protected and reset upon completion. Remove all electric plates, surface hardware, etc, before painting, protect and replace when completed. Mask all machinery name plates and all machined parts not receiving a paint finish. Dripped or spattered paint shall be promptly removed. Lay drop cloths in all areas where painting is being done to adequately protect flooring and other work from all damage during the operation and until the finished job is accepted.
3. On metal surfaces apply each coat of paint at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. One gallon of paint as originally furnished by the manufacturer shall not cover a greater area when applied by spray gun than when applied unthinned by brush. Deficiencies in film thickness shall be corrected by the application of an additional coat(s). On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative finish either by decreasing the coverage rate or by applying additional coats of paint.

B. Field Priming

1. Steel members, metal castings, mechanical and electrical equipment and other metals which are shop primed before delivery at the site will not require a prime coat on the job. All piping and other bare metals to be painted shall receive one coat of primer before exposure to the weather, and this prime coat shall be the first coat as specified in the painting schedule. Surface preparation of bare metal shall be the responsibility of the CONTRACTOR.
2. Equipment which is specified to receive a baked-on enamel finish or other factory finish shall not be field painted unless the finish has been damaged in transit or during installation. Surfaces that have been shop painted and have been damaged, or where the shop coat or coats of paint have deteriorated, shall be properly cleaned and retouched before any successive painting is done on them in the field. All such field painting shall match as nearly as possible the original finish. Preparation and painting shall be provided by the CONTRACTOR.
3. Equipment shipped with a protective shop painting coat or coats shall be touched up to the satisfaction of the ENGINEER with primers as recommended by the manufacturer of the finish paint. Preparation and painting shall be provided by the CONTRACTOR.

C. Field Painting

1. All painting at the site shall be under the strict inspection of the ENGINEER. Only skilled painters and, where dictated by special conditions or systems and so ordered, specialist painters shall be used on the work.
2. All paint shall be at room temperature before applying, and no painting shall be done when the temperature is below 60 degrees F. The temperature of all rooms to be painted shall be maintained at 60 degrees F minimum at all hours of the day and shall include weekends. The rooms shall be completely dry with no traces of moisture on the surfaces to be painted.

The building must be totally enclosed (permanent roof completely installed), weather tight, well ventilated and adequately illuminated in order to begin any painting activities.

3. Successive coats of paint shall be different shades (from paint manufacturer's stock or shop mixed paint) of the required colors so as to make each coat easily distinguishable from each other with the final undercoat the approximate shade of the finished coat to ensure no show-through as approved.
4. Finish surfaces shall not show brush marks or other irregularities. Undercoats shall be thoroughly and uniformly sanded with the type paper appropriate for the undercoats to remove defects and provide a smooth even surface. Top and bottom edges of doors shall be painted.
5. Painting shall be continuous and shall be accomplished in an orderly manner so as to facilitate inspection. Materials subject to weather shall be primed coated as quickly as possible. Surfaces of exposed members that will be inaccessible after erection shall be cleaned and painted before erection.
6. All painting shall be performed by approved methods with number of coats modified as required to obtain the total dry film thickness specified. Spray painting shall be performed specifically by methods submitted and as approved by the ENGINEER.
7. All surfaces to be painted as well as the atmosphere in which painting is to be done shall be kept warm and dry by heating and ventilation, if necessary, until each coat of paint has hardened. Any defective paint shall be scraped off and repainted in accordance with the ENGINEER's directions.
8. Before final acceptance of the work, all damaged surfaces of paint shall be cleaned and repainted as directed by the ENGINEER.
9. Only the aluminum work noted on the Drawings or in the Painting Schedule shall be field painted.

D. Field Touch-up of Shop-Applied Prime Coats

1. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC SP-1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.
2. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces with a broom or brush wetted with a solution of trisodium phosphate, detergent, and water. Before applying intermediate or finish coats to inorganic zinc primers, remove any soluble zinc salts that have formed by means of scrubbing with a stiff bristle brush. Rinse scrubbed surfaces with clean water.
3. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC SP-7. Take care that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.

4. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-10. Take care that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.
5. Use repair procedures on damaged primer which protects adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles, and abrasive particle sizes, short blast nozzle distance from surface, shielding, and/or masking.
6. After abrasive blast cleaning of damaged and defective areas, remove dust, blast particles, and other debris by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.
7. Surfaces that are shop primed with inorganic zinc primers shall receive a field touch-up of organic zinc primer to cover all scratches or abraded areas.
8. Other surfaces that are shop primed shall receive a field touch-up of the same primer used in the original prime coat.

3.04 CLEANUP

- A. At all times keep the premises free from accumulation of waste material and rubbish caused by employees or work. At the completion of the painting, remove all tools, scaffolding, surplus materials and all rubbish from and about the buildings and leave the work "broom clean" unless more exactly specified.
- B. Upon completion, remove all paint where it has been spilled, splashed, or spattered on all surfaces, including floors, fixtures, equipment, furniture, etc, leaving the work ready for inspection.

END OF SECTION

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SECTION 11200

STAINLESS STEEL STORAGE TANKS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The CONTRACTOR shall furnish, deliver, install, test and place in satisfactory operation stainless steel storage tanks for centrate storage, complete with all necessary accessories as specified and/or as shown in the Contract Documents.
 - 1. The CONTRACTOR shall provide cone bottom 316 stainless steel tank and accessories per section 2.02, complete and in place, in accordance with the Contract Documents.
 - 2. Unit Responsibility: The CONTRACTOR shall be responsible for furnishing the cone bottom tank and its accessories as indicated.
- B. Furnish all labor, materials, equipment and incidentals required to remove the existing polyethylene bulk storage tank and install the new cone bottom 316 stainless steel tank, field test, complete and make ready for service, as shown on the Drawings and as specified herein.
 - 1. The CONTRACTOR shall design, furnish and install anchorage of the cone bottom 316 stainless steel tank to the concrete slab.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 1 - General Requirements
- B. Division 5 - Metals
- C. Division 11 - Equipment and General Provision
- D. Division 15 - Mechanical
- E. Division 16 - Electrical

1.03 SUBMITTALS

- A. The CONTRACTOR shall submit complete Shop Drawings, Performance Affidavits, design calculations, and other information as specified in accordance with Section 01300, Section 01730, and related sections listed in 1.02 of this section of the specifications.
- B. Shop Drawings shall include, but not be limited to, the following:

1. Tank dimensions, including wall thicknesses and member sizes and base plate geometry
 2. Layout of fittings, nozzles and appurtenances
 3. Materials of construction
 4. Total weight of the shipped materials.
 5. Complete erection, installation, and adjustment instructions and recommendations.
- C. The CONTRACTOR shall be responsible for coordinating all interfaces with related mechanical, structural, electrical and instrumentation and control work. The CONTRACTOR shall be responsible for providing all accessory equipment and all work associated with installation of the equipment.
- D. The CONTRACTOR shall submit to the ENGINEER for review drawings and design calculations for the tank and its anchorage, signed and sealed by a Professional Civil or Structural Engineer currently registered in the State of California. Design calculations shall be prepared in accordance with Section 01350 of the Specifications. Drawings and design calculations shall be approved prior to fabrication of the tank.

1.04 MANUFACTURERS

- A. The materials covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations. The 316 stainless steel storage tank shall be as manufactured by Heritage Equipment Company or equal.

1.05 RESPONSIBILITIES AND GUARANTEE

- A. The tank manufacturer shall be fully responsible for the structural design, integrity and water-tightness of the tank, including all anchorages and connections. The tank manufacturer shall warrant the tanks for materials and workmanship for a period of two (2) years after the Substantial Completion of the project. Warranty shall be submitted with the Shop Drawings. The tank manufacturer shall replace or repair defective or unsatisfactory tanks during the warranty period at no cost to the Owner.

1.06 CONTRACTOR'S RESPONSIBILITY

- A. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the Owner's operating personnel in its maintenance and operation as outlined in Section 11000, Equipment General Provisions and Division 1. The services of the manufacturer's representative shall be provided for a period of not less than two (2) days in two (2) separate trips as follows:
1. At least one trip of one (1) day to check and supervise the installation of the equipment.

2. One trip of one (1) day after acceptance of the equipment to supervise initial start-up and operation and instruct the Owner's personnel in proper operation and maintenance of the equipment. Startup and training shall be coordinated with the Owner, and the Owner shall have final approval authority for the scheduled date(s).
- B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out with the Owner on each day he/she is at the project.
 - C. A written report covering the representative's findings and installation approval shall be mailed directly to the Engineer covering all inspection and outlining in detail any deficiencies noted.
 - D. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

PART 2 EQUIPMENT

2.01 GENERAL

- A. All tank capacities (volumes) specified shall include only that volume in the straight shell below the overflow pipe invert elevation and above the pump suction connection. At least 3 inches of freeboard shall be provided between the invert elevation of the overflow pipe and the top of the straight shell.
- B. The tanks shall be anchored to concrete slab by the Contractor in accordance with the Specifications and manufacturer's recommendations.

2.02 STEEL STORAGE TANKS

A. Centrate Tank

Quantity Type	One (1) Vertical, Cylindrical Above Ground Service Cone Bottom Dome Top
Ends	
Nominal Capacity (Total)	670 gallons
Nominal Diameter	5'-6"
Nominal Straight Shell Height	3'-5"
Overall Height of Tank (without legs)	4' 11"
Height of Tank Dome Top	3"
Height of Tank Bottom Cone	1'
Heat Tracing	No
Connection Openings:	
Top Fill	10"
Bottom Discharge	6"
Drain into Centrate Tank	2"
Vent	4"
Hinged Inspection Hatch	12"
Level Switch LL and HH	6"
Level Element	4"

1. Centrate storage tank nozzles sized and configured as follows:

Degree*	Height	Size	Description
Top dead center	-	10"	Inlet
Bottom dead center	-	6"	Outlet
30	Top	2"	Instrument Drain
180	Top	4"	Vent
202.5	Top	12"	Inspection Hatch
120	Top	6"	Level Switch LL and HH
315	Top	4"	Level Element
*Refer to Drawings for nozzle degree references			

2.03 MATERIALS AND CONSTRUCTION

A. General

1. All materials shall be new, and both workmanship and material shall be of the very best quality, entirely suitable for the service to which they are to be subjected.
2. The Centrate tank will be stored in an outdoor storage area with temperatures ranging from 30 to 100 degrees F.
3. The tanks shall be fabricated of 316 stainless steel. The minimum plate thickness shall be 3/8-inch. Plate materials shall be flange 316 stainless steel conforming to ASTM A240. All joints shall be of butt weld construction. The tanks shall be fabricated in three-ring courses and shall be stress relieved. Bolts, nuts and washers shall be 316 stainless steel.
4. The tank tops shall be as indicated on the Drawings with openings and connections as shown on the Drawings. The bulk tank tops shall be able to support a 250-lb load on a 4-inch by 4-inch area.
5. All welds shall be ground smooth, and all interior corner welds shall be ground to a minimum 1/4-inch radius. All corners and sharp edges shall be rounded and ground smooth.
6. Pipe connections shall be flanged Schedule 40 316 stainless steel pipe conforming to ASTM A312. Gaskets shall be EPDM. Fittings shall conform to ASTM A182, seamless Schedule 40. GALVANIZED PIPE AND FITTING MATERIALS SHALL NOT BE ACCEPTED.

B. Surface Preparation and Painting

1. The tank interior and exterior shall be cleaned of all oil, grease, dirt, rust, loose and tight mill scale, by cleaning in accordance with SSPC-SP-5, Blast Cleaning for the interior and SSPC-SP-6 Commercial Blast Cleaning for the exterior.

C. Safety Requirements

1. The Contractor shall furnish and install all precautionary labeling.

2.05 CONNECTIONS AND ACCESSORIES

- A. Connections - All connections/openings shall be flanged in accordance with ANSI B16.5 150 pounds and provided with flanged gasket. Flanged connections, nozzles, and openings shall be steel gusseted and flat face.
- B. Fill Line - Tank fill lines shall be as indicated on the Drawings. All pipe supports, hardware, accessories, etc., shall be provided. Vertical piping into the tanks shall be supported every five feet.
- C. Drain Line - All pipe supports, hardware, accessories, etc., shall be provided by the Contractor. Vertical piping from the tank shall be supported every 5 feet and shall be parallel to the tank wall and not less than 6 inches from the tank wall. The valves shall be as specified in Section 15100, Check Valves.
- D. Outlet Lines - Outlet lines shall be as indicated on the Drawings. Outlet piping to the centrate pumps shall be supported every five feet. All pipe supports, hardware, accessories, etc., shall be provided. Outlet lines shall be supplied and furnished by the Contractor as shown on the Drawings.
- E. Vent - The storage tank shall be provided with a top-mounted vent line, as indicated on the Drawings, extended to the atmosphere with a stainless steel insect screen. The vent line shall be furnished by the Contractor as shown on the Drawings.
- E. Level Sensor - The centrate tank shall be provided with level sensors in accordance with Division 16, Instrumentation. Valves shall be provided to isolate the gauges. The mounting and connecting requirements shall be coordinated with the instrument supplier.
- F. Level Switch - The tanks shall be provided with level switches in accordance with Division 16, Instrumentation. Valves shall be provided to isolate the switches. The mounting and connecting requirements shall be coordinated with the instrument supplier.
- G. Lifting Lugs - The tanks shall be provided with a minimum of four lifting lugs, three of them around the top edge of the tanks and one at the base of the tanks. Lugs shall be resistant to corrosion by the specified chemical. Lifting lugs shall be capable of withstanding weight of an empty tank with a safety factor of 3 to 1.
- H. Support Legs - The tank shall be supported by a minimum of four (4) legs. Support legs shall be designed to withstand the weight of the tank and full contents (to top of straight shell) of fluid with a specific gravity of 1.3. The support legs shall be designed to withstand lateral forces due to wind or seismic loads as determined in accordance with ASCE 7. Design of support legs and anchorage shall be in accordance with Section 01350 of the Specifications. The manufacturer of the tank shall submit structural calculations signed and sealed by a Professional Civil or Structural Engineer currently registered in the State of California.
- I. Certification Label - The tanks shall be provided with permanently attached 316 stainless steel certification labels providing the following information:
 - Type of material stored

- Concentration of material stored
- Specific gravity
- Maximum temperature
- Tank capacity
- Manufacturer
- Date of manufacture

J. Identification Sign - Signs shall be attached to the tank at locations as directed by the Engineer. Sign layout shall be submitted for approval. Signage for identification of the tanks shall be provided as follows:

- NFPA Placard Centrate Storage Tank

PART 3 EXECUTION

3.01 INSTALLATION

- A. The Contractor shall furnish and install the tank and related items in accordance with the manufacturers' recommendations and in accordance with Section 00810, Supplement to General Provisions.
- B. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.
- C. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.
- D. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.
- E. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.
- F. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.
- G. All miscellaneous metal work shall be erected square, plum and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.
- H. All piping, valves, fittings, conduit, wiring, etc., required to interconnect system components shall be furnished and installed by the Contractor.

3.02 TESTING

- A. Upon completion of installation of tanks and prior to connecting piping, Contractor shall provide blind flanges or other suitable plugs for all openings in the tank and conduct a leakage test using water. The tank shall be filled with clean water provided by the Contractor from a source approved by the Engineer up to the top of the tank and left to sit over a two hour test period. There shall be no leakage over the test period. Leakage around openings in the tank shall be stopped by tightening nuts and bolts or replacing gaskets as required. Upon satisfactory completion of leakage test Contractor shall drain the tank and dispose of water in a suitable manner.

3.03 MANUFACTURER'S SERVICE

- A. The Contractor shall arrange for the equipment manufacturer to furnish the service of qualified service persons with at least three years of experience who are regularly involved in the inspection, handling installation, start-up, troubleshooting, testing, maintenance, and operation of chemical storage tanks. The service persons shall:
 - 1. Witness and check installation of the tank.
 - 2. Assist the Contractor in conducting field tests and preparing a written report as specified below.
 - 3. Witness and check start-up of the systems.
 - 4. Assist the Contractor in making adjustments and modifications as necessary to optimize operation of system components.
 - 5. Correct any problems with storage tanks and accessories noted during the installation, tests, and start-up.
 - 6. Submit written report certifying that the storage tank have been properly installed, tested, and adjusted, that the systems operate as specified or as required, and that all controls and protective devices operate properly. The report shall include date of final acceptance test as well as a listing of all persons present during the tests.
 - 7. Investigate and supervise correction of any operating problems which may arise up to the end of the guarantee period of the equipment.
 - 8. Instruct Owner personnel in the operation and maintenance of the equipment.
- B. Such services shall be furnished at no additional cost to the Owner and shall entail a minimum of two site visits of one-day duration excluding any travel time to and from the facility.

END OF SECTION

SECTION 11224

INLINE STATIC MIXERS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, equipment, materials and incidentals required and completely install and place into operation the inline static mixers for chemical mixing as shown on the Drawings and as specified herein.
- B. The units shall be furnished and installed with all necessary accessory equipment and auxiliaries, whether specifically mentioned in this Section or not, and as required for an installation incorporating the highest standards for the type of service specified.

1.02 RELATED WORK

- A. Special Provisions are included in Section 01170.
- B. Miscellaneous metal used in fabrication are included in Section 05500.
- C. Mechanical piping and valves are specified in Division 15.
- D. Field painting is included in Section 09902.
- E. Instrumentation and controls provided in this section shall adhere to Instrumentation and Control Specifications Sections in Division 13.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, Shop Drawings and product data for the equipment being furnished. Submittals shall include the following:
 - 1. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment.
 - 2. Certified Shop and installation Drawings showing all details of construction, dimensions and anchor bolt requirements.
 - 3. Complete bill of materials for the equipment.
 - 4. Spare parts list.
 - 5. Description of surface preparation and shop prime painting, including certification that the paint to be used to shop prime the equipment is compatible with the finish coat paint to be applied to the equipment.
 - 6. The weight of each component.
- B. Design Data
 - 1. Design calculations and/or other data demonstrating that the equipment process design

requirements are met.

2. Design loads.

C. Operation and Maintenance Data

1. Submit operation and maintenance data in accordance with Section 01730.

1.04 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1. ANSI B16.5 - Pipe Flanges and Flanged Fittings

B. National Bureau of Standards (NBS)

1. NBS PS 15-69 Custom Contact-Molded Reinforced Polyester Chemical Resistant Process Equipment

1.05 QUALITY ASSURANCE

- A. All the equipment specified under this Section shall be furnished by a single manufacturer and shall be products of a manufacturer having at least 10 years of current and continuous experience in the design and production of such equipment. The manufacturer shall submit a list of at least 10 operating facilities having equipment similar to that specified herein. The manufacturer shall have the sole responsibility for the proper functioning of the equipment as furnished. The CONTRACTOR shall have sole responsibility for the proper installation of the equipment in accordance with the Manufacturer's recommendations.
- B. This Section is intended to give a general description of what is required, but does not cover all details which may vary in accordance with the exact requirements of the equipment as offered. It is, however, intended to cover the furnishing, delivery, installation, field testing and field calibration of all materials and appurtenances as required. All additional equipment necessary to meet the design, performance and installation requirements of this specification not specifically mentioned in this Section or shown on the Drawings shall be furnished and installed at no additional cost to the OWNER.

1.06 SYSTEM DESCRIPTION

A. Static Mixers

1. Inline static mixers shall be provided as shown on the Drawings for the following applications.

B. Anionic polymer application upstream of Fourth Stage Treatment units:

- | | |
|---------------------------|--|
| 1. Primary Fluid | Sludge from Lamella Clarifiers
and to Centrifuge Feed |
| a. Flow Rate (gpm) | 80 |
| b. Temperature Range (°F) | 40 – 90 |

- | | | |
|----|---------------------------------------|--|
| c. | Pressure Range (psig) | 5 – 10 |
| 2. | Chemical | 1% Anionic polymer
(Nalco Nalclear® 7768) |
| a. | Flow Rate (gph) | 5.1 |
| b. | Viscosity (cps) | Not available |
| c. | Specific Gravity | 1.04 |
| d. | pH | 3.6 – 5.0 |
| 3. | Physical Data | |
| a. | Pipe Diameter (in) | 4 |
| b. | Maximum allowable pressure Drop (psi) | 1.5 |
| c. | End Connections/Specification | Flanged |

C. Injection Quill

1.07 DELIVERY, STORAGE AND HANDLING

- A. Delivery, storage, and handling shall be in accordance with Section 01600.
- B. Factory assembled parts and components shall not be disassembled for shipment unless permission is received in writing from the ENGINEER.
- C. All equipment and parts shall be properly protected against damage and deterioration during prolonged storage at the site.

1.08 MAINTENANCE

- A. Furnish one set of all special tools required for normal maintenance of the equipment furnished under this Section. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate the equipment for which the tools are intended.
- B. Furnish the manufacturer's recommended spare parts for 1 year normal operation and maintenance of the equipment.
- C. All spare parts shall be suitably packaged or boxed for long-term storage. Each part shall be clearly identified by part description, part number and other pertinent information or data.

PART 2 PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and equipment model numbers is for the purpose of establishing the standard of quality and equipment general configuration desired.

- B. Equipment weighing over 100 lbs shall be provided with lifting lugs.
- C. 16 gauge stainless steel nameplates giving the name of the manufacturer, equipment model number, speed, rated capacity and all other pertinent data shall be attached to each static mixer.

2.02 MATERIALS

- A. Equipment anchor bolts and washers shall be Type 316 stainless steel. Nuts shall be stainless steel of lesser hardness than the bolts to prevent galling.
- B. Static mixers shall be constructed of 316 stainless steel.

2.03 ACCEPTABLE MANUFACTURERS

- A. The static mixers shall be by Westfall, Komax, or equal.
- B. The injection quill shall be Saf-T-Flo model EB-164.

2.04 STATIC MIXER

- A. The static mixer shall be of the continuous mixing design wherein the elemental geometry divides and rotates the influent flow while approaching a plug flow condition. The static mixer configuration shall consist of full elements which rotate the flow radially in opposing directions as the flow moves axially through the mixer and shall provide complete mixing at design conditions. Mixers utilizing baffles and back mixing are unacceptable.
- B. The minimum cross-sectional flow area of the static mixer shall be at least 98 percent of the open pipe area to avoid obstruction of flow and plugging.
- C. The static mixer housing shall be designed to withstand the operating pressure specified in 1.06. The housing shall have end connections as specified in 1.06. The end connections are to be integrally molded with the body of the mixer.
- D. The static mixer elements shall be constructed so as to eliminate material hang up and to impart a uniform shear to process fluids. The elements shall be also constructed such that they have a minimum surface area exposed to corrosion and abrasion.
- E. The average variation of the chemical concentration in the feed water, 20 pipe diameters downstream of the static mixer shall be within 1 percent.
- F. Total number of units is two (2). One will be used in the feed line for centrifuge no. 1 and one will be used in the feed line for centrifuge no. 2.
- G. Manufacturer shall provide 1 injection quills per mixer fabricated from 316 Stainless Steel. Injection quills shall have built in check valves and ½-inch NPT threads for chemical process connections.

2.05 SHOP TESTING

- A. The mixers shall be given the manufacturer's standard quality control inspections and tests to ensure the quality of materials used in the manufacture of the units and workmanship conform to the specified requirements and highest industry practice, and the units have been correctly and

adequately prepared for shipment, long-term site storage and initial operation.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Static Mixer installation shall be as shown on the Drawings and in strict accordance with the manufacturer's instructions and recommendations.
- B. The CONTRACTOR shall supply all necessary accessories, temporary lifting equipment, labor and all other requirements for satisfactory installation.

3.02 FIELD TESTING

- A. Test all of the equipment to demonstrate that the equipment is installed correctly and is in proper operating condition and free from vibration and other defects or faults. Furnish all labor and incidentals required to conduct such tests and to correct to the full satisfaction of the ENGINEER all defects or deficiencies noted.
- B. In the event the mixers fail to meet the requirements specified above, the necessary changes shall be made and the mixers retested. If the mixers remain unable to meet the specified requirements the mixers shall be removed and replaced with mixers that meet the requirements of this specification at no additional cost to the OWNER.

END OF SECTION

SECTION 11240

POLYMER DOSING SKIDS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install, ready for operation, chemical feeder pumps, pulsation dampeners, back pressure valves, pressure relief valves, pressure switches, pressure gauges, speed controllers and all other appurtenances necessary for the polymer feed systems, as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Field painting is included in Section 09902.
- B. Vertical cross-linked polyethylene storage tank is included in Section 11345.
- C. Instrumentation and control work, except as specified herein, is included in Division 13. Instrumentation and controls provided in this section shall adhere to Instrumentation and Control Specifications Sections in Division 13.
- D. Piping, valves and supports other than those specified herein are included under respective Sections of Division 15.
- E. Electrical work, except as specified herein is included in Division 16.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings showing details of fabrication and erection of all materials and equipment furnished under this Section, including a complete master wiring diagram.
- B. Operation and Maintenance Data
 - 1. Operation manuals covering instruction and maintenance sheets on each type of equipment supplied shall be furnished to the ENGINEER as provided in Section 01730.

1.04 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. ANSI Z55.1 - Gray Finishes for Industrial Apparatus and Equipment.
- B. National Electrical Manufacturers Association (NEMA)
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. All the equipment specified under this Section shall be furnished by a single manufacturer and shall be products of a manufacturer regularly engaged in the production of such equipment. The manufacturer shall have the sole responsibility for the proper functioning of all equipment furnished.
- B. The following equipment specified herein is intended to give a general description of what is required, but does not cover all details which may vary in accordance with the exact requirements of the equipment as offered. It is, however, intended to cover the furnishing, delivery, installation, field testing and field calibration of all materials and apparatus as required. Any additional equipment necessary for the proper operation of the proposed installation not specifically mentioned in this Section and/or shown on the Drawings shall be furnished and installed.

1.06 SYSTEM DESCRIPTION

- A. The polymer dosing skid described herein are paced by a 4-20 mA DC flow signal. The polymer dosing skid supplier shall provide signal converters to ensure compatibility with pacing signals being provided under Section 13300.
- B. Anionic Polymer (Nalclear® 7768)
 - 1. Peristaltic pumps shall be used to feed 0.5% to 1% anionic polymer solution from the new day tank to the centrifuge(s) as shown on the Drawings with an output range of 0.0100-100 gph.
 - 2. Chemical Properties:
 - a. Service fluid 0.5% – 1% Nalclear® 7768
 - b. Ambient temp (°F) 40 – 100
 - c. Fluid temp (°F) 40 – 90
 - d. pH 3.6 – 5.0
 - e. Specific gravity 1.04

1.07 EXTRA STOCK

- A. Tools: One set of special tools for normal maintenance shall be furnished. They shall be supplied in a lockable steel cabinet or case.
- B. Spare parts shall be labeled appropriately and furnished with the equipment as follows:
 - 1. For each peristaltic pump, provide:
 - a. Two (2) spare tube assemblies or cartridge assemblies for each pump.
 - b. One (1) set of spare roller, tube, cover plate, and check valve.
 - c. One 1,000 cc calibration chamber with isolation ball valve.

1.08 POWER SUPPLY

- A. Power requirements including power factor correction capacitor requirements shall be as specified in Section 16001.

PART 2 PRODUCTS

2.01 SKID

- A. Single, dual or multiple pump systems.
 - 1. The skid shall be constructed of ½ (or ¾”) thick marine grade high density polyethylene sheet material and have a tensile strength greater than 4100 psi. The polyethylene sheet material shall be 100% UV inhibited. Molded skids shall not be accepted.
 - 2. There shall be two side walls, a pump mounting base, and one rear back plate with top support structure.
 - 3. Two 316 stainless steel pump mounting brackets with four mounting slots shall be provided per pump. Pump mounting brackets shall be secured to the skid structure with 316 stainless steel hardware.
 - 4. All piping shall be securely mounted to the polyethylene skid with secure plastic mounts and 316 stainless-steel fasteners. Ball valves shall be mounted with polyethylene mounting plates and four 316 stainless steel fasteners.
 - 5. Chemical containment shall be built into the chemical feed skid.
 - 6. Piping shall be ½” (¾”, 1”) diameter schedule 80 PVC
 - 7. True union ball valves shall be PVC (or CPVC) with FKM/Viton shaft bearings and seals. Seals and O-rings shall be selected by the skid fabricator to be compatible with the chemical being used. All ball valves shall be Asahi Type 21.
 - 8. Unions shall be schedule 80 PVC.
 - 9. Seals must be Viton.
 - 10. One chemical inlet ports shall be provided as required.
 - 11. One chemical outlet ports shall be provided as required.
 - 12. One drain shall be provided on the chemical suction side of the metering pumps.
 - 13. A calibration column fill line / discharge valve shall be included to assist in filling the calibration column and relieving pressure on the discharge side of the pumps. This line shall be vented back to the storage tank.
 - 14. All socket weld joints shall be chemically welded with gray CPVC 724 industrial pipe cement with the use of P-70 industrial primer for chemical applications. All joints shall be

squared, beveled and 100% seated. All socket welded joints shall have a full five-year field replacement warranty by the manufacture.

15. System shall have a five-year manufacturer's warranty on all chemically welded joints. Any leaks shall be repaired, on site, at the manufactures expense.
16. All skid components shall carry the manufacturer's standard warranty not less than two years.
17. To prevent leaks, no threaded joints shall be permitted on the skid assembly.
18. The skid system shall be model # DHWS-2M4-43-43W65H24D manufactured by D&H Water Systems, Inc. Oceanside, CA 92054, to match existing dosing skid (Polymer Pumps 1 & 2).

2.02 FLOW INDICATOR

- A. Flow Indicator shall be located in the discharge side of the piping system to provide a visual indication of fluid movement through the system.
 1. The flow indicator body shall be machined from clear cast acrylic with a ceramic ball indicator and polypropylene ball stop.
 2. The flow indicator shall be secured to the piping system with PVC socket weld connectors and half unions.

2.03 DIAPHRAGM CHECK VALVES

- A. Diaphragm check valves shall be located at the discharge side of each peristaltic pump to prevent the back flow of fluid through the pump.
 1. The diaphragm check valve shall be PVC with a 1.0 – 1.5 PSI cracking pressure.
 2. The maximum inlet working pressure shall be 150 PSI.
 3. Seals may be specified as Viton seals as the default selection
 4. Ball check valves shall not be permitted for this application.

2.04 PRESSURE RELIEF VALVES

- A. Pressure relief valves (PRV) shall be located on the discharge side of each pump to prevent excessive pressure in the system. Fluid shall be returned to the inlet side of the system if the pre-set maximum system pressure is exceeded.
 1. The PRV shall be PVC, CPVC with a PTFE diaphragm seal.
 2. The PRV shall have infinite adjustment increments from 15 to 150 psi.
 3. The PRV shall have a 3 year manufacturer's warranty.
 4. Pressure relieve valve shall be by Griffco.

2.05 CALIBRATION CYLINDERS

- A. Calibration cylinders shall be located in the inlet side of the system to permit metering pump output volume calibration.
 - 1. Valves shall permit the cylinder to be filled by gravity if possible. If gravity fill is not available, a by-pass line shall be provided to allow the metering pump to be used to fill the calibration cylinder.
 - 2. The cylinder shall be clear PVC with PVC socket weld end caps.
 - 3. Calibration Cylinder shall have a 3 year manufacturer's warranty.
 - 4. Calibration Cylinder shall be by Griffco

2.06 PRESSURE GAUGES

- A. Pressure gauge and guard shall be located in the discharge side of the system to indicate system pressure.
 - 1. The liquid filled gauge shall be stainless steel and include a blow-out plug.
 - 2. The gauge shall be bottom mounted to the guard with ¼" NPT stainless steel threads.
 - 3. The temperature compensated oil filled gauge guard shall be PVC with ½" socket weld bottom connection.
 - 4. Pressure gauge shall have 2.5" dial, stainless steel case and 316 stainless steel Internals with 1.6% accuracy. The pressure gauge range shall be 0 – 60 psi.
 - 5. The pressure gauge shall be Ashcroft model 1008S.

2.07 PUMP MOTOR AND DRIVE

- A. Peristaltic Metering Pump
 - 1. Peristaltic metering pump shall be a positive displacement, peristaltic type tubing pump with a brushless variable speed motor, non-spring-loaded roller assembly located in the pumphead, integral tube failure detection system, tube life roller revolution counter with user alarm set-point and flexible tubing with attached connection fittings. FLEXFLO M4 model shall be capable of output volumes from 0.0028 to 158.5 gallons per hour (0.0108 to 600 liter per hour).
 - 2. There shall be no valves, diaphragms, springs, or dynamic seals in the fluid path. Process fluid shall contact the pump tubing assembly and connection fittings only.
 - 3. Pump shall be capable of 24-hour continuous duty, self-priming and operating in either direction of flow at the rated maximum pressure of up to 125 PSI (8.6 bar).
 - 4. Pump shall be capable of running dry without damage.

5. Pump shall be capable of operating in either direction without output variation.
6. Suction lift shall be 30 feet (9.14 m) of water.
7. Pump shall be warranted by the manufacturer for a period of five years. Warranty shall include chemical damage to the pump head and roller assembly for a period of two years.
8. The pump shall be FLEXFLO Municipal peristaltic pump, manufactured in the U.S.A. by Blue-White.

B. Pump Head

1. The pump head shall be a single, unbroken track with a clear removable cover.
2. Tube failure detection sensors shall be constructed of two Hastelloy C pins that are located at the bottom of the pump head. The Hastelloy C pins shall act as electrical contacts. When both Hastelloy C pins are immersed in a conductive fluid, a circuit shall be completed between the pins and indicate a tube failure has occurred. Tube failure detection system shall not trigger with water contact from rain or condensation. Float type switches shall not be used. Process fluid waste ports or leak drains shall not be provided.
3. Squeeze rollers with encapsulated ball bearings shall be directly coupled to a one-piece thermoplastic rotor. Four nylon rollers shall be provided; two squeeze rollers for tubing compression shall be located 180 degrees apart and two guide rollers that do not compress the tubing shall be located 180 degrees apart. The roller diameters and occlusion gap shall be factory set to provide the optimum tubing compression; field adjustment shall not be required. Spring-loaded or hinged rollers shall not be used.
4. Squeeze and guide roller arms shall be removeable for ease of replacement.
5. Rotor assembly shall be installed on a D-shaped, chrome plated motor shaft and removable without tools.
6. For tubing installation and removal, rotor assembly shall be rotated by the motor drive at 6 RPM maximum when the pumphead cover is removed. Hand cranking of the rotor assembly shall not be required.
7. Pump head and tubing compression surface shall be corrosion resistant Valox thermoplastic.
8. The pump head cover shall be clear, polycarbonate thermoplastic with an integral ball bearing fitted to support the overhung load on the motor shaft. Cover shall include an imbedded magnetic safety interlock which will limit the motor rotation speed to 6 RPM when removed.
9. Cover shall be positively secured to the pump head using a minimum of four thumb screws. Tools shall not be required to remove the pump head cover.

C. Pump Tube Assembly

1. To ensure pump performance and accuracy, only tubing provided by the manufacturer is

acceptable.

2. Pump tube shall be assembled to connection fittings of PVDF material.
3. Connection fittings shall be permanently clamped to the tubing with stainless steel clamps or over molded directly to the tubing. To prevent tubing misalignment and ensure accuracy, fittings shall insert into keyed slots located in the pump head and secured in place by the pump head cover.
4. Connection fittings shall be 3/8" M/NPT. (Engineer to specify)

D. Drive System

1. Shall be factory installed and totally enclosed in a NEMA 4X, (IP66) wash-down enclosure. Capable of operating on any input power from 110VAC to 240VAC, 50/60 Hz single phase supply without user configuration or selection switches.
2. Motor
 - a. Reversible, brushless DC gear motor rated for continuous duty.
 - b. Motor shall include overload protection.
 - c. The maximum gear motor RPM shall be 125 RPM.
3. Enclosure
 - a. Bottom housing shall be pressure cast aluminum with acidic liquid iron phosphate three-stage clean and coat pretreatment and exterior grade corrosion resistant polyester polyurethane powder coat.
 - b. Top housing shall be structural foam molded Noryl engineered thermoplastic.
 - c. Rated NEMA 4X (IP66).
 - d. Provided with 316SS floor/shelf level mounting brackets and hardware. Optional: provide extended height brackets for mounting pump 4.5 inches above grade level. (Engineer to specify)
 - e. M12 receptacles shall be located at the rear of the pump for input and output signals.
 - f. RJ45 receptacle shall be located at the rear of the pump for use with EtherNet/IP and Modbus TCP/IP.
 - g. One M12 receptacle shall be located at the rear of the pump for use with Profibus.
4. Control Circuitry. All control circuitries shall be integral to the pump.
 - a. All control circuitries shall be integral to the pump and capable of adjusting the pump motor speed from 0.01% to 100.0% in 0.01% increments less than 10% motor speed, in 0.01% and in 0.1% increments greater than 10% motor speed (10,000:1 turndown ratio).

- b. The pump output shall be capable of being manually controlled via front panel touchscreen. The pump motor speed shall be adjustable from 0.01% to 100.0% in 0.01% increments less than 10% motor speed and in 0.1% increments greater than 10% motor speed.
- c. The pump output shall be capable of being remotely controlled via 4-20mA analog input. The input resolution shall be 0.01 of input value and capable of adjusting the pump motor speed from 0% to 100.0% motor speed in 0.1% increments. Four values shall be user configurable to define the low and high points on the output slope: a low input value, the required pump percentage of motor speed at the low input value, a high input value, the required pump percentage of motor speed at the high input value.
- d. The pump output shall be capable of being remotely controlled via TTL/CMOS digital high-speed pulse type input and an AC sine wave type pulse input in the range of 0 to 1,000 Hz. The frequency resolution shall be 1 Hz and capable of adjusting the pump motor speed from 0% to 100.0% motor speed in 0.1% increments. Four values shall be user configurable to define the low and high points on the output slope: a low input value, the required pump percentage of motor speed at the low input value, a high input value, the required pump percentage of motor speed at the high input value.
- e. The pump output shall be capable of being remotely controlled via pulse triggered batching. The pump shall accept a TTL/CMOS digital pulse type input and a contact closure type pulse input in the range of 1 to 5,629,499,534,21,312 pulses per batch. The batch time shall be adjustable from 1 to 5,629,499,534,21,312 seconds. The pump motor speed during the batch shall be adjustable from 0% to 100.0% motor speed in 0.1% increments.
- f. Pump shall be capable of remote priming via non-powered contact closure loop.
- g. The pump output shall be capable of being controlled via EtherNet/IP, Modbus TCP/IP, or Profibus.
- h. Provide a front panel touchscreen control for stop/start, configuration menu access and navigation, operating mode selection, display options selection, tube info data, and reverse direction.
- i. Provide a multi-color LCD touchscreen display for menu driven configuration settings, pump output value, service alerts, tube failure detection (TFD) system and flow verification system (FVS) alarms status, remote input signal values, tubing life timer value. Display color shall be green when indicating run operation, blue when in idle, yellow when in stand-by, and red to indicate an alarm condition exists.
- j. Provide for remote stop/start pump via non-powered contact closure loop.
- k. Provide a user selectable 4-20mA and 0-1,000Hz output signal which are scalable and proportional to pump output volume.
- l. Provide four contact closure alarm outputs. Three rated at 1A-115VAC, 0.8A-30VDC and one rated at 6A-250VAC, 5A-30VDC. Each alarm output shall be assignable to monitor any of the following pump functions: TFD system, FVS system, motor run/stop, motor failed to respond to commands, motor is running in reverse, general alarm (TFD, FVS, and/or motor over current), input signal failure, output signal failure, remote/local

control status, revolution counter (tube life) set-point, or monitor which of the nine different pump operating modes is currently active.

- m. Provide a four-digit password protected configuration menu.
- n. Provide a flow verification system with programmable alarm delay time from 1-1000 seconds. FVS system shall monitor the FVS flow sensor while pump is running only. System shall not monitor pump while not running.

E. SAFETY

- 1. The pump shall be certified to NSF Standard 61 Drinking Water System Components, UL standard 778 motor operated pump and CSA standard C22.2 process control equipment.
- 2. Manufactured to ISO 9001:2015 requirements and processes.
- 3. Tube Failure Detection (TFD) system sensors shall be wholly located in the pump head. TFD system will stop the pump within three seconds of leak detection. To prevent false alarms due to rain, wash-down, condensation, etc., tube failure detection system shall not trigger with water contact. Process fluid waste ports or leak drains shall not be provided.
- 4. Pump head cover shall include an imbedded magnetic safety interlock which will stop the pump when removed. Pump rotor speed shall be limited to 6 RPM when cover is removed.
- 5. Secondary user confirmation input required for motor reversal, tube life revolution count reset, and factory default configuration reset.

PART 3 EXECUTION

3.01 INSTALLATION

- A. The polymer dosing skid and accessory equipment shall be installed in accordance with the manufacturer's instructions and located as shown on the Drawings. Local electrical shutoffs for power supplied to field equipment shall be provided.
- B. On each pump suction provide a PVC flushing water connection complete with PVC ball and check valve arranged so that the pump can be manually flushed on pump shut down. Connect to the protected plant water system.

3.02 MANUFACTURER'S SERVICE

- A. The following shall be done by a qualified serviceman of the manufacturer of the equipment and accessories supplied. Provide a minimum of two (2) 8-hour man days.
 - 1. Supervision: Checking the installation of all components before power is applied.
 - 2. Check out: Placing the equipment into operation, field calibration, and making necessary adjustments. Field calibration of each chemical feeder pump shall include graphing of pump capacity curves for 100, 75, 50, 25, 10 percent stroke adjustment. Curves shall be developed for 100, 75, 50, 25 percent motor speed (total of 20 curves). Curves shall be submitted to the ENGINEER for review.

3. Instruction: The manufacturer shall provide one 8-hour man day to instruct the OWNER's personnel in the use, operation and maintenance of all the equipment.
4. All manufacturers must modify their standard equipment to meet the specifications. Any field modifications required to correct deficiencies shall be at the contractor's expense.
5. The system manufacturer shall have a minimum of 10 years of experience manufacturing the specific type of skids specified.
6. The manufacturer shall have a minimum of ten local references for similar skids provided over the last five years.

3.03 TESTING

A. Field Tests

1. After the skid has been completely checked out as described above, such tests as are necessary to indicate that pump discharge conforms to the specified requirements and shall be conducted in the presence of the ENGINEER.
2. Tests are to be conducted to the point of discharge at selected stroke and speeds and to confirm the repeatability of settings. CONTRACTOR shall supply all chemical solutions necessary for testing.

END OF SECTION

SECTION 11315

PROGRESSIVE CAVITY PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install a progressive cavity pump as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Equipment Operation and Maintenance Training is included in Section 01715.
- B. Operating and Maintenance Manuals are included in Section 01730.
- C. Field painting is included in Section 09902.
- D. Basic Mechanical Materials and Methods are included in Division 15.
- E. Electric Motors are included in Section 16001.
- F. Variable Frequency Drive Controllers are included in Section 16482.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, the following:
 - 1. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.
 - 2. Descriptive literature, bulletins and/or catalogs of the equipment.
 - 3. Data on the characteristics and performance of the pump. The data shall include guaranteed performance curves, based on actual shop tests of like pumping units, which show that they meet the specified requirements for head, capacity and horsepower. Curves shall be submitted on 8-1/2-in by 11-in sheets.
 - 4. Complete data on motors and power factor correction capacitors in accordance with Division 16.
 - 5. Complete master wiring diagrams, elementary or control schematics, including coordination with other electrical control devices.
 - 6. The total weight of the equipment, including the weights of the larger components.
 - 7. A complete total bill of materials for all equipment.
 - 8. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, etc on the list. List bearings by the bearing manufacturer's numbers only.

9. Noise data as specified in Section 01136.
10. Complete description of surface preparation and shop prime painting.

B. Operating and Maintenance Data

1. Operating and maintenance instructions shall be furnished to the ENGINEER as provided for in Section 01730. The instructions shall be prepared specifically for this installation and shall include all cuts, drawings, equipment lists, descriptions, etc, that are required to instruct operating and maintenance personnel unfamiliar with such equipment.
2. A factory representative who has complete knowledge of proper operation and maintenance of the pump shall be provided to instruct representatives of the OWNER on proper operation and maintenance. See Section 01715. Provide training agenda and training materials per Section 01715.

1.04 REFERENCE STANDARDS

- A. American National Standard Institute (ANSI)
- B. American Bearing Manufacturers Association (ABMA)
- C. National Electrical Manufacturers Association (NEMA)
- D. American Gear Manufacturers Association (AGMA)
- E. Occupational Safety and Health Administration (OSHA)
- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. Should equipment that differs from the specified requirements be offered and determined to be equal to that specified, such equipment shall be acceptable only on the basis that any revisions in the layout and construction of the structures, piping, electrical, and appurtenant equipment, required to accommodate such a substitution shall be made at no additional cost to the OWNER.
- B. Pump, drive unit and motor shall be furnished by the pump manufacturer and be factory-mounted on a common base plate of cast iron or fabricated steel.

1.06 SYSTEM DESCRIPTION

- A. Centrate Pump 1 and 2 – P-740-1 and P-740-2:
 1. All of the equipment specified for the Centrate Pumps are intended to be standard equipment designed for use in pumping centrate from a centrifuge that processes aluminum coagulant sludge. The maximum expected solids concentration is 0.5 percent.
 2. Pumps shall have a design capacity of 170 gpm at a maximum pressure of 30 psig. Operating pressure will be as low as 15 psi. Maximum pump speed shall be 400 rpm.
 3. The pumps shall be of the compact, close-coupled design. The gear reducer shall be sized for a minimum service factor of 1.5 and designed with a thrust load capability of 150

percent of the actual thrust load.

4. The pump shall be controlled locally and remotely for start-stop.
5. The pump motor shall be 10 hp, inverter duty.

1.07 MAINTENANCE

A. Tools and Spare Parts

1. One set of all special tools required for normal operation and maintenance shall be provided.
2. The following spare parts shall be provided:
 - a. One set of gaskets for each pump.
 - b. One set of mechanical seals for each pump.
 - c. One rotor and one stator.
 - d. One set of shaft universal joints.
3. Special tools and spare parts shall be furnished in accordance with Section 01136.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Netzsch NEMO Model NM063BY01L07K.2

2.02 MATERIALS AND EQUIPMENT

A. General

1. The equipment specified herein is intended to be pumping equipment of proven ability as manufactured by a reputable firm having experience in the production of such equipment. The equipment furnished shall be designed, constructed and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings.
2. All parts shall be so designed and proportioned as to have liberal strength and stiffness and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs and adjustment.
3. All necessary foundation bolts, plates, nuts and washers shall be furnished by the equipment manufacturer and shall be of Type 316 stainless steel. Minimum foundation bolt diameter shall be 3/4-in.
4. Stainless steel nameplates giving the name of the manufacturer, the rated capacity, head, speed and any other pertinent data shall be attached to the pump.

5. The manufacturer shall supply motor, factory-mounted to a common base plate with the pump.
6. The nameplate rating of the motor shall not be exceeded, nor shall the motor design service factor be reduced when its pump is operating at any point on its characteristic curve.
7. Pump and pump base shall have suitable provisions to collect leakage and permit it to be drained away.
8. The pump and drive shall conform to the noise limitations specified in Section 01136.

B. Pump

1. Pump shall be heavy duty, positive displacement, single stage, progressive cavity type. The pump body shall be of thick-walled cast iron and shall incorporate two inspection ports 180 degrees apart. The pump shall be cradle mounted to permit the suction port to be rotated to any angle perpendicular to the centerline of the pump. Suction shall be 6-in and discharge shall be 4-in, 125 lb ANSI cast iron flanged.
2. The pump rotor shall be machined of high carbon tool steel, hardened to a Rockwell "C" value of 57 to 60 and covered with a heavy layer of hard chrome plate at least 0.01-in thick for abrasion resistance.
3. The rotor shall rotate relative to a one-piece, EPDM rubber stator of approximate 55 Durometer hardness (Shore A) chemically bonded to its steel tube housing. The stator shall be arranged to prevent the pumped material from contacting the bonding or the tube.
4. The rotor shall be joined to the drive shaft by a carbon steel connecting rod and crowned-gear type, grease-lubricated, sealed universal joints of chrome alloy tool steel of adequate design to transmit the required thrust and torque while allowing the rotor to move through its eccentric path. The gear joint seals shall be clamped at both outside and inside diameters and recessed within heavy walled steel tubing to prevent damage by rags or other objects.
5. To maximize universal joint and seal life, the connecting rod operating angle shall not exceed 1-1/4 degrees off center. To minimize the moment of the transmitted radial force on the bearings and to minimize overall pump length, the connecting rod shall telescope within a hollow drive shaft and shall be attached to the drive shaft in close proximity to the bearings. This point of attachment shall not be more distant from the nearest bearing than the spacing between the two bearings. This method of drive shall minimize the shaft deflection in the stuffing box area.
6. The drive shaft shall be mounted in two ball or tapered roller bearings. The ABMA minimum B-10 life expectancy of the bearings shall be in excess of 100,000 hours at the maximum operating conditions specified herein. Fittings shall be provided for grease lubrication of the bearings.
7. The pump shall be supplied with mechanical seals.

C. Motor

1. Motor shall be horizontal, totally enclosed, fan cooled, foot mounted, NEMA Design B, of horsepower and speed as specified above and shall conform to Division 16.
2. Provide a factory-installed winding temperature detector with leads terminating in the main conduit box. The winding temperature detector shall be normally open, bimetallic contacts, one per phase winding.

D. Base

1. The motor, drive and pump shall be mounted on a common base of welded steel or cast iron. Provide grout holes for grouting to the concrete base.

2.03 SURFACE PREPARATION AND SHOP PRIME PAINTING

- A. All surfaces shall be prepared and shop primed as part of the work under this Section. Surface preparation and shop priming shall be as specified in Section 09901.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. The pump assembly shall be installed under supervision of a representative of the manufacturer supplying the equipment. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations and shall be acceptable for use in food packaging plants or NSF 61 approved. Anchor bolts shall be set in accordance with the manufacturer's recommendations.

3.02 INSPECTION AND TESTING

- A. Furnish the services of a factory representative for a minimum of two days who has complete knowledge of proper operation and maintenance to inspect the final installation and supervise a test run of the equipment.
- B. Synthetic ISO 320 or equivalent synthetic SAE 90W oil shall be used on the pump joints.
- C. Mobil Polyrex EM grease shall be used on the pump motor.
- D. All oils and greases need to be specified and supplied by the manufacturer for warranty coverage.
- E. After the pump has been completely installed, the CONTRACTOR, under the direction of the manufacturer's factory representative, shall conduct in the presence of the ENGINEER, such tests as are necessary to ensure that pump operation and performance conforms to the requirements specified. Supply all electric power necessary to complete the field tests. Pump shall be operated for at least 24 hours prior to test completion.
- F. If the pump performance does not meet the specified requirements, corrective measures shall be taken, or pump shall be removed and replaced with pump which satisfies the conditions

specified at no additional cost to the OWNER.

END OF SECTION

SECTION 11345

VERTICAL CROSSLINKED POLYETHYLENE STORAGE TANKS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required to install, field test, complete and make ready for service a vertical crosslinked polyethylene storage tank as shown on the Drawings and as specified herein.
- B. Furnish all labor, materials, equipment and incidentals required to remove and re-install in a new location, field test, complete and make ready for service two existing vertical crosslinked polyethylene storage tanks as shown on the Drawings and as specified herein.
 - 1. The CONTRACTOR shall furnish and install a new anchorage system for the new polymer day tank.

1.02 RELATED WORK

- A. Piping, Valves and Appurtenances and Pipe Hangers and Supports are included in Division 15.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, calculations and shop drawings for the tank anchorage system.
 - 1. The anchorage systems provided under this Section shall be designed in accordance with the provisions of 2022 California Building Code (CBC) and the latest edition of the International Building Code (IBC) to withstand seismic and wind loads in addition to other loads. Design calculations shall be prepared by a California licensed professional engineer and submitted to the ENGINEER for approval. Submittals shall be in accordance with Section 01136 and 01300. Seismic design parameters are summarized in the Drawings.
 - 2. Shop drawings signed and sealed by a Professional Engineer registered in the State of California. Shop drawings shall include but not limited to:
 - a. Layout placement drawings with the number, types and locations of seismic/wind restraints.
 - b. Indicate details of support locations, material sizes and gauges, finish, and connection to steel platform.

1.04 SYSTEM DESCRIPTION

- A. A new polymer day tank for storage of diluted liquid anionic polymer (Nalco Nalclear® 7768) 1% polymer shall be installed in the existing outdoor area on the south side of the existing Water Treatment Plant.
- B. Dimensions of the new polymer day tank shall be as follows:
 - 1. Overall Diameter: 4'-0"
 - 2. Overall Height: 6'-1/2"

3. Tank Capacity: 405 gallons

- 1.05 Manufacturer: New polymer day tank shall be a 405gallon SAFE-Tank® Assembly manufactured by Poly Processing Company or equal. HANDLING
- A. Flange faces shall be protected from damage. All openings are to be securely covered to prevent the entrance of dirt, water and debris.
 - B. Nozzles or other fittings shall not be used for lifting. Manway may be used for lifting only if recommended by manufacturer and only according to procedures submitted by manufacturer.

PART 2 PRODUCTS

2.02 GENERAL

- 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.
- B. Like items of materials, equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts and manufacturer's service.
- C. Anchor bolts and hold-down devices shall be provided by the tank manufacturer.
- D. Tank shall be manufactured by Poly Processing Co., or equal.

2.03 MATERIALS

- A. Plastic
 - 1. The tanks shall be molded from Metallocene high density crosslinked polyethylene. The resin used shall be Paxon 7004 as manufactured by Exxon/Mobile Chemical, or equal. Shop drawings shall include the materials of construction, properties and chemical compatibility information.
- B. Fillers and Pigments
 - 1. The plastic shall be opaque and shall not contain any fillers. All plastic shall contain a minimum of 0.25 percent U.V. stabilizer and maximum of 0.60 percent. Pigments may be added as desired by the Owner, not to exceed 0.5 percent of dry blended or 2 percent if melt compounded of the total weight of the tanks.

2.04 CROSSLINKED POLYETHYLENE TANK

- A. The crosslinked polyethylene tank shall be designed for the following:
 - 1. Polymer day tank – TK-753
 - a. Dimensions:
 - 1) Inner Tank Diameter: 3'-8"
 - 2) Outer Tank Diameter: 4'-0"

- 3) Sidewall Height: 5'-2"
- 4) Top of Tank Height: 6'-½"
- b. Minimum Tank Wall Thickness: 0.19-in
- c. Minimum Nominal Volume: 405 gallons
- d. Tank Color: Natural
- e. Number of Tanks: 1
- f. Mixer: No
- g. Nozzle Materials:
 - 1) Bolts, nuts and washers: 316SS
 - 2) Gaskets: Viton Seals
- h. Dome Fittings: Bulkhead
 - 1) Bolts: 316SS
 - 2) Fume Gasket: Viton Seals
 - 3) Body Gasket: Viton Seals

B. The crosslinked polyethylene tanks shall be constructed by the rotational molding process.

C. The nominal properties of the material are as follows based on molded parts:

Test Procedure	Units	Value
Density / ASTM D1505	g/cc	.940 to .945
ESCR Cond. A, F50 / ASTM D1693 10% Igepal	Hrs.	> 1000
Tensile Strength / ASTM D638	Psi.	2,600
Elongation at Break 2-in/min. / ASTM D638	Percent	400
Vicat Softening Temperature / ASTM D1525	Degrees F.	240
Brittleness Temperature / ASTM D746	Degrees F.	-130
Flexural Modulus / ASTM D790	Psi.	100,000 to 110,000
Heat Distortion Temp. / ASTM D648 At 66 psi	Degrees C.	67°
Low Temperature Impact ARM-Low Impact for 1/8-in specimen	Ft. lbs.	75
Polyethylene Notch Test (PENT) ASTM F 1473 (176 degrees F, 350 psi)	Hrs.	>1000
Long Term Hydrostatic (LTHS) (Creep) At 140 degrees F	Psi.	900

- D. Storage tanks shall be cylindrical, flat-bottomed and vertical with dimensions, details and accessories as shown on the Drawings and as specified herein. The finished surface shall be smooth and as free as commercially practicable from visual defects, such as foreign inclusions, air bubbles, pin holes and craters.
- E. The tank diameter shall be measured externally. Tolerance on the outside diameter including out of roundness shall be plus/minus 3 percent. Measurement shall be taken in a horizontal position. The knuckle radius at bottom to wall shall be a minimum of 1-in.
- F. The tanks (wall thickness at tank bottom) shall be designed with a hoop stress value of no greater than 600 psi at 100 degrees F, with a safety factor of no less than 2, using the Barlow formula for calculating wall thickness. A minimum liquid specific gravity of 1.9 shall be used for wall thickness calculations. A minimum liquid specific gravity of 1.7 shall be used for wall thickness calculations
- G. All edges cut out, such as manway shall be trimmed to have smooth edges.
- H. 316SS clips, blocks and accessories shall be provided to securely anchor the tank to the concrete tank pad.

2.05 ACCESSORIES

- A. The bulk storage tanks shall be equipped with the following nozzles configured as shown on the Drawings:
 - 1. Nozzles sized as follows:
 - a. One 1-in fill (side)
 - b. One 1½-in discharge to metering pumps (bottom, bulkhead fitting type)
 - c. One 8-in level element (top)
 - d. One 6-inch level switch LL and HH (top)
 - e. One 2-in drain (bottom, bulkhead fitting type)
 - f. One 2-in vent (top)
 - 2. Identification labels (6-in high lettering) with tank designation, NFPA placard and tank number.
- B. Nozzles
 - 1. All nozzles attached to the chemical storage tanks below the full level of the tanks shall be bulkhead style. The bulkhead attached to the tank wall shall be 150 lb ANSI and be constructed of PVC. Flanges greater than 3-in shall have machined back face to contour of tank. There shall be a minimum of four 2-in diameter all thread bolts. Each bolt shall have a gasket, which is on the inside of the tank, and each flange shall have a gasket on the outside of the tank. Nozzle for pump suction shall be sized to allow opening equal to full inside diameter of pump suction piping.
- C. Dome Fittings

1. Fume-tight Dome Fittings

- a. Bulkhead fittings shall be PVC Schedule 80 with Viton gaskets. Use only at top of dome, where dome is flat.
- D. The tank level sight tube shall be supported off of the side of the storage tank.
- E. Each storage tank shall be supplied with a crosslinked polyethylene pad between the bottom of the tank and the concrete tank pad.

2.06 SHOP TESTING

- A. The tank manufacturer shall have quality control procedures adequate to insure that all fabrications comply with these Specifications. Quality control shall include a final inspection the manufacturer and written record of this final inspection. The objective of manufacturer's quality control and inspection procedure shall be to have the tank comply with the Specifications and Drawings at the time of first inspection, thus eliminating any need for rework by the manufacturer or a second inspection by the ENGINEER.
- B. Inspection records shall be made for each tank. Inspection records shall be available to the Engineer. Upon request, manufacturer shall send a copy of his inspection records to the Engineer for review prior to inspection by the ENGINEER.
- C. Final acceptance by the Engineer may be contingent upon satisfactory inspection upon arrival, delivery, installation and testing at the job site.
- D. The tank manufacturer shall perform the tests described below prior to shipping. Test samples shall be taken from the manway cut out areas or where fittings are inserted in each tank. The ENGINEER or Engineering representative shall have the option of witnessing these factory tests. Notification of these tests shall be forwarded to the ENGINEER at least 10 working days before the scheduled testing date.
 1. Impact Test: ASTM D746 Standard method shall be used in this test. Sample shall not shatter at 120 ft/lbs with sample at minus 20 degrees F for a 2-in wall thickness. For a wall thickness less than 2-in, the sample shall not shatter at 100 ft/lbs and minus 20 degrees F.
 2. Degree of Crosslinking Test: ASTM D2765 as modified by Phillips PTC Report 193 shall be used in this test. A minimum of 70 percent Gel must be obtained.
 3. Hydrostatic Test: Each tank shall be filled with water and checked for leaks no less than one hour after filling.

PART 3 EXECUTION

3.01 INITIAL INSPECTION

- A. Prior to removal of the existing bulk storage tank, CONTRACTOR shall thoroughly inspect and document the condition of the tank interior and exterior. Any apparent defects shall be brought to the attention of the ENGINEER. If any defects require repair, removal of the tank shall not commence until all required repairs have been completed as approved by the ENGINEER.

3.02 INSTALLATION

- A. Install the new and reinstall the existing crosslinked polyethylene tanks in accordance with the Drawings and the manufacturer's instructions.
- B. Tanks shall be installed on crosslinked polyethylene pad, or other resilient support as recommended by the manufacturer to provide for an even bearing on the concrete pad.
- C. Make all pipe connections to tank as shown on the Drawings. Reducers and flexible connectors shall be used as necessary to adapt to tank connection. Piping sizes are shown on the Drawings.
- D. Following the field test and repair of leaks, tanks and support members shall be anchored in their final position according to the manufacturer's recommendations.

3.03 FIELD TESTING

- A. After installation, the tanks shall be field tested by filling with water. The tank and fittings shall hold water without loss, evidence of weeping or capillary action for a period of 24 hours prior to acceptance as verified by Owner's Representative. The ENGINEER may also inspect each tank for defects, damage and conformance with these Specifications.
- B. After testing, the tanks shall be thoroughly cleaned and dried.
- C. Should any defects that were not documented during the initial inspection become evident during inspection or testing or if any defects found during the initial inspection were not properly repaired, the CONTRACTOR shall repair or replace the defective tank or fitting as approved by the ENGINEER.

END OF SECTION

SECTION 11363

DEWATERING CENTRIFUGE

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and manufacture, assemble, shop test, deliver and install complete one centrifuge for processing of aluminum chlorohydrate (ACH) coagulant sludge from a water treatment facility.
- B. The new centrifuge (Centrifuge 2) shall be a complete unit and shall include but not be limited to:
 - 1. A rotating assembly consisting of a bowl and scroll conveyor with main bearings, mounted on a frame.
 - 2. An electric main motor drive assembly.
 - 3. A scroll drive system consisting of either a AC inverter duty motor, or a DC variable speed backdrive motor.
 - 4. A centrifuge control panel.
 - 5. Separate motor controller panel (complete with all motor starters/drives/controllers).
 - 6. Vibration isolators for the centrifuge and main motor.
 - 7. A centrate chute with adapter for a 6-inch flanged pipe connection.
 - 8. A solids chute.
 - 9. A diverter gate, per Section 15207.
 - 10. All flexible connections.
 - 11. Auxiliary and accessory devices, equipment, or materials necessary for system operation, or to interface equipment provided under this Section with equipment provided under other Sections, shall be included whether specified or not.
 - 12. Auxiliary and accessories devices, equipment or materials where not specified shall be as recommended by the manufacturer of the primary equipment. These devices, equipment, or materials shall be of the highest quality of their respective kinds.
- C. The Contractor is to provide new electrical and control panels and other components for the existing Centrifuge 1. New panels shall be complete full operating capability of the existing centrifuge and shall include but not be limited to:
 - 1. A centrifuge control panel.
 - 2. Separate motor controller panel (complete with all motor starters/drives/controllers).
 - 3. A solids chute.
 - 4. A diverter gate, per Section 15207.

5. Auxiliary and accessory devices, equipment, or materials necessary for system operation, or to interface equipment provided under this Section with equipment provided under other Sections, shall be included whether specified or not.
 6. Auxiliary and accessories devices, equipment or materials where not specified shall be as recommended by the manufacturer of the primary equipment. These devices, equipment, or materials shall be of the highest quality of their respective kinds.
- D. All equipment specified herein shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings and specifications, engineering data, instructions and recommendations of the equipment manufacturer. The centrifuge units shall be the product of suppliers regularly engaged in the design and manufacture of centrifuges and shall be specifically designed for the intended conditions of service. Appurtenant equipment shall be new and shall be designed, fabricated and assembled in accordance with the best engineering and shop practices. Individual parts shall be manufactured to standard sizes and gauges. Components of the centrifuge shall be designed for the stresses that may occur during fabrication, shipping, erection, or maintenance. Materials shall be suitable for service conditions and as described herein.
1. The centrifuge manufacturer will be responsible for providing a complete centrifuge system, as described herein, and for delivering the equipment to the job site.
 2. The equipment shall be installed by the CONTRACTOR, who will be responsible for off-loading the equipment, providing any temporary storage in accordance with the manufacturer's recommendation for storage and installing the equipment in place. Installation will include mounting the unit, piping the unit, and providing power to the panels and all interconnected wiring and piping required between various components.
 3. The centrifuge and the controls shall each be tested prior to shipment.
 4. The equipment will be shipped in a minimum number of components; and they will typically be comprised of the centrifuge skid assembly with drive and backdrive, control panel, and other parts.

1.2 RELATED WORK

- A. Electric motors, except as specified herein, are included in Section 16220.
- B. Variable frequency drives, except as specified herein, are included in Section 16260.
- C. Structural steel and framing are included in Division 5.
- D. Field painting is included in Section 09902.
- E. Polymer feed pumps are included in Section 11240.
- F. Progressive cavity pumps are included in Section 11315.
- G. Instrumentation and control work, except as specified herein, is included in Division 13. Instrumentation and controls provided in this section shall adhere to Instrumentation and Control Specifications Sections in Division 13.
- H. Piping, valves, pipe hangers and supports and appurtenances, except as specified herein, are

included in Division 15.

- I. Electrical work, except as specified herein, is included in Division 16.

1.3 SUBMITTALS

A. Submit the following:

1. Installation and dimensional drawings certified correct for the specific application, showing details of construction, dimensions and anchor bolts.
2. Manufacturer Qualifications:
 - a. List centrifuge installations of comparable size in the U.S. from water/wastewater treatment plants (as applicable) with:
 - 1) A brief description of each installation (thickening or dewatering (as applicable), flow, feed concentration, additive consumption, cake dryness, and recovery)
 - 2) Name of owner of installation, telephone number, and contact person.
 - 3) Date of installation.
 - 4) Description of sludge
 - 5) Most current description of the water/wastewater and sludge processes of each plant
3. General Information:
 - a. Typical system description of operations. List component identification on schematic diagrams. Identify all input/outputs to PLC in tabular format using standard point tagging and documenting rack, slot, point allocation for each.
 - b. Operating and maintenance manuals shall be written in US standards. Operating and maintenance manuals will be specific to equipment purchased.
 - c. All drawings and data marked to show only items applicable to work. Show all data, bill of materials, rated capacities, material of construction, layouts of all components, and all feed and discharge piping arrangements. Show details of construction dimensions, and anchor bolt locations.
 - d. Recommend cleaning instruction, procedures and safety precautions for equipment.
 - e. Motor controller panel shop drawings for both new and existing centrifuges to include:
 - 1) Exterior and interior elevations and panel outline to scale showing all panel components and cross referenced to the bill of materials

- 2) 480 VAC and 120 VAC Power distribution and control schematics
 - 3) Equipment interconnect drawings showing all required wiring connections for all panel resident and field device connections including conduit sizes in sufficient detail for the Contractor to provide complete installation of all centrifuge equipment provided under this Section.
 - 4) Bill of materials
 - 5) Catalog cut sheets of all panel components including protective devices, motor controllers, and all other panel equipment
 - 6) Clarifications and exceptions
- f. Control Panel shop drawings for both new and existing centrifuges to include:
- 1) Exterior and interior elevations and panel outline to scale showing all panel components and cross referenced to the bill of materials
 - 2) 120 VAC and low voltage DC power distribution and control schematics
 - 3) Equipment interconnect drawings showing all required wiring connections for all panel resident and field device connections including conduit sizes in sufficient detail for the Contractor to provide complete installation of all centrifuge equipment provided under this Section.
 - 4) Bill of materials
 - 5) Catalog cut sheets of all panel components including programmable automation controller components, switches, relays, power supplies, and all other panel equipment
- g. Clarifications and exceptions
- h. Sequence of operations including list of functions monitored, controlled and alarmed.
- i. Setting plans with tolerances for anchor bolts
- j. Supplied tools and spares
- k. List of Recommended spare parts not supplied.
- l. Typical installation inspection reports.

- m. Test reports that certify that most severe service abrasion resistant materials supplied are in accordance with ASTM G65, Procedure A abrasion test. FMC Corporation, Colorado School Of Mines, Kennametal, Inc., and the Falex Corporation have laboratories qualified to perform this test. At a minimum the report should include the following:
 - a) Typical material analysis
 - b) ASTM standards
 - c) Manufacturer's name
- 2) Recommendations for both short and long term storage.
- 3) Weights and lifting points of all equipment and subassemblies
- 4) Identify any special handling requirements
- 5) Shop and field-testing procedures.
- n. Training lesson plan. Owner's approval required one week prior to scheduled training.
- o. Vibration isolator information
 - 1) Product data
 - 2) Design information
 - 3) Performance certificate

1.4 QUALITY ASSURANCE

A. Qualifications

- 1. Welders to be employed on the project shall provide evidence that they have passed AWS or DIN qualifications tests, within the previous 12 months. Submit evidence of compliance.
- 2. The centrifuge manufacturer shall have built similar equipment of similar type, size and capacity and must have in the opinion of the ENGINEER, appropriate experience and sufficient test data to demonstrate that the equipment to be supplied will meet all specified requirements. The manufacturer shall submit documentation demonstrating experience in design, manufacture and start-up of dewatering centrifuges of similar capacity and complexity and provide documentation of at least three dewatering facilities each of which has been operating in the United States for 3 or more years, or for a minimum of 15,000 hours, whichever is less.

B. Certifications

- 1. Certify that materials and equipment specified herein conform to the respective standards referenced (Section 01665).
- 2. Certify that shop test equipment has been calibrated.
- 3. Certify that field test equipment has been calibrated and checked.

C. Pre-Installation Conference

1. A pre-installation conference will be held to confirm the scope of work and responsibilities of the attendees.
2. The conference will be held 4 weeks prior to commencing installation work. It shall be indicated on the CONTRACTOR's current progress schedule.
3. The conference will be held at the plant site.

D. Services of Manufacturer's Representative

1. Provide services of a manufacturer's services representative(s), specifically trained on the installation, start-up, operation, and maintenance of the new and the existing centrifuge. Submit qualifications of service representative(s) for approval. The number of required days listed below are exclusive of travel time and do not relieve CONTRACTOR of obligation to provide sufficient service to place equipment in satisfactory operation.
 - a. Installation Assistance: One 8-hour day to assist in location of anchor bolts, setting, leveling, field erection, coordination of piping, electrical, miscellaneous utility connections.
 - b. Start-up Assistance: Assist in check-out, start-up, calibration, functional testing, performance testing (per Section 3.3 Performance Testing), and acceptance testing.
 - c. Operations Training: One 8-hour days of classroom and hands-on instruction which will cover the theory of operation, actual operation of the centrifuge, polymer systems (if furnished by the centrifuge manufacturer) and optimization of the centrifuge operations.
 - d. Maintenance Training: Provide classroom and hands-on training in separate sessions for electrical maintenance, instrumentation maintenance and mechanical maintenance. Each class or separate session shall be conducted in two sessions on consecutive days consisting of 4 hours each.
 - e. Such services shall be furnished at no additional cost to the Owner and shall entail of period of no less than thirteen (13) days and a minimum of three (3) site visits, for a minimum of eight (8) hour day.
 - f. Allow the CONTRACTOR to record all training sessions. The record shall be made available to the OWNER.

1.5 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A48 – Standard Specification for Gray Iron Castings.
3. ASTM A242 - Standard Specification for High-Strength Low Alloy Structural Steel.
4. ASTM A480 – Standard Specification for Flat-Rolled Stainless and Heat Resisting Steel Plate, Sheet and Strip.
5. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel

Structural Tubing in Rounds and Shapes

6. ASTM G65 - Standard Test Method for Measuring Abrasion Using the Dry Sand/Rubber Wheel Apparatus.

- B. American Concrete Institute (ACI)
- C. American Institute of Steel Construction (AISC)
- D. Instrument Society of America (ISA)
- E. American Welding Society (AWS)
- F. National Electrical Manufacturer's Association (NEMA)
- G. National Electrical Code (NEC)
- H. Underwriters Laboratories Inc. (UL)
- I. Institute of Electrical and Electronic ENGINEERs (IEEE)
- J. American National Standards Institute (ANSI)
 - 1. ANSI B15 – Ball Bearings, Local Bearings and Fatigue Life
 - 2. ANSI B16.1 - Standard for Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
- K. American Gear Manufacturers Association (AGMA)
- L. American Bearing Manufacturers Association (ABMA)
- M. The Society for Protective Coatings (SSPC)
 - 1. SSPC SP-6 – Joint Surface Preparation Specification Commercial Blast Cleaning
 - 2. SSPC SP10 – Joint Surface Preparation Standard Near White Blast Cleaning
- N. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.6 SYSTEM DESCRIPTION

A. General

- 1. The centrifuge 2 (CEN-732-2) specified herein is of the counter-current design, horizontal, solid bowl type. The bowl of the centrifuge must be removed vertically from the frame and casing.
- 2. The centrifuge shall be continuously fed sludge conditioned with polymer by individual progressive cavity type feed pumps. The sludge shall be fed into the center of the equipment where the solids are thrown against the wall of the bowl, which is rotating at high speeds thus generating high centrifugal forces. An internal screw conveyor shall continuously move the solids deposited against the bowl wall to one end of the machine where they are plowed up a beach and discharged out a solids discharge chute. The cake shall discharge onto cake

conveying equipment. The clarified liquid shall continuously flow over adjustable weirs at the other end of the machine where it discharges into a centrate chute that connects to plant piping. The centrifuges shall be provided with back drives to vary the speed of the conveyor to optimize sludge processing.

3. Centrifuge 1 (CEN-732-1) is an existing unit similar to the equipment described for CEN-732-2. Provide new diverter gate per Section 15207. Provide new motor controller panels and equipment control panel to replace existing.

B. System Responsibility

1. The CONTRACTOR shall be responsible for system integration of all centrifuge ancillary equipment provided by others and required for a complete and operable system.

C. Design Requirements

1. The centrifuge shall be capable of processing typical ACH coagulant sludge from a water treatment facility.
2. The sludge shall be as described herein:
 - a. Feed type: ACH coagulant sludge
 - b. Feed Concentration (% T.S.): 1% – 2%
 - c. pH: 4
 - d. Temperature (°F): 40 – 90
3. The centrifuges shall be manufactured to meet or exceed each of the following physical parameters:
 - a. Nominal inside bowl diameter, (in): 14
 - b. Minimum bowl length, (in): 59.52
 - c. Operating centrifugal force (at inside bowl wall diameter): 3,500 G
4. The water supply available shall be as follows:
 - a. Bowl Flushing: 25 GPM up to the feed rate
 - b. CIP Flushing: 13 GPM
 - c. Temperature: Ambient (40 – 90° F)

D. Performance Requirements

1. When processing sludge with characteristics as specified above, the centrifuge shall be capable of exhibiting the following process parameters:
 - a. Maximum Sludge Feed Rate (gpm) exclusive of polymer: 70 gpm at 1-2% solids
 - b. Solids Rate (d-lbs/hr): 160

- c. Percent Cake Solids (%T.S.): > 25 (to be confirmed by Alfa Laval and OMWD, to match existing percent cake solids)
 - d. Percent Recovery (%T.S.S.): 95
 - e. Polymer Dosage (active lb/dry ton): 15
- E. New centrifuge shall be an Alfa-Laval Aldec 45, or newer replacement model at the time of construction, no alternatives will be considered. Existing centrifuge components replaced under this Contract shall be provided by Alfa-Laval to allow full operation of the existing equipment, no alternatives will be considered.

1.7 WARRANTY

A. Warranty

1. The centrifuge shall be warranted to be free from defects in materials and workmanship for a period of twenty-four (24) months after successful completion of Acceptance Testing, beneficial use. The warranty shall cover all repairs for all systems furnished by the manufacturer. Manufacturer shall repair or replace, at its option, any such equipment found to be defective, provided written notice of the alleged defect is received within twelve months after successful completion of Acceptance Testing, beneficial use, or for a period not to exceed eighteen months from shipment.

PART 2 PRODUCTS

2.01 GENERAL

- A. The new centrifuge shall be a solid bowl, horizontal, scroll type unit and shall be specifically designed to handle the sludge specified above. The centrifuge shall be capable of continuous (or intermittent) operations with minimum of maintenance.
- B. The centrifuge shall be equipped with:
 1. Vibration isolators
 2. Drive motor
 3. Belt guards
 4. Operating controls
 5. Backdrive assembly
 6. Planetary Gear reducer
 7. Vibration Switch
 8. Diverter Gate
 9. All other accessories as specified herein and required to operate

2.02 MATERIALS

- A. All wetted parts of the centrifuge rotating assembly shall be 316 or duplex stainless steel, except for the “O” rings, seals, and abrasion-resistant material. “O” rings shall be Nitrile rubber; lip-type seals shall be Nitrile rubber.
- B. The feed tube will be constructed of stainless steel.
- C. The frame will be fabricated from structural tubular steel and shall contain no weighted aggregate.
- D. The upper casing will be 316 stainless steel with 316 stainless protecting the wetted parts of the lower casing.
- E. The belt guards will be constructed of stainless steel.

2.03 CENTRIFUGE

A. Bowl

- 1. The bowl shall be manufactured from centrifugal castings of type duplex stainless steel, and designed to operate at a minimum of 3,500 x G at the inside bowl wall diameter for maximum process flexibility and reliability and to withstand all centrifugal forces encountered at design operating speeds with adequate safety factors. Rolled and welded or static cast bowls shall not be allowed. The bowl shall be inspected for cracks, shrinkage, porosity, or other defects.
- 2. Nominal bowl thickness of the cylindrical and conical sections will be a minimum of 0.43 inches. The front and rear bowl hubs shall have a minimum nominal thickness of 1.18 inches and 0.91 inches respectively. The centrifuge bowl shall be supported by roller bearings mounted in pillow blocks and fitted for convenient external lubrication. Main bearings shall have a calculated life of at least 100,000 hours at standard operating speeds based on the SKF New Life calculation and in accordance with DIN ISO 281 requirements.
- 3. Flow through the centrifuge shall be counter current such that there are no centrate tubes to maintain. Pool depth shall be readily adjustable via weir plates located at the large diameter end of the bowl that do not require removing the rotating assembly from the frame. Solids shall be discharged at the small diameter end of the bowl.

B. Scroll Conveyor

- 1. Each centrifuge shall include a 316 stainless steel horizontal conical-cylindrical scroll conveyor equipped with helical flights independently mounted concentrically within the bowl. The scroll shall utilize a differential speed to convey solids from the cylindrical section to the conical section and out of the bowl with a minimum disturbance to the pool, and to the maximum advantage of the variable speed backdrive described in this section. The scroll conveyor shall be supported on grease lubricated anti-friction ball or roller bearings sealed from process contamination.
- 2. The edge and the face of the conveyor flights shall be protected from wear as described in the abrasion protection section, paragraph 2.03.H.
 - a. The scroll conveyor shall be designed such that the feed leaving the feed tube is accelerated in a feed zone. The feed material leaving the conveyor hub will pass through

hardsurfaced feed ports. The feed shall be evenly discharged into the bowl. The flights on the conveyor shall be designed with flow equalization windows to allow axial flow of centrate for minimum disturbance to the pool and maximum settling of fine particles.

C. Gear Box

1. The centrifuge shall be equipped with a multistage planetary gearbox to provide control of the differential speed between the centrifuge bowl and conveyor. The gear unit shall have a torque capacity of 3.5 kNm (2,582 ft-lbs).
2. Lubricating oil is self-contained and shall be high performance gear oil.
3. The gearbox shall be independently balanced from the centrifuge, and interchangeable. Each gear unit should be protected from damage due to high torque overload.
4. A thermal overload protection device shall not be considered as providing for sufficient protection for the gear unit.
5. Hydraulic drive units or externally cooled gearboxes will not be acceptable.

D. Frame and Casings

1. The rotating assembly and bearings of the centrifuge will rest on a steel frame.
2. The frame and casing shall be supplied on a modular frame fabricated from structural tubular steel. The modular frame shall support both the drive motor and backdrive and shall provide a adequate clearance from floor to the solids discharge connection and centrate discharge connection. The casing assembly will be provided with a 316 stainless steel upper casing, specifically designed for rigidity and noise reduction. Fiberglass upper casing shall not be allowed to maintain safety. The case shall be designed to act as a protective guard and to provide a complete enclosure for odor containment. The casing top shall be gasketed.
3. The bottom of the casing shall be fitted with a flexible solids discharge and a flexible centrate connection. The lower casing shall be fabricated from carbon steel with stainless steel cladding on the wetted parts.
4. The case top shall be hinged or removable and bolted in place.
5. Vibration isolators for the drive motor and backdrive shall be supplied as required. Conduit boxes for all centrifuge mounted switches, except those specifically related to the main drive motor, shall be mounted on the base.

E. Feed Tube

1. Sludge shall be fed to the centrifuge by means of a pump, supplied by others, suitable to minimize turbulence and pulsation. The minimum inlet pressure to the centrifuge shall be 4 psig at 40 gpm (when used on water with viscosity of 1 Centipoise).
2. The feed connection to the centrifuge shall be a 2 inch hose connection. The feed tube shall also include a three-quarter inch NPT connection for polymer.
3. The feed flow to the centrifuge shall be monitored by a magnetic flow meter provided by

others.

F. Drive System

1. The bowl drive system shall consist of an electric motor and a belt drive system. The belt drive system shall consist of multiple belts as required to provide full capacity and also to withstand the full starting torque of the system.
2. The drive system shall use one motor for the bowl drive and a separate backdrive for differential adjustment.

G. Backdrive System

1. Each centrifuge shall be furnished with a complete backdrive system to control differential speed between the conveyor and the bowl. The backdrive shall provide an infinitely adjustable differential speed variation over its range of operation.
2. Each backdrive system shall be furnished with all the required instrumentation and electrical controls to meet the operating requirements of this specification.
3. Backdrives utilizing hydraulic drive, or water cooled units will not be acceptable.

H. Abrasion Protection

1. In order to minimize wear due to abrasive materials in the feed, replaceable hard surfacing shall be provided at all points where the abrasive action of the sludge will cause wear on the metal parts of the centrifuge. The following shall be considered a minimum degree of hard surfacing required.
 - a. Bowl Wall: The bowl wall and conical extensions shall be protected with minimum of eight (8) welded ribs designed to trap a protective layer of solids between the bowl wall and the conveyor.
 - b. Conveyor Feed Ports: The conveyor feed ports shall be protected from abrasion by field replaceable solid sintered tungsten carbide elements.
 - c. Solids Discharge Ports: The solids discharge ports shall be protected from abrasion by field replaceable tungsten carbide inserts.
 - d. Solids Discharge Casing: a replaceable stainless steel or urethane insert shall protect the solids discharge casing.
 - e. Scroll Conveyor Flights: The edge and face of the conveyor flights shall be protected against abrasion from the solids by a series of welded-on sintered tungsten carbide tile assemblies from two wraps beyond the feed zone through the solids discharge end. Each tile assembly shall be weight correct, and consist of a solid sintered tungsten carbide wear part braised to a stainless steel back-up holder. Each assembly shall be individually replaceable and shall include the ability to monitor wear by means of visual inspection. Spray hardsurfacing applied to a back-up plate will not be allowed. The tile assemblies must extend 0.5 inches beyond the radial edge of the conveyor flight. The remaining scroll conveyor edge and face shall be protected from abrasion by flame sprayed hardsurfacing containing a minimum 40% tungsten carbide particles. Stellite or ceramic hardsurfaced tiles are not acceptable.

2.04 NOISE AND VIBRATION

- A. The centrifuge shall be equipped with vibration isolators and noise suppression devices of an energy efficient design, such that the average noise level measured at three (3) feet around the periphery of the complete centrifuge assembly shall not exceed the 88 dBA when tested at the manufacturing facility without feed and with the inlet and discharge closed.
- B. The centrifuge, when running without feed, shall be measured for vibration at the manufacturing facility. The vibration shall be less than or equal to 6.5 mm/s RMS when measured at the pillow blocks under dry shop conditions.

2.05 LUBRICATION

- A. All bearings on the centrifuge shall be grease lubricated through suitably located fittings.
- B. The gearbox lubrication shall be self-contained and consist of high performance gear oil.
- C. All oils and greases need to be specified and supplied by the manufacturer for warranty coverage.

2.06 VIBRATION ISOLATORS AND FLEXIBLE CONNECTIONS

- A. The equipment manufacturer shall furnish vibration isolators which shall be capable of dampening vibration in all directions created during normal and emergency operation of the equipment. The vibration isolators shall be sized by the centrifuge Supplier. The centrifuge unit shall be mounted on not less than four Rubber or Spring type isolators. Isolators shall be designed for external level adjustment. After installation, isolators shall be inspected and adjusted by a qualified representative of the centrifuge Supplier.
- B. The vibration isolators shall be provided for the entire centrifuge assembly.
- C. Flexible connections shall be provided for all liquid feed and discharge points, including sludge feed, polymer feed, centrate discharge, flushing water feed, and solids chute.
- D. Flexible connectors shall be of black molded neoprene, two-ply fabric reinforced with polyester cord, complete with stainless steel back-up flanges (if required) and hardware. Neoprene flanges shall match the dimensions of the centrifuge casing flanges. Face-to-face flange dimension shall be not less than 12-inches.
- E. Vibration isolators shall limit exciting frequency transferred from the centrifuge to the centrifuge platform to less than 3Hz.
- F. There shall be no rigid connections to the centrifuge.

2.07 ANCHOR BOLTS

- A. Anchor bolts shall be sized by the centrifuge manufacturer, and shall be supplied by the CONTRACTOR. Anchor bolts shall be 316 stainless steel.

2.08 FLEXIBLE CONNECTORS

- A. To insure a quiet installation, flexible connectors shall be provided to isolate the centrifuge from the building structure. Flexible connectors include the solids discharge splashguard, flexible feed connections, flexible centrate connection, and flexible polymer connection for the feed tube. These items are to be supplied by the centrifuge manufacturer:
1. The solids discharge connection shall be constructed of stainless steel and will be designed to support the centrifuge discharge slide gate and actuator specified in Section 15207. All hardware shall be constructed of 316 stainless steel.
 2. The flexible feed connection shall be constructed of black neoprene hose with a 2 inch hose clamp fitting mounted on a 2 inch 150 lb. flange connection.
 3. The flexible centrate connection shall be constructed of black neoprene and stainless steel with a 6 inch flanged connection.
 4. The flexible polymer connection shall be approximately 12 inches long with a three-quarter inch NPT connector on the centrifuge feed tube side and a three-quarter inch NPT polymer connection to process piping.
- B. The installing CONTRACTOR shall furnish all electrical flexible connectors including: drive motor, backdrive and centrifuge junction boxes. The installing CONTRACTOR shall insure that all electrical codes are met.

2.09 STANDARD TOOLS

- A. One set of the following standard tools to be provided to assemble and disassemble the centrifuge as required by the owner. The following tools shall be supplied as a minimum:
1. 1 set of Special tools including conveyor lifter.
 2. 1 set of lubricants for start-up
 3. 1 set of spare O-rings and seals
 4. 1 set spare drive belts
 5. 3 sets of spare plate dams as selected by manufacturer
 6. 1 set of main and conveyor bearings

2.10 PAINT SYSTEM

- A. Paint system shall be manufacturer's standard system consisting of a catalyzed epoxy primer and a top coating of aliphatic acrylic urethane. All carbon steel and cast iron shall be properly prepared and cleaned in accordance with standard practice. A total of seven mils for primer and finish coat shall be applied.

2.11 CONTROLS & MOTORS

- A. General

1. The control system shall be complete with a NEMA 4X platform mounted centrifuge operator control panel, and a NEMA 4X platform mounted starter/backdrive panel.
2. Operator control panel shall not contain any components operating at voltage levels over 120VAC. All 480V drives and other components shall be contained in the starter/backdrive panel.

B. Centrifuge Control Panels (Centrifuge 1 and Centrifuge 2)

1. The centrifuge operator control panels (LCP-731A and LCP-732A) shall contain Decanter Management System (DMS) all controller components including a graphic color operator interface unit with touch screen, an elapsed time meter, emergency stop push-button, alarm horn, and alarm acknowledge/lamp rest push-button. A duplex 120 VAC receptacle for customer use up to 3 amps, non-inductive loads shall be mounted internal to the enclosure.
2. The starter/drive panels (LCP-731 and LCP-732) shall contain the Main Drive and Backdrive Variable Frequency Drives with Power Loss Ride Through protection, including variable frequency drives, protective equipment, control power transformers, and all other equipment operating at voltages over 150V AC to ground.
3. All components in all control panels shall be completely factory wired. All external control connection points shall terminate on terminal blocks with ferrules on wire ends to prevent fraying of wires during connection and servicing. There shall be a minimum of 10% spare terminal connection points supplied.
4. The enclosure shall be brushed finish 316 stainless steel.
5. The backdrive shall be controlled by the integral Backdrive Controller (B.C.), which controls delta rpm in the speed control mode, and scroll torque in the automatic control mode. The unit shall provide digital display of bowl speed, pinion speed, delta rpm, and torque. Applicable set point values are entered via a numeric keypad. The main drive shall also include control, monitoring, and alarm features.
6. Control logic shall be by the DMS and its associated operator interface unit. The operator interface unit consists of a color display with touch screen. All operator functions described below will be provided through menus and function keys on the DMS operator interface unit. The DMS shall be supplied with battery back-up capability so all programs and settings are retained if a power supply failure occurs. Digital and analogue I/O units shall be supplied.
7. The DMS and associated operator interface unit shall operate off an internal 24V D.C. power supply derived from 120VAC control power from control power transformers located in the starter/drive panel. Control power transformers shall include primary and secondary protection as required by the NEC. All +24 VDC power supplies shall provide short circuit protection.
8. The operator interface unit shall be capable of automatic or manual start/stop operations, selecting load or differential control with adjustable set points, as well as provide display readings of the following: Centrifuge drive motor amps, sludge and polymer actual flow rates, sludge and polymer desired flow rates, fault monitoring, and pre-set and actual timing operations, local/remote control status, and auto/manual control status, backdrive

torque, backdrive speed, differential speed, and bowl speed. All monitoring and control of external systems and components shall be via the Ethernet I/P network interface between LCP-731A and LCP-732A and Plant SCADA.

9. Operator interface shall be programmed to include color conventions and operating sequences that match the look and feel of the Plant SCADA system HMI as specified in Section 13401.
10. The DMS LCP-732A shall be supplied with operator interface controls or selector keys to allow the operator to toggle between feed pump 2 or feed pump 3 and polymer pump 3 or polymer pump 4 per Section 11240.
11. The DMS LCP-731A shall be supplied with operator interface controls or selector keys to allow the operator to toggle between feed pump 1 or feed pump 2 and existing polymer pump 1 or polymer pump 2.
12. The DMS shall have the capability to be network connected to external control system for remote operation and monitoring of the centrifuge and ancillary equipment such as conveyors, feed pumps, diverter gates, etc.
13. The DMS shall interface directly with a plant SCADA or DMS system via fiber optic Ethernet communication cables as shown on the Contract Documents.
14. The elapsed time meter shall be a six (6) digit, non-reset, register type with the last digit reading in tenths of an hour. Battery operated meters are not acceptable.
15. In the event of a power loss the control panels shall have the ability to provide Power Loss Ride Through Protection that will allow the centrifuge to run through a short duration power blip, generally defined as 3-5 seconds. If the power outage extends past the 3-5 seconds the system will signal a shutdown of the operating feed pump and polymer pump and put the centrifuge into the production standby mode for a programmed set time. If power is restored during this time the feed pump and polymer pump will automatically restart and production will resume. Should the power not be restored, the control system must allow the centrifuge to be brought to a stop in a normal shutdown mode (as if it had power); including a normal flush cycle along with maintaining the differential speed during the coast down period. This system will allow the centrifuge to scroll the solids out and be available for an immediate restart, once power is restored.
16. Control panel control wire shall be #16 AWG minimum, shall conform to UL standards, and shall be type MTW. Wiring used for external devices shall be as specified in Section 16120.
17. A ground lug shall be supplied on the panel. All customer interface contacts are provided through isolated 10 amp interposing relays. Contacts shall be suitable for 24 VDC or 120 VAC control. DMS shall provide 24 V DC control voltage for all external inputs via control power transformers as specified.
18. Each wire segment shall be numbered at each end using tubular heat shrinkable markers with permanent mechanically stamped. The wire numbers shall correspond to those on the wiring diagram. Wrap around or clip type numbers are not acceptable.
19. Nameplates shall agree with the wiring diagram, and shall be made of 1/16" thick

laminated acrylic. Letters shall be black on a white background to prevent obscuring text with dirt build-up, and shall be 1/8" in height

20. The centrifuge shall be equipped with an accelerometer type vibration monitor to protect against excessive vibration. The monitor shall be interlocked with the controls to shut down the centrifuge if excessive vibration is sensed. The monitor shall provide an analog output signal proportional to the vibration magnitude for display and monitoring at the DMS operator interface
21. The centrifuge shall be equipped with a cover switch so the centrifuge cannot be started when the cover is open.
22. Field mounting of the control panels and all interconnecting wiring between the centrifuge, ancillary equipment, operator panel, and starter panel shall be provided by the installing CONTRACTOR.
23. Provide conformal coating of all circuit boards.

C. Centrifuge Starter/Backdrive Panels

1. Each centrifuge starter/drive panel shall be a free standing ventilated enclosure, containing a main circuit breaker or rotary type fused disconnect with a through the door handle, a common buss variable frequency drive (VFD) system for the centrifuge backdrive and maindrive motor, and a backdrive motor starter. The starter/drive panels each be fed by a single 480VAC feeder as shown on the electrical single line diagrams. All internal 480V distribution and control power shall be provided within the starter/drive panel by the centrifuge supplier. The VFD system shall be sized in accordance with the centrifuge supplier's design requirements and shall be as specified in Section 16260. The drive system shall be capable of a flying restart after any shutdown including power outage. The starter/drive panel shall be rated for 22,000 symmetrical amp at 480VAC sized in accordance with centrifuge system requirements and the NEC.
2. The enclosure is to be painted with enclosure manufacturers stand paint system.

D. Drive Motors

1. Motors shall comply with the requirements of Section 16220 unless specifically noted otherwise..
2. The motors shall be squirrel cage induction motors suitable for VFD starting, 40 HP, 1800 rpm, TEFC, inverter duty per NEMA MG-1, with a non-hydroscopic class F insulation system limited to a B temperature rise, 1.15 service factor on sine wave/1.00 service factor on non-sinusoidal waveform, NEMA design B, standard long shaft for v-belt drive, and terminal box rotatable in 180 degree increments. The motors shall be provided with thermal protection using a bi-metal thermal switch. The motor shall have copper windings and be of high thermal capacity design for operation on 460/3/60 power. Fluid coupling/clutch starting systems shall not be allowed.
3. With the motor at ambient temperature, it shall be capable of making (2) complete starts in succession with coasting to rest between starts. The motor shall be capable of one (1) immediate restart after of any shutdown except motor overload. The motor shall not take longer than five minutes (each start) to accelerate to full rated rpm on at 90% nameplate

voltage while maintaining operation below name plated full load amps. The motor shall be rated by the motor manufacturer as having a noise level not exceeding 85 dBA (sound pressure) when measured at three (3) feet from the motor in any direction. The motor bearings shall be grease lubricated, ball or roller anti-friction type of standard manufacture. The bearings shall be conservatively designed to withstand all stresses of the service specified. Motor bearings shall have a minimum life rating of 40,000 hours of operation.

E. Main Drive & Backdrive – Variable Frequency Drives

1. The Maindrive VFD and Backdrive VFD shall be housed in the Centrifuge Starter/Drive Panel, containing both AC VFD controllers and a BD motor blower starter if required. The main drive and backdrive AC motor VFD controller shall be a flux vector controlled, sine coded, PWM drive conforming to the requirements of 16260 unless specifically noted otherwise.
 - a. Output contactors must be provided for each VFD to ensure positive power disconnect on over speed, emergency stop fault, and at reset conditions. A positive speed measurement device must be provided for over speed protection.
 - b. The drive shall include the following minimum features:
 - 1) IGBT (Insulated Gate Bipolar Transistor) power module.
 - 2) On-board alphanumeric digital display for programming and indication of set-up operating, circuit analysis, and diagnostic data.
 - 3) Set-up parameters shall be stored in EPROM memory that does not require battery back up.

UL, Canadian UL, or CSA Labels.
 - 4) Product of ISO 9001 certified production facility.
 - 5) Designed to provide 100,000 hours mean time between failures with specified preventative maintenance.
 - 6) Inner loop torque control strategy with mathematical torque and flux calculation updates every 25 microseconds (40,000 times per second).
 - 7) Operation from 3-phase power rated 380 to 690 VAC +/- 10% and 48 to 63 Hz.
 - 8) The drive shall employ a Full Wave rectifier to prevent input line notching and operate at fundamental power factor of 0.98 at all speeds and loads.
Drive efficiency shall be 97% or higher at full speed and load.
 - 9) An internally mounted line reactor shall be provided to reduce input current harmonic content, provide protection from power line transients such as utility power factor correction capacitor switching transients and reduce RFI emission.
 - 10) An automatic motor parameter ID function shall define the motor equivalent circuit in the VFD.
 - 11) Flux optimization to limit the audible noise produced by the motor and to

maximize the efficiency by providing the optimum magnetic flux for any given speed/torque operating point.

- 12) Ethernet I/P communication module to allow communication with DMS.
 - 13) Backdrive and Main drive VFDs shall have encoder speed feedback interface card.
 - 14) Conformal coating of all circuit boards.
- c. As a minimum the drive will include the following adjustable parameters of indication.
- 1) Adjustable Parameters
 - a) Torque Limit Level
 - b) Minimum/Maximum RPM
 - c) Output signal selection and scaling
 - d) Input signal scaling
 - e) Preset speeds
 - f) Motor full load current
 - g) Motor Base RPM
 - 2) Indication
 - a) Motor torque
 - b) Motor Current
 - c) Motor Speed
 - d) Motor Speed Set-point
 - e) Motor Power
 - f) External Torque Reference
 - g) DC Buss Voltage
 - h) Motor Temperature

2. Maindrive System Performance

- a. Speed regulation of 0.4% or better
- b. 100% Torque output in all Four Quadrant Control when required
- c. Torque signal accuracy of +/- 5%

- d. Overload Capacity of 150% for 1 minute, 200% peak
 - e. Torque limiting of motor torque, 0 – 200%
- 3. VFD drives shall be ABBACS880 for main and back drive motors.
 - 4. Centrifuge VFD requirements are unique to centrifugation equipment. Centrifuge VFD requirements in this section shall take precedent over general VFD requirements for other equipment listed in the general equipment requirements or general electrical requirements.
- F. Backdrive Motor
- 1. Motors shall comply with the requirements of Section 16220 unless specifically noted otherwise..
 - 2.
 - 3. The motor shall be a premium efficiency squirrel cage induction motor for VFD duty, 7.5 HP, TEFC, blower cooled, inverter duty per NEMA MG-1, 1.15 service factor on sinusoidal waveform/1.0 service factor on non-sinusoidal waveform, NEMA design B, with class F insulation and class B rise, and a pinion pickup sensor for pinion speed feedback control. The motor shall have copper windings and be designed for operation on 460/3/60 power and balanced for centrifuge operation. Thermal protection in the motor shall be bi- metallic thermostat.
- G. Control System Operation
- 1. Centrifuge 1 and Centrifuge 2 shall be programmed and configured to run identically. The centrifuges shall run separately as well as concurrently.
 - 2. The centrifuge shall be able to be started automatically or manually. To automatically start the centrifuge, provide “Auto Start” key on the operator interface unit.
 - 3. The DMS will issue a “run” command to the centrifuge main drive motor and the bowl will begin to accelerate. The polymer and feed systems shall be interlocked with the centrifuge controls to prevent their operation at this time. During acceleration of the centrifuge, the DMS shall issue a “run” command to the backdrive and a “start-up speed” command to the backdrive controller (B.C.). This will make the backdrive run at a pre-programmed start-up speed as set in the B.C. to provide the maximum scrolling of residual solids from the bowl. After a pre-set, timed interval, during which the bowl has reached full operating speed, the feed and polymer pumps will then be called to start. As process requirements vary, the backdrive speed shall be adjustable via the B.C., which shall maintain the set speed utilizing a closed loop, feedback. In this mode, the backdrive speed shall be maintained while the torque is allowed to vary as process parameters change.
 - 4. Automatic torque mode may also be selected at any time. In this mode the backdrive torque shall be maintained while the speed is allowed to vary, within pre-set limits, in order to maximize residence time. If torque begins to rise above the set point, the differential speed shall be increased to scroll solids out of the bowl at a faster rate, thereby lowering the torque back to the set point. The DMS shall be equipped with a built in PID Autotune feature that will allow for automatic adjustment of the PID Proportional, Integral

and Derivative values from the operator interface. Separate software, controllers, and communication cables shall not be required to activate this feature.

5. The centrifuge shall be able to be started manually as well, by pressing the appropriate keys as prompted by the manual operation screen of the operator interface unit.
6. Upon stopping the centrifuge by pressing the “Auto Stop” key on the operator interface unit, or via a fault condition, the feed and polymer system interlock contact shall open, thereby insuring feed to the centrifuge is stopped. An auto flush valve will also be opened for a pre-determined time during shutdown.
7. A Synchro Clean-In-Place (CIP) System shall be provided. This system is used for optimal cleaning of the centrifuge. The CIP run cycle can be started anytime the main drive motor is at rest as determined by the shutdown timer. Before initiation of the CIP start sequence, all faults must be cleared. A “CIP Start” key is pressed to begin the CIP cycle. The backdrive will be energized and begin to rotate in the reverse direction at a low speed for a predetermined time. At the same time, the main drive will accelerate the bowl to a low speed in the forward direction. At the end of the set time, the backdrive and drive will then toggle direction, causing a water “sloshing” effect within the centrifuge bowl and conveyor. The process will continue until the predetermined overall time ends, a “CIP Stop” key is depressed, or a fault occurs. Any shutdown fault will terminate the CIP cycle. The centrifuge slide gate will automatically be closed during CIP cycles causing water used to be discharged to the centrate line.

H. Control System Fault Detection

1. In the event that a fault condition occurs, the sounding of an alarm horn will take place, and an alarm text fault message will be displayed on the operator interface unit to facilitate trouble shooting. An Alarm Acknowledge push-button, mounted on the front panel, will flash when a fault condition occurs. When pressed, the horn will be silenced and the flashing will turn solid. When the alarm fault is corrected and reset, the solid light will be turned off.
2. The following faults shall be provided as alert conditions and shall signal shut off the feed pump and polymer systems as required via the Ethernet link:
 - a. Feed pump fault
 - b. Polymer system fault
 - c. Torque alert
 - d. Low differential
3. The following faults shall be provided as alarms and will cause shutdown of the main drive and backdrive motors:
 - a. Main motor overheat
 - b. Main drive malfunction
 - c. Excessive vibration

- d. Backdrive motor overheated
- e. Backdrive malfunction
- f. Centrifuge cover open
- g. Torque alarm
- h. Centrifuge bowl over speed

I. Help Menu

- 1. A screen shall be provided within the DMS to provide the operator with on-line help pages for each controlled device. The help pages shall include relevant flow charts and written descriptions as provided in the O&M manual.

2.12 CONTROL – AUXILIARY EQUIPMENT INTERFACES

- A. The following auxiliary control must be provided within the centrifuge control panel for use with currently installed equipment and future installed options. These features must be able to be enabled or disabled as required from the Operator Interface Unit. Centrifuge supplier to enable actual configuration at start-up. Installing CONTRACTOR is required to coordinate and ensure proper interface between the centrifuge control panel and auxiliary equipment supplied in other sections.
 - 1. Positive Displacement Sludge Feed Pump Interface. In hand, the pump speed shall be controlled locally from the VFD, but still interlocked with the centrifuge feed permissive or a bypass valve position switch feedback signal. In the auto position, the pump shall accept a run command and a 4- 20mA speed control signal from the centrifuge Decanter Management System. In the off position, the pump shall be locked out of operation. The pump shall also be provided with on/off status contacts.

PART 3 EXECUTION

3.1 PREPARATION

- A. The installing CONTRACTOR shall conduct a field inspection to verify the foundations and other preparations are complete and that the site is ready for installation of the centrifuges.
- B. All equipment shall be properly crated to protect any and all components from damage during shipment.
- C. The CONTRACTOR shall ensure that all parts are properly protected so that no damage or deterioration will occur during a prolonged delay from the time of delivery until installation is complete and the units and equipment are ready.
- D. Unfinished iron or unpainted steel surfaces shall be properly protected to prevent rust

and corrosion.

- E. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment and proper care shall be taken to protect parts from the entrance of water during shipment, storage, and handling.
- F. A year's supply of the manufacturer's recommended oil, grease and hydraulic fluids required for the equipment operation, shall be furnished with the centrifuges.

3.2 INSTALLATION

- A. Installation of the new centrifuge shall be in accordance with the recommendation of the centrifuge manufacturer to ensure that the system is properly installed.
- B. Representatives of the centrifuge manufacturer(s), who have complete knowledge and experience in the proper installation, start up and operation of the equipment, shall inspect the final installation and supervise the field acceptance tests of the equipment. No equipment shall be energized unless there is written authorization from the manufacturer or unless it is done in the presence of the manufacturer's service representative. All controls, interlocks and alarms shall be checked in the presence of the ENGINEER to assure proper control and equipment protection.
- C. Supply all anchor bolts with necessary nuts and washers for the mounting of all equipment supplied. The anchor bolts shall be minimum 3/4-in diameter and made of Type 316 stainless steel. Anchor bolt layout drawings shall be supplied to the ENGINEER with shop drawing submittals.
- D. Contractor shall provide all necessary interconnecting conduit and wire to the centrifuge components in accordance with Section 16120 and 16130 as required by the centrifuge supplier. Provide interconnecting conduit and wire for both new and modified centrifuge systems per the interconnection Reference Drawings provided in the Contract Documents. Final conduit and wire shall be provided based on the final interconnection drawings provided by the Centrifuge supplier following approval of the Centrifuge system submittals.

E. FUNCTIONAL TESTING

- 1. After installation of the units, and after all systems have run in steady state, the CONTRACTOR shall perform a functionality test under the supervision of the manufacturer in the presence of ENGINEER.
- 2. Centrifuge shall run for four hours without failure. At the beginning, middle, and at the end of this test, the operator will record all temperature indicators, pressure gauges, and flow indicators. All safety devices shall be checked for satisfactory operation. The no-load amperage of the main drive motor shall be recorded. The start timer and acceleration time to running speed shall be adjusted, if necessary. The belt tension shall be, checked and readjusted if necessary, at the end of the test.
- 3. Any malfunctions that appear during the tests shall be corrected and additional testing performed, to assure that the problem has been corrected.

3.3 PERFORMANCE TESTING

- A. Start-up services and performance testing shall be performed by the centrifuge manufacturer as described and required to place the equipment into proper operation and demonstrate to the Owner that the equipment shall satisfactorily perform the functions and criteria specified in Section 1.6.
- B. The performance test shall be conducted prior to final completion and prior to contractor demobilization.
- C. In the event that the equipment is not meeting the guaranteed performance standards, the Contractor shall have the equipment altered as necessary to meet the guaranteed performance standards. If modifications are made to the centrifuge utilized for performance testing, for the purpose of meeting performance guarantees, such modifications shall be made to the other centrifuge assemblies upon notification to the Contractor by the Owner. All costs associated with the modifications shall be borne by the Contractor.
- D. Upon modifying the test centrifuge assembly, the Contractor must repeat the performance test series. The new results will govern.
- E. Test records shall be maintained to insure that the specified results are met through the duration of the test.
- F. The Contractor is responsible for all tools, meters and test instruments necessary to demonstrate these requirements.
- G. The Engineer may request certified test data or call for on-site test to confirm the accuracy of all instruments used in testing.
- H. Following completion of each centrifuge installation phase, including electrical and process piping and the completion of all other support systems such as centrifuge feed pumps, centrate pumps and polymer system, the centrifuge shall be started and placed into operation by the centrifuge manufacturer. All signals, controls, interlocks and alarms shall be checked to assure proper operation and control.
- I. Contractor shall notify the Engineer when process start-up and performance testing shall take place so the Engineer and Owner can observe. A minimum of 72 hours' notice shall be provided.
- J. Provide all test apparatus required at no extra cost to Owner.
- K. The solids capture shall be determined based on the following equation:

$$\text{Capture} = \frac{c * (f-e)}{f * (c-e)} * 100$$

Where: c = cake solids (%TS),
f = feed solids (%TS), and
e = centrate solids (%TS).

L. PERFORMANCE TESTING DEMONSTRATION

1. General:
 - a. For the demonstration, the system shall be defined as including all equipment, panels, controls, instruments, wiring and miscellaneous equipment specified in this Section.
2. The purpose of the performance test is to demonstrate that all equipment is operational as specified herein to the satisfaction of the Owner. All aspects of the system shall be demonstrated to meet the criteria specified in this Section. Each performance test shall consist of meeting the criteria as specified below.
 1. The performance test shall be conducted on the centrifuge installed. Testing should include both centrifuges operating concurrently. The test shall be conducted at the performance requirements of Section 1.6 of this specification over a period of five consecutive operating days (three days optimization and two days testing). The performance test shall be conducted for a minimum of six hours per day during day shifts, Monday through Friday.
 2. At minimum, one factory trained technician shall be present during the entire performance test.
 3. The Owner shall be permitted at his option to witness portions or all of the performance test.
 4. Successful completion of the performance test shall be required prior to Final Acceptance of the equipment. However, successful completion of the performance does not constitute grounds for final acceptance.

M. Mechanical Criteria Segment:

1. If total downtime exceeds 3 hours, the performance test shall not be accepted. A new performance test shall be scheduled after adjustments are made by the Contractor and/or centrifuge manufacturer.
2. The Contractor shall be permitted to adjust operation of the centrifuge and polymer dosages during the performance test.
3. No maintenance shall be permitted during the demonstration period except routine maintenance recommended in Supplier's Operation and Maintenance Manual. This includes only the maintenance tasks which are to be performed more than once every week.

N. Process Criteria Segment:

1. General:

- a. Contractor shall collect data during each hour of the test.
 - b. The Owner, at his option, shall assist in data collection and determine time and location of sample collection.
 - c. The Owner, at his option, shall be provided with duplicate samples by the Contractor.
 - d. Data shall be tabulated for each shift.
 - e. The final performance data shall be the arithmetic average of the sum of the data from the last two days testing data. The final performance data shall demonstrate that the centrifuge meets the operating conditions and performance guarantees specified in Section 1.6 D of this Specification.
 - f. The date, time, and sampler shall be recorded for each sample taken or data point collected.
 - g. Contractor shall perform the necessary laboratory analysis.
2. Data Collection and Analysis:
- a. Feed, cake and flow stream samples shall be sampled once per hour and analyzed by the Contractor.
 - b. Polymer usage shall be monitored during the test. Polymer usage shall be recorded at approximately the same time samples are taken of feed, cake, and centrate. Total quantity of polymer utilized per day shall be recorded. Polymer for the centrifuge field acceptance test shall be provided by the Contractor.
 - c. Sludge feed and total polymer flow shall be monitored during the test. These flows shall be recorded at the same time feed, centrate, and cake measurements are taken. Total quantity of sludge fed per day shall be recorded.
- O. Upon successful completion of the performance test, the centrifuge Manufacturer shall prepare a written report. This report shall be submitted to the Owner and Engineer and shall summarize pertinent details regarding the test as well as test results to demonstrate that the tested centrifuge shall comply with specified performance criteria.

3.3 MANUFACTURER'S FIELD SERVICES

- A. All equipment will be given running tests by Contractor at the job Site following installation of the equipment and controls. Should the tests indicate any malfunction, Contractor shall make any necessary repairs and adjustments. Such tests and adjustments shall be repeated until, in the opinion of the Engineer, the installation is complete, and the equipment is functioning properly and accurately, and is ready for permanent operation.

- B. A factory trained representative of the Manufacturer shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of three visits to the Site. The first visit shall be for assistance in the installation of equipment. The second visit shall be for checking the completed installation, to complete field tests, and supervise initial operations. The third visit shall be to instruct the Owner's personnel in the proper care, operation, and maintenance of the equipment in accordance with Section 01821.
- C. Manufacturer's Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the Owner.

END OF SECTION

SECTION 13401

PROCESS INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.01 DESCRIPTION

- A. A single Control System Integrator (CSI) as a subcontractor to the General Contractor, shall furnish all services and equipment for the Project facility controls, local communication networks, local interfaces to remote communication networks, and project field instrumentation as specified herein.
- B. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and Subcontractors to review all sections to ensure a complete and coordinated project.
- C. Furnish field instrumentation, Process Automation Controller (PAC), Human Machine Interface (HMI), Operator Interface Terminal (OIT), and communication and network equipment hardware and software fully installed, configured, programmed, tested, commissioned, and documented for a fully function process control system as specified and shown on the Contract Documents,
- D. Equipment shall be fabricated, assembled, installed and placed in proper operating condition in full conformity with the Contract Documents, engineering data, instructions, and recommendations of the equipment manufacturer as approved by the District.

1.02 SCOPE OF WORK

- A. The work shall include the following:
 - 1. Provide all materials, equipment, labor and services required to achieve a fully integrated and operational system. Design and coordinate the instrument and process control system for proper operation with related equipment and materials furnished under this section of specification and related existing equipment.
 - 2. Provide all field instrumentation, sensors, analyzers, and devices as shown and as specified for monitoring and control functions.
 - 3. Auxiliary and accessory devices necessary for system operation or performance, such as transducers or relays to interface with existing equipment or equipment provided by others under other Sections of these Specifications whether they are shown on the Drawings or not.
 - 4. Provide modifications to the existing central station HMI and programming and/or configuration for all PAC, OIT, and network/communications equipment. All HMI, PAC, and OIT configuration and/or programing software shall be the CSI licensed copies. However, providing programming software is not required under this Contract.
 - 5. Interfacing to specific process control packaged systems including but not limited to:
 - a. Section 11363 – Dewatering Centrifuge
- B. The CSI shall use the equipment, instrument, and loop numbering scheme that has been developed and shown on the Drawings and process control descriptions in the development of the CSI's

submittals. The CSI shall not deviate from or modify said numbering scheme without the District's approval.

- C. All work shall be coordinated with its operating personnel to minimize impact on the system daily operations. The following is a list of existing facilities where work will be performed or possibly impacted by work under this Contract.

- 1. David C. McCollom Water Treatment Plant

- D. Programming approaches shall match existing District PAC system logic in place at the WTP to the greatest extent possible. Existing programs, system graphic standards, programming standards, programming requirements, and existing panel record drawings shall be provided upon request following Notice to Proceed and at the specified coordination workshops.
- E. HMI and OIT equipment programming, configuration, graphical interfaces, appearance, color standards, and other features shall match existing District systems to the greatest extent possible to provide an identical look and feel to the existing.
- F. All new PAC programming and HMI graphics shall be appended to and be compatible with existing programs and graphic systems. Programs, documentation, databases, and graphic systems shall match the existing programming and configuration approach to the greatest extent possible and as specified.
- G. PAC hardware is not required to be provided under this Project. However, all programming of existing platforms provided under this Contract shall be updated, revised, fully tested, documented, and verified to be functional and operating properly.
- H. New OIT graphics shall match the “look-and feel” of the District’s overall system control approach with respect to colors, tag and naming conventions, control sequences, operator functions, etc.
- I. Related Work
 - 1. Seismic anchoring criteria and requirements shall be as specified in Section 01350
 - 2. Dewatering Centrifuge is specified in Section 11363.
 - 3. Sample loop wiring diagrams are included for reference in Appendix 13401-A.
 - 4. Project PAC Input/Output (I/O) list is included in Appendix 13401-B.
 - 5. Project Instrument List is included in Appendix 13401-C.
 - 6. Project Process Control Descriptions are included in Appendix 13401-D.
 - 7. P&IDs and Control System Architecture Block Diagrams are included in the Drawings
 - 8. Electrical equipment is included in Division 16.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300 shop drawings, submittals, and information for the materials and equipment furnished under this Section. Shop drawings shall be submitted as detailed herein. They shall be complete; giving equipment specifications, details of connections, wiring,

ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature will not be acceptable.

1. Shop drawings shall fully demonstrate that the equipment and services to be furnished comply with the provisions of these Specifications and shall provide a true and complete record of the equipment as manufactured and delivered.
2. Submittals shall be submitted as electronic bookmarked "PDF" formatted files or submitted as hard-copy, bound documentation. Hard-copy submittals shall be bound in separate three-ring binders, with an index and sectional dividers, with all drawings reduced to a maximum size of 11-inch by 17-inch for inclusion within the binder.
3. Submittal drawings' title block shall include, as a minimum, the CSI's or responsible subcontractor's registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing.
4. Submittal shall include the following:
 - a. Project Plan, Deviation List, and Schedule
 - b. Field Instrumentation
 - c. Process Control System Hardware and Software
 - d. Testing Plan
 - e. Spares, Expendables, and Test Equipment

B. Project Plan, Exception/Deviation List, and Schedule

1. The CSI Project Plan shall be submitted and favorably reviewed before any further submittals will be accepted or reviewed. Any and all project submittals received prior to submittal and favorable review of the Project Plan shall be returned to the CSI with a "Not Reviewed" status.
2. Provide an overview of the proposed control system in clear text format describing the CSI's understanding and approach to the project work, system architecture drawing, interfaces to other systems, schedule, startup, and coordination.
3. Submit a proposed list of anticipated shop drawings and submittals.
4. Provide a deficiency or exceptions to the Specifications and Drawings. The Deviation List shall consist of a review of the Division 13 documents indicating conformance or proposed deviations. Include the reason for exception, the exact nature of the exception and the proposed substitution so that a proper evaluation may be made by Engineer.
5. Submit project schedule shall clearly show all major tasks, anticipated task dates and durations, milestone dates, linkages between tasks, and identification of critical elements. Schedule shall include:
 - a. Identification and timing for receipt of any District furnished information.
 - b. Coordination with the overall project plan provided by the General Contractor under Special Provisions.

- c. Control system project submittals.
- d. Proposed dates for project Coordination Workshop.
- e. Hardware and software purchasing, fabrication, and assembly (following approval of related submittals)
- f. Procurement, shipment, and installation of all field instrumentation and control system equipment
- g. Schedule for system testing, cutover, startup, and/or going on-line for each major system.

C. Field Instrumentation

- 1. Submit complete documentation of all field instruments using ISA-S20 data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment ordered by the loop numbering system as shown in the Contract Documents.
- 2. Submit separate data sheets for each instrument including:
 - a. Plant Equipment Number and ISA tag number.
 - b. Product (item) name used herein and on the Contract Drawings.
 - c. Manufacturer's complete model number.
 - d. Location of the device.
 - e. Input - Output characteristics.
 - f. Range, size, and graduations in engineering units.
 - g. Physical size with dimensions, enclosure NEMA classification and mounting details in sufficient detail to determine compliance with the requirements of the Contract Documents.
 - h. Materials of construction for enclosure and wetted parts.
 - i. Instrument or control device sizing calculations where applicable.
 - j. Certified calibration data for all flow metering devices.
 - k. Two-wire or four-wire device type as applicable.
 - l. Submit index and data sheets in electronic format as well as hard copies on 8-1/2" x 11" formats. Electronic format shall be in Microsoft Excel or Word. Submit electronic copy on Read/Write CD-ROMs disks formatted for IBM compatible personal computers.

D. Process Control System Hardware and Software Submittal

- 1. Catalog cuts for PAC, including input modules, output modules, and network interface modules. Submit system bill of materials and descriptive literature for each hardware component that fully describes the units being provided.

2. Catalog cuts for communication devices including network switches, cables, peripherals, patch panels, and power supplies. Submit system bill of materials and descriptive literature for each hardware component, which fully describes the units being provided.
3. Complete system Input/Output (I/O) list for equipment connected to the control system under this Contract. The I/O list shall include I/O name (or spare), type, physical location, point address, functional description (text that includes signal source, control function, etc.), range (engineering units) and equivalent analog to digital “count” conversion, alarm limits (low-low, low, high, high-high, etc.), relay normal status contact configuration. Both hard I/O and software (network delivered) I/O shall be included. The I/O list shall be sorted in order by:
 - a. Physical location: Panel, Rack, CPU Name, or Remote I/O Drop
 - b. Interface: Hardwired I/O, Software I/O (Ethernet I/P, Modbus TCP, wireless, etc.)
 - c. I/O Type: AI, AO, DI, DO, PI, PO, etc.
 - d. Loop Number
 - e. Device Tag
 - f. Calibration Range and Setpoint (Analog)
4. Complete block diagram showing the inter-connections between major hardware components, media type between components, raceway requirements (conduit, wireway, etc.), raceway identification, network protocol used at each network level, and all hardware components showing the interconnection of all modules, interface devices, modems, and plug-in circuit boards.
5. A list of all hardware electrical and environmental characteristics and requirements. All planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts in order to enable the CSI to proceed with the detailed site preparation for all equipment.
6. Submit software logic and documentation for ladder logic, flow chart/function block, high level language or other controller language used for the application engineering, process control logic development effort.
 - a. Software logic and documentation shall match existing District programming formats, structure, and look and feel.
 - b. Each program module, subroutine, or function block shall be fully described in a program overview that defines the scanned inputs, scanned outputs, definition of constants and variables, and function of the routine.
 - c. Program documentation shall include individual rung, network, and/or command descriptions with abundant comments to clearly identify function and intent of each code segment. Link between “coil” and “contact” shall be clearly presented, the function of each timer described, the purpose of each subroutine call labeled and defined, etc.
 - d. Program documentation shall be sufficiently clear to allow determination of compliance with the process control requirements included in the Process Control Loop Descriptions included in Appendix 13401-A and as shown on the Drawings.

- e. The software submittal shall demonstrate that all logic provided under this project follows the same structure and format and reflects a common programming approach.
7. Submit software logic and documentation for OIT and HMI graphics.
- a. Database development: Submit cross reference index of I/O allocation, controller memory address, HMI or OIT graphic systems address, and HMI or OIT graphic screen where the I/O point will appear. Every physical I/O point as well as calculated or virtual I/O required for the implementation of the process scheme shall be included.
 - b. Standard graphic format: Submit final drafts of standard graphical screen layouts defining screen zones, navigation strategy, color standards, standard graphic modules, control pop-up scheme, and other generalized user interface approach to be used for system graphics.
 - c. Process graphical development: Submit final drafts of logs, reports, trends, and process graphic displays for OIT and HMI development. The specifics of what shall appear on each display and report and any calculations are required to support them shall be presented. Final drafts shall reflect the graphical system requirements as specified herein as well as the result of the specified coordination meetings.
- E. Testing Plan
- 1. Test Procedure Submittals: The CSI shall submit procedures proposed to be followed for each test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests. Include sign-off forms for each testing phase or loop (per the specifications) with sign-off areas for the CSI and District. Submit separate procedures for each specified test phase including:
 - a. Operational Readiness Test (ORT)
 - b. Functional Acceptance Test (FAT)
 - c. 30-Day Acceptance Test.
 - 2. Test Documentation: Upon completion of each required test, document the test by submitting a copy of the signed off test procedures. Testing shall not be considered complete until the signed-off test procedures have been submitted and favorably reviewed. Submittal of other test documentation, including “highlighted” wiring diagrams with field technician notes are not acceptable substitutes for the formal test documentation.
- F. Training Plan – Not Used
- G. Spares, Expendables, and Test Equipment Submittal
- 1. Submit for each Subsystem:
 - a. A list of, and descriptive literature for spares, expendables and test equipment to be provided under this Contract.
 - b. A separate list of, and descriptive literature for, additional spares, expendables and test equipment recommended by the CSI.

- c. Storage instructions for all spare parts.

1.04 REFERENCE STANDARDS

- A. Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.
- B. American Society for Testing and Materials (ASTM).
 - 1. ASTM A269 – Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- C. Instrumentation, Systems, and Automation Society (ISA)
 - 1. ISA S5.2 – Binary Logic Diagrams for Process Operations
 - 2. ISA S5.3 – Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.
 - 3. ISA S5.4 – Instrument Loop Diagrams
 - 4. ISA S20 – Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
- D. National Fire Protection Agency (NFPA)
 - 1. NFPA 70 – National Electrical Code.
- E. Underwriters Laboratories, Inc. (UL)
 - 1. UL 508 – Industrial Control Equipment
- F. Institute of Electrical and Electronic Engineers (IEEE)
 - 1. IEEE Standard 472 – Electrical Surge Protection
- G. National Electrical Manufacturers Associations (NEMA)
 - 1. NEMA ICS6 – Enclosures for Industrial Controls and Systems

1.05 QUALITY ASSURANCE

- A. The equipment and components specified herein were current products at the time of the design. Should the specified equipment become unavailable during construction, due to obsolescence or loss of commercial availability, the CSI shall provide the latest product within the product line for approval or equivalent that meets the technical requirements of the specification.
- B. The CSI shall be a "systems house" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry.

1. For the purposes of this Specification Section, a "systems house" shall be interpreted to mean an organization that complies with all of the following criteria:
 - a. Employs a professional Control Systems Engineer or Electrical Engineer registered in the State of California to supervise or perform the work required by this Specification Section.
 - b. Employs personnel on this project who have successfully completed ISA or manufacturers' training courses on general process instrumentation and configuration and implementation of the specific process controllers, computers, and software proposed for this project.
 - c. Has performed work of similar or greater complexity at water or wastewater treatment facilities on at least five previous projects.
 - d. Has been actively engaged in the type of work as specified in this Specification Section for a minimum of five years.
 - e. Has been actively engaged in industrial process control programming using Rockwell ControlLogix platforms with RSLogix software and system integration for a minimum of ten years.
 - f. Has been certified in HMI configuration using Inductive Automation, Ignition software and system integration for a minimum of five years.
2. The CSI shall maintain a permanent, fully staffed and equipped service facility within 4 hours travel time of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the CSI shall be capable of responding to on-site problems within 12 hours of notice.
3. Actual installation of the instrumentation system need not be performed by the CSI's employees; however, the CSI as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.
4. The CSI shall furnish equipment that is the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.

1.06 SYSTEM DESCRIPTION

- A. The existing PAC CPU and I/O equipment, remote I/O equipment, as well as the facility's HMI and OIT systems are as shown on the Drawings and be updated to accommodate the new and modified centrifuge systems. The plant SCADA system monitors the functions of the packaged centrifuge control system via a network link. Control of the centrifuge equipment are provided as part of the centrifuge package provided by the centrifuge system supplier as specified in Section 11363.
- B. Updated permissives and control interlocks from the plant processes shall be provided to both the new and existing (replaced and updated) centrifuge package controls via the network links as shown on the Drawings and as described in the detailed loop descriptions included in Appendix 13401-D.
- C. System auxiliary pumps, chemical feed systems, control valves, and other ancillary systems are controlled by the existing plant PAC system as modified under this Contract via the existing

Remote I/O racks and central PAC processors. Refer to Appendix 13401-D for detailed loop descriptions for integration under this Contract.

- D. The existing plant HMI and OIT systems shall be updated to provide status monitoring, alarm monitoring, and remote operational control of the auxiliary systems and existing and new centrifuge systems by plant operators.

1.07 STORAGE AND HANDLING

- A. Equipment shall not be stored out-of-doors. Equipment shall be stored in dry permanent shelters including in-line equipment and shall be adequately protected against mechanical damage. Equipment stored in untreated spaces shall have condensation space heaters installed to prevent moisture condensing on or within the equipment. Provide suitable power source for space heaters as required.
- B. Specific storage requirements shall be in accordance with the manufacturer's recommendations of the equipment being provided.
- C. If any apparatus has been damaged, such damage shall be repaired by the CSI at their own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such tests as directed by the District. All mitigation effort shall be at the cost and expense of the CSI, or the apparatus shall be replaced by the CSI at no additional cost to the District.

1.08 PROJECT/SITE REQUIREMENTS

- A. Environmental Requirements. Provide NEMA 4X stainless steel enclosures.
- B. Elevation: Equipment shall be designed to operate at a ground elevation of approximately 500 feet above mean sea level.
- C. Temperature:
 - 1. Outdoor areas' equipment shall be suitable for -30 to 50 C degrees ambient.
 - 2. Equipment located in indoor locations shall be suitable for 10 to 40 C degrees ambient minimum.
 - 3. Storage temperatures shall range from 0 to 50 C degrees ambient minimum.
 - 4. Additional cooling or heating shall be furnished if required by the equipment as specified herein.
- D. Relative Humidity. Air conditioned area equipment shall be suitable for 20 to 95 percent relative, non-condensing humidity. All other equipment shall be suitable for 0 to 100 percent relative, condensing humidity.
- E. Power Supply: 120 volts AC sources of electrical power supply shall be from unregulated industrial panel boards (either utility or standby generator) unless a UPS power source is indicated on the Drawings.

1.09 QUALITY ASSURANCE

- A. The equipment and components specified herein were current products at the time of the design. Should the specified equipment become unavailable during construction, due to obsolescence or loss of commercial availability, the CSI shall provide the latest product within the product line for approval or equivalent that meets the technical requirements of the specification.
- B. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the Contractor shall bear full responsibility for such violations and assume all costs arising therefrom.

1.10 MAINTENANCE

A. Test Equipment – NOT USED

B. Spare Parts

- 1. In addition to the items noted below and in the other specification sections, the CSI shall provide suitable spare parts and expendable items in sufficient quantities to sustain the pump control system for a period of 1 year after final acceptance. All spare parts shall be delivered to the site before testing begins.
- 2. Furnish the following spare parts at a minimum:
 - a. Timers - One of each type provided
 - b. Relays - One of each type provided
 - c. Fuses - 10% (minimum of 5) of each type and size provided
 - d. Light bulbs - 10% (minimum of 5) of each type provided
 - e. Power supplies – One of each type provided including PAC power supplies if applicable
 - f. Cable Connectors or Terminations: Two of each type provided

1.11 COORDINATION MEETING

- A. The CSI shall schedule and hold one mandatory control system coordination meeting during the shop drawing submittal phase of the project. The meeting shall include as a minimum the District, the CSI, the Contractor, the electrical subcontractor, and other subcontractors performing any portion of the instrumentation system installation.
 - 1. The meeting shall be held no less than 30 calendar days in advance of the required shop drawing submittal. The purpose of the meeting shall be for the CSI's to summarize the CSI's understanding of the project, proposed hardware and software platforms, discuss any proposed substitutions or alternatives; present the Contractor's and CSI's project schedule; schedule testing and delivery milestone dates; and request any additional information required from the District.
 - 2. Existing programming approaches and details shall be requested by the CSI following Notice to Proceed for discussion and review at the coordination workshop. The CSI shall review existing District PAC programs, programming approaches, graphical standards, and other

programming criteria as necessary to establish requirements for program modifications and enhancements to integrate the new process control components into the existing water treatment plant control system.

3. Review screen graphic approaches and standards with the District and present their preliminary screen layouts. The CSI shall also present their approach for integrating the new process controller programming provided under this Contract with the existing process controller programming.
4. The CSI shall prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date for review and comment by the District. The meeting will last up to four (4) hours.

1.12 FINAL SYSTEM DOCUMENTATION

- A. Submit operation and maintenance manuals covering instruction and maintenance on each type of equipment in accordance with the Section 01730.
- B. The instructions shall be bound in three-ring binders with drawings reduced or folded for inclusion and shall provide at least the following as a minimum.
 1. A comprehensive table of contents
 2. A functional description of the entire system, with references to the systems schematic drawings and instructions.
 3. "As Built" set of the CSI approved control schematics, panel fabrication, and other CSI provided detailed shop drawings.
 4. Index and instrument data sheets of the field devices supplied, including serial numbers, ranges and pertinent data.
 5. Index and product data sheets of non-instrumentation equipment supplied, including serial numbers, ranges and pertinent data.
 6. Detailed service, maintenance and operation instructions for each item supplied.
 7. Complete parts lists with stock numbers and name, address and telephone number of the local supplier.
- C. The CSI's final documentation shall be new documentation written specifically for this project, but may include standard and modified standard documentation. Modifications to existing hardware or software manuals shall be made on the respective pages or inserted adjacent to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.
- D. The manuals shall contain all illustrations, detailed drawings, wiring diagrams and instructions necessary for installing, operating and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such figures shall be formatted within the printing of the page to form a legible, durable, and permanent reference book.

- E. Submit original software diskettes, CD-ROMs, or data packs of all software provided under this Contract. Submit original paper based or electronic documentation of all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers, etc. All software provided under this Contract shall be licensed to the District.
- F. Documentation shall include information from submittals updated to reflect the as-built or as-left system. Incorporate any modifications to the system resulting from the acceptance testing process.
- G. The Hardware Maintenance Documentation shall describe the detailed preventive and corrective procedures required to keep the system in good operating condition. A manual shall be furnished for all delivered hardware including peripherals. Include at a minimum the following:
 - 1. Operation Information: Detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
 - 2. Preventative-Maintenance Instructions: All applicable visual examinations, hardware testing and diagnostic routines and the adjustments necessary for periodic preventive maintenance.
 - 3. Corrective-Maintenance Instructions: Methodology for locating malfunctions down to the component replacement level. Include adequate details for locating the cause of an equipment malfunction, probable source(s) of trouble, and instructions for remedying the malfunction.
 - 4. Parts Information: Identify each replaceable or field-repairable component. All parts shall be identified on a bill of materials list on a drawing. Provide component manufacturer's contact information including name, local representative, phone numbers, web sites, and e-mail.
- H. The Software Maintenance documentation shall be sufficient for software maintenance and modification of the provided software and programming. Include at a minimum the following:
 - 1. Application/Custom Software Manuals - Each custom program developed specifically for the system shall include the following information as a minimum:
 - a. Table of Contents
 - b. Overview of the program in plain English text
 - c. Narrative describing specifically how the program works. Identify all calculations, references to process I/O points, and operator inputs with cross references to the logic diagrams or code.
 - 2. Software Listings and Databases- Submit copies of well-annotated as-built program listings. Listings shall reflect the as-built condition of the logic development following successful completion of acceptance testing. Include the following at a minimum:
 - a. All listings associated with the system generation and software configuration (e.g., system parameterization tables, build maps, disk maps, etc.). Submittals shall be included for process controllers, HMI application software, OIT application software, database applications, and all other equipment where specific programs or scripts were developed for this Project.
 - b. Listings of all I/O and variable data bases configured for and associated with the system.

- c. Listing of all custom or modified software developed specifically for the system. Listings shall reflect any changes made after the functional acceptance test.
3. Machine Readable Documentation - Provide as-built documentation on CD-ROMs. Data packs, or downloadable files. Program files shall be submitted in machine readable format for all programs developed under this Contract. The machine readable documentation shall include all documentation files including logic, annotation, and configuration files. Any changes made during or after acceptance testing shall be incorporated.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Substitutions on functions or type of equipment specified will not be acceptable unless specifically noted. In order to insure the interchangeability of parts, the maintenance of quality, the ease of interfacing between the various subsystems and the establishment of minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained. In order to insure compatibility between all equipment, it shall be the responsibility of the CSI to coordinate all interface requirements with mechanical and electrical systems and furnish any signal isolation devices that might be required.
- B. To facilitate the District's future operation and maintenance, products shall be of the same major instrumentation manufacturer, with panel mounted devices of the same type and model as far as possible.
- C. Physical
 1. All instrumentation supplied shall be of the manufacturer's latest design and shall produce or be activated by signals that are established standards for the water industry.
 2. All electronic instrumentation shall be of the solid-state type and shall utilize either fieldbus protocol where specified herein, or linear transmission signals of isolated 4 to 20 mA dc (milliampere direct current). However, signals between instruments within the same panel or cabinet may be 1-5V dc (volts direct current).
 3. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed.
 4. Provide mounting hardware and floor stands, wall brackets, fasteners, or instrument racks. stainless steel. Provide and size anchors in accordance per the seismic calculations as required per Section 01350. Provide minimum size anchor of 3/8-inch.
 5. All indicators shall be linear in engineering process units unless otherwise noted.
 6. All transmitters shall be provided with either integral indicators or conduit mounted indicators in process units, accurate to two percent or better.
 7. Electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for their purpose, to assure optimum long term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent

relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.

8. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, and shall consist of equipment models that are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.
9. All electronic/digital equipment shall be provided with radio frequency interference protection.

D. Electrical

1. Equipment shall be designed to operate on a 60 Hertz alternating current power source at a nominal 117 volts, plus or minus 10 percent, except where specifically noted. Where possible, all field instruments shall be 24 VDC loop fieldbus powered as specified. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop or fieldbus link. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
2. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.
3. Equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored unless otherwise noted.
4. All transmitter output signals shall include signal and power source isolation.

E. Nameplates

1. All panels and field instruments shall be supplied with suitable nameplates that identify the panel and individual devices as required.
2. Provide legend plates or 1-in by 3-in engraved nameplates with 1/4-in lettering for identification of door mounted control devices, pilot lights and meters. Nameplates shall be a 3/32-inch thick, black and white, laminated Bakelite or Lamecoid with engraved inscriptions. The letters shall be white against a black background. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.
3. Each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the Drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start). Orient nameplates to facilitate reading the device identifier from a cursory inspection. Do not mount nameplates behind or under equipment.
4. Provide nameplate fasteners and mounting as follows:
 - a. Stainless steel wire, 0.048-inch diameter with stainless steel crimped clamps for hanging nameplates.
 - b. Epoxy adhesive for cabinet mounted nameplates.

2.02 TUBING AND FITTINGS

- A. All instrument tubing shall be fully annealed ASTM A269 Seamless 316 grade free of OD scratches having the following dimensional characteristics or as required to fit the specific installation:
 - 1. 1/4-inches to 1/2-inches O.D. by 0.035 wall thickness.
- B. All instrument shut-off valves and associated fittings shall be supplied in accordance with the piping specifications and all instrument installation details. Fittings shall be Swagelok 316 stainless steel or equal and valves shall be Whitey 316 stainless steel or equal.
- C. All tubetrack shall be supported by stainless steel hardware and installed as per manufacturer's installation instructions.

2.03 MAGNETIC FLOWMETER

- A. Flow Element
 - 1. Type:
 - a. Pulsed DC type.
 - 2. Function/Performance:
 - a. Operating Temperature: Process liquid temperatures of -10° to 70° C and an ambient of -10° to 60° C.
 - b. RFI protection: RFI protection to be provided.
 - c. Pressure rating: Equal to piping system where meter is installed.
 - d. Additional: Meter shall be capable of running empty indefinitely without damage to any component.
 - 3. Physical:
 - a. Metering Tube: 304 stainless steel or equivalent.
 - b. Flanges: ANSI 150 lb. or DIN PN 16 carbon steel, as required by the piping system, unless otherwise indicated.
 - c. Liner: Polyurethane unless otherwise indicated on the Drawings or in the Instrument Device Schedule.
 - d. Electrodes: 316 stainless steel, bullet nosed or elliptical self-cleaning type unless otherwise noted.
 - e. Housing: Meters below grade shall be suitable for submergence for up to 48 hours to a depth of 30 ft (9m). Meters above grade shall be NEMA 4X (IP65).
 - f. Finish: All external surfaces shall have a chemical and corrosion resistant finish.
 - 4. Accessories/Documentation Required:

- a. Factory calibration: All meters shall be factory calibrated. A copy of the report shall be included in the O&M manual.
 - b. Grounding: Meter shall be grounded in accordance with the manufacturer's recommendation. Provide ground ring, ground wires, gaskets, etc., as required. All materials shall be suitable for the liquid being measured.
 - c. Signal cable for installation between the flow tube and the transmitter. Length shall be as required by installation indicated on the Drawings.
 5. Manufacturer(s):
 - a. Sparling Tiger-Mag, FM 656 no equal to match existing
- B. Flow Converter/Transmitter
1. Type:
 - a. Microprocessor based; intelligent transmitter compatible with flow tube provided.
 - b. The transmitter shall be mounted integrally on the flow tube, or remotely mounted on an instrument stand, wall, or control panel as shown on the Drawings.
 2. Functional/Performance:
 - a. Accuracy (including flowtube): Plus/minus 0.5 percent of flowrate.
 - b. Operating Temperature: -10 to 50° C.
 - c. Output: Isolated 4-20 mA with HART protocol. Current output adjustable over the full range of the instrument.
 - d. Diagnostics: Self diagnostics with on screen display of faults.
 - e. Display: Digital indicator displaying flow in engineering units indicated in the Instrument Device Schedule.
 - f. Totalizer: A fully configurable totalizer integral to the transmitter. Totalized flow shall be displayed.
 - g. Empty Tube Zero: The transmitter shall include a feature that will lock the output at zero when no flow is detected. The empty tube zero feature shall be enabled automatically when the transmitter detects no flow or manually through a contact input.
 3. Physical:
 - a. Transmitter shall be suitable for surface or instrument stand mounting.
 - b. Enclosure shall be NEMA 4X (IP65).
 - c. 120VAC input power or as shown on the Instrument List.

4. Accessories/ Required:
 - a. Keypad where required for transmitter configuration.
 - b. If hand-held programmers, special tools, software or cables are required for configuration and setup, the CSI shall provide one set of configuration equipment, plus and additional set of configuration equipment for every five flow meters provided on this project..
5. Manufacturer(s):
 - a. Sparling Tiger-Mag, FM656 no equal to match existing

2.04 THERMAL DISPERSION FLOW SWITCH

- A. Type:
 1. Thermal dispersion flow switch with integral electronics enclosure.
 2. In line with flowbody for line sizes 1-inch and smaller; insertion type for all other line sizes unless noted otherwise on the Drawings or Instrument Schedule.
- B. Function/Performance
 1. Range: 1 to 125 ft/s (0.3 to 38 m/s) in air.
 2. Process Operating Temperature: -40 to 170° C.
 3. Operating Temperature for Electronics: -40 to 60° C.
 4. Accuracy: Plus/minus 5 percent of reading.
 5. Repeatability: Plus/minus 0.5% of reading.
 6. Output: DPDT contacts rated 6 A at 120 VAC adjustable over the range of the instrument.
- C. Physical:
 1. Wetted parts to be 316 stainless steel.
 2. Electronics head to be NEMA 4X (IP65) for non-hazardous process gases.
 3. A/C power will be as specified herein.
- D. Manufacturers:
 1. Fluid Components International FLT93-F or FCI 2000.
 2. Approved equal.

2.05 METAL TUBE VARIABLE AREA FLOWMETERS

A. Type:

1. Polysulfone or stainless steel tube variable area flowmeter.

B. Function/Performance:

1. Accuracy: Plus/minus 3 percent of full scale from 10 to 100 percent of full scale.
2. Repeatability: 0.25 percent of full scale.
3. Indicator: Indicates flow in engineering units or percent of full scale as required for the application.

C. Physical:

1. ANSI 150 pound or DIN PN40 flanged connections.
2. Flanges and metal tube shall be polysulfone or stainless steel. Float and guide wire shall be 316 stainless steel.

D. Accessories

1. Provide adapters and fittings as required for the application.

E. Manufacturer:

1. Blue-White F-451, with accessories and features as specified
2. Brooks MT 3809.
3. ABB Series 10A5400.
4. Approved equal.

2.06 SUBMERSIBLE LEVEL TRANSMITTER – SEVERE DUTY

A. Type:

1. Submersible, hydrostatic pressure type level transmitter designed for harsh applications.

B. Function/Performance:

1. Range: Range selected shall be the manufacturer's standard range closest to the span to be measured.
2. Temperature Compensation: Temperature compensated over a range of 0 to 93° C.
3. Accuracy: Plus/minus 0.25 percent of range.
4. Over Pressure: Transducer shall be protected for over pressure of 2.0 times the span.
5. Output: 4-20 mA proportional to the calibrated span.

C. Physical:

1. The transmitter assembly shall have a 316 stainless steel body with a large diameter bottom diaphragm.
2. The transmitter diaphragm shall be protected by a full width ¼" thick 316SS protection plate mounted on 1-1/4" standoffs.
3. Sensors shall be suspended by cable. Cable shall include a vent tube for the transducer.
4. Sensor shall be suspended with a tension-relieving mounting clamp, from a 4-inch (100 mm) flange. Clamp and flange shall be 316 stainless steels.
5. Sensor shall be submersible (IP68) and shall be CSA approve or CENELEC (EEx ia IIC T4) certified intrinsically safe when intrinsically safe barriers are provided for the instrument loop.
6. 24 VDC loop powered.

D. Accessories Required:

1. Sufficient manufacturer's cable for installation between the sensor and the transmitter as indicated on the Drawings. The cable shall be reinforced to support the weight of the transducer and cable.
2. Cable clamp provided by instrument supplier, for suspending instrument.
3. Any fittings required for pressure calibration of the instrument.

E. Manufacturer(s):

1. WIKA LH-10, no equal to match existing equipment.

2.07 ULTRASONIC LEVEL METER

A. Transducer

1. Type:
 - a. Non-contact, ultrasonic level transducer.
2. Function/Performance:
 - a. Measuring Range: Transducer range shall be suitable for the installation indicated on the Drawings, up to 50 ft (15m).
 - b. Temperature Range: -30 to 70° C.
 - c. Relative humidity: 0 to 100 percent.
 - d. Temperature Compensation: Transducers shall be provided with integral temperature sensors for temperature compensation.

3. Physical:
 - a. Transducers shall be potted/encapsulated in a Kynar or other chemical and corrosion resistant housing.
 - b. The surface of transducers shall be Teflon coated where mounted on chemical tanks and exposed to vapors in the tanks that are not compatible with the transducer material.
 - c. Transducers shall be capable of being completely submersed without damage.
 - d. Transducers shall be suitable for surface, pipe, or flange mounting as indicated on the Drawings. Appropriate mounting hardware shall be provided. Flanges shall be nominal 8-inch or as shown on the Drawings, resistant to attack by the medium being metered, or where required, shall be protected by corrosion resistant coatings and facings.
4. Options/Accessories Required:
 - a. Transducers located in areas where freezing condensation may occur shall be provided with special heaters or other type of transducer protection designed to prevent sensor icing.
 - b. Signal cable as recommended by the manufacturer, for installation between the transducer(s) and the transmitter. Length, up to 1000 feet (300 m), shall be as required by installation indicated on the Drawings.
5. Manufacturer(s):
 - a. Siemens Model XPS
 - b. Approved equal.

B. Transmitter/Converter

1. Type:
 - a. Microprocessor based compatible with the transducer(s) provided.
2. Functional/Performance:
 - a. Resolution (including transducer): Plus/minus 0.1% of range or 0.08 inches (2 mm), whichever is greater.
 - b. Accuracy (including transducer): Plus/minus 0.25% of range or 0.24 inches (6 mm).
 - c. Range: As required by the installation indicated on the drawings.
 - d. Temperature Range: -20 to 50° C.
 - e. Output: One isolated 4-20 mA output with HART communication and 4 alarm contacts adjustable to trip at any point in the instrument range. Output contacts shall be rated 5 A at 230 VAC.
 - f. Temperature Compensation: Compensation over the temperature range of the sensor.

- g. Display: Digital indicator displaying level/differential level or volume in engineering units or percent as indicated on the Drawings or in the Instrument Device Schedule.
 - h. Diagnostics: On screen instructions and display of self diagnostics.
 - i. Loss of Signal: Transmitter shall ignore momentary loss-of-echo signals and shall indicate loss of echo on the transmitter unit.
 - j. Configuration Protection: Programmable parameters shall be protected using E2PROM. Battery backup protection is not acceptable
- 3. Physical:
 - a. Transmitter shall be suitable for surface or pipe stand mounting.
 - b. Enclosure shall be NEMA 4X (IP65).
 - c. 120VAC input power or as shown on the Instrument List.
- 4. Accessories Required:
 - a. Handheld programmer where required for configuration and calibration of the instrument.
- 5. Manufacturer(s):
 - a. Siemens Model HydroRanger 200.
 - b. Approved equal.

2.08 RF ADMITTANCE TYPE POINT LEVEL SWITCH

A. Sensor

- 1. Type:
 - a. Rigid probe.
- 2. Function/Performance:
 - a. Range: Range and trip points shall be as indicated in the instrument device schedule.
 - b. Operating Temperature: -40 to 60° C.
- 3. Physical:
 - a. Probe diameters shall be 0.375 inches (9.5 mm) minimum. The probe diameter shall be as recommended by the supplier for the conditions of installation, i.e. probe length and degree of agitation in the tank.
 - b. Probes shall be completely insulated. For corrosive applications the insulating material shall be resistant to corrosion by the medium being metered. Insulating material shall be bonded to the probe.

- c. In corrosive applications, other parts exposed to the process shall also be coated for protection against corrosion.
 - d. Probe assembly shall include an integral ground reference element where installed in concrete structures or non-metallic tanks. Ground reference elements shall be coated with or manufactured from materials resistant to corrosion by the medium being metered.
 - e. Probe mounting shall be a 4 inch (100 mm), 150 lb., 316 stainless steel flange for non corrosive applications. Flanges for corrosive applications shall be of materials resistant to corrosion by the medium being metered, or shall be protected by corrosion resistant coatings and facings.
 - 4. Manufacturer(s):
 - a. Warrick (GEMS) no equal to match existing equipment.
- B. Converter/Relays
- 1. Type:
 - a. Integrally mounted electronic converter and relays.
 - 2. Functional/Performance:
 - a. System Accuracy: Plus/minus 1% of span.
 - b. Operating Temperature: -40 to 60° C.
 - c. Output: 5 A, 120 VAC contacts for the number of switching points indicated on the drawings.
 - 3. Physical:
 - a. Housing (including indicator): NEMA 4X (IP65) for non hazardous locations.
 - b. Power supply will be as specified herein.
 - 4. Manufacturer(s):
 - a. Warrick (GEMS) no equal to match existing equipment

2.09 PRESSURE SWITCH

- A. Type:
 - 1. Diaphragm actuated.
- B. Function/Performance:
 - 1. Repeatability: Better than 1 percent of full scale.
 - 2. Setpoint: Field adjustable and set between 30 and 70 percent of the adjustable range.

3. Dead Band: Fixed unless adjustable dead band requirement is noted in the Instrument Device Schedule.
4. Reset: Unit shall be of the automatic reset type unless noted otherwise in the Instrument Device Schedule.
5. Over Range Protection: Over range protection to 150% of the maximum process line pressure.
6. Output: Single pole double throw (SPDT) unless requirement for double pole double throw (DPDT) switch is shown on the instrument device schedule. Switch rating shall be 10 A at 230 VAC.

C. Physical:

1. Housing: NEMA 4X (IP65) for non hazardous areas.
2. Switch Assemblies: Hermetically sealed switches.
3. Wetted Parts: 316L stainless steel diaphragm, viton seals, 316 stainless steel connection port.

D. Accessories/Options Required:

1. Shutoff Valve: Provide a 316 stainless steel shutoff valve. Valve shall be by D/A Manufacturing, Anderson Greenwood, or approved equal.
2. Where indicate on the instrument device schedule, provide a 316 SS snubber for pulsation dampening.

E. Manufacturer(s):

1. Ashcroft no equal to match existing equipment.

2.10 SOLENOID VALVES

- A. General: Provide solenoid valves suitable for water applications, with 304 stainless steel body and wetted parts, lead free conforming to the Safe Drinking Water Act Section 1417, and UL listed. Provide a manual override feature to allow operation of valves in the event of power outage. Provide solenoid valves with minimum temperature operating range from 0-40 degrees C.
- B. Housing and Assembly: NEMA 4X (IP65) except where explosion proof valves are required for use in Classified areas as shown on the Drawing. Provide NBR or PTFE seals and discs with stainless steel springs and silver shading coil. Safe working pressure rating shall be 150 psi minimum.
- C. Wetted Parts: 316L stainless steel diaphragm, viton seals, 316 stainless steel connection port.
- D. Orifice size and coil operating voltage shall be as shown on the Drawings. Provide Normally-Open or Normally-Closed as required by the application.
- E. Manufacturer(s):
 1. ASCO (Emerson), no equal to match existing equipment.

2.11 SUSPENDED SOLIDS ANALYZER (NOT USED)

2.12 CONTROL PANELS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

- A. Equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices are diagrammatic only. Exact locations shall be as determined by the CSI during development and fabrication of systems.
- B. The Drawings indicate the intent and not the precise nature of the interconnection between the individual instruments. Exact nature of the final equipment interconnections shall be as determined by the CSI during development and fabrication of systems.
- C. The process control system software and hardware shall be configured as required to achieve the functional requirements per the Contract Documents.
- D. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as required by the device manufacturer. In no case shall more than one ground point be employed for each shield.
- E. Unless specifically shown in the Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the Drawings. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifolds for calibration, testing and blowdown service shall also be provided. For slurries, chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.
- F. All piping and tubing to and from field instrumentation shall be provided with necessary unions, calibrations and test tees, couplings, adaptors, and shut-off valves. Process tubing shall be installed to slope from the instrument toward process for gas measurement service and from the process toward the instrument for liquid measurement service. Provide drain/vent valves or fittings at any process tubing points where the required slopes cannot be maintained.
- G. Provide local electrical shutoffs and disconnects for all 4-wire field instruments requiring 120 VAC power. Electrical disconnects shall be suitably rated disconnect switches or manual motor starters as specified under Division 16.
- H. Provide all brackets, hangers, and miscellaneous metals required for mounting of equipment. Mounting hardware shall be installed in a workmanlike manner and not interfere with any other equipment.
- I. The CSI shall provide on-site service to oversee installation. Certify that all field wiring for power and signal circuits are completed in accordance with manufacturer's requirements and best industry practice. Provide all necessary system grounding to insure a satisfactory functioning installation.

3.02 SCADA SYSTEM CONFIGURATION

- A. General: Refer to Appendix 13401-D for control and system monitoring requirements for new and existing sites. Develop the control system applications to implement the operational control descriptions for all systems. All process automation controller (PAC) programming,

communication networks, and Human Machine Interface (HMI) graphics and programming shall be performed by the CSI. This Appendix is provided to clarify control strategies to be used to program the system.

- B. The CSI shall utilize their own licensed development software necessary to perform the PAC and HMI configuration work specified herein. Providing development software is not required under this Contract. All other software that may be necessary for a fully configured and operational system including network configuration, alternative PAC configuration packages, and other software shall be provided under this Contract at no additional cost to the District. . All new software licenses and warranties shall be assigned to the District.
- C. Update system configurations and application for the work specified at the HMI located at SCADA Central.
- D. Match the look and feel of the existing graphic screens, color conventions, reports, database configuration, and PAC programming to the greatest extent possible. Examples of District addressing approach, screen graphics, and reports will be provided to the CSI following Notice to Proceed. The existing programming approach and look and feel shall be followed without exception.
- E. Provide Ethernet based network interface for new equipment, fully configured and tested where shown on the drawings. Ethernet network implemented under this Contract shall be compatible with existing OMWD protocols presently in operation at the plant.
- F. The CSI shall be responsible for creating or modifying a minimum of fifteen (15) process specific graphic screen for each PAC or RIO location provided under this Contract. The term “graphic screen” shall refer to the process specific graphic along with all secondary pop-up/pull-down screens used for control, alarm acknowledgement, etc. In addition, CSI shall modify up to three overall main system overview and navigation screens to incorporate modified or new sites as shown on the Contract Documents.
- G. Modified process areas shall maintain full integration into the District’s existing security, system alarm log, and data historian systems.
- H. Provide real time and historical variable trending of all discrete and analog points provided or modified under this Contract to match existing trending screens.
- I. Modification of existing District reports is not required under this Contract.

3.03 TESTING

A. General

- 1. Testing for the control system elements shall be in conform to and coordinated with Section 01665.
- 2. Provide a complete operational control system. Confirmation of an operational control system is dependent upon results derived from test procedures as specified in this Section. CSI shall provide testing prior to shipment of the equipment and also testing of the equipment once installed in the field. Once the system is in operation an additional 30-Day Acceptance Test is required.

3. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.
4. All tests shall be conducted in accordance with approved procedures, forms, and checklist all as submitted by the CSI. Each test to be performed shall be described and a space provided after it for signoff by the appropriate parties after its satisfactory completion. Include "punchlist" forms with the test procedure to document issues that arise during the testing. Punchlist forms shall include a resolution section that allows a description of the correction and signoff areas for CSI and District.
5. Copies of the sign off test procedures, forms and checklists will constitute the required test documentation. The test result forms shall be submitted for review and approval at the completion of each test.
6. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment and data, provide suitable means of simulation. Define these simulations techniques in the test procedures.
7. The District reserves the right to test or retest all specified functions, whether or not explicitly stated on the Test Procedures, as required to determine compliance with the functional requirements of the overall system. Such testing required to determine compliance with the Contract Documents shall be performed at no additional cost to the District.

B. Operational Readiness Test (ORT)

1. General: Prior to startup and the Functional Acceptance Test, the entire system shall be certified (inspected, wired, calibrated, tested, and documented) by the CSI that it is installed and ready for the ORT as defined below. The certification shall confirm that all testing procedures specified herein under the ORT have been successfully completed in their entirety by the CSI prior to scheduling of the witnessed ORT.
2. Loop/Component Inspections and Tests: The entire system shall be checked for proper installation, calibrated and adjusted on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and these Specifications. PID loop tuning shall be completed to achieve functional and stable control loop operation.
3. The Loop/Component Inspections and Tests shall be implemented using forms and checklists developed by the CSI and approved by the District. Each loop shall have a Loop Status Report to organize and track its inspection, adjustment and calibration. These reports shall include the following information and checkoff items with spaces for sign off by the CSI and District:
 - a. Project Name, Test Date, Contractor Name, CSI Name, District Name, and Technician Name
 - b. Loop Number
 - c. Tag Number for each component.

- d. Checkoffs/signoffs for each component.
 - 1) Tag/identification
 - 2) Installation
 - 3) Termination – wiring and tubing
 - 4) Scale, Range, and Setpoint as applicable
 - 5) Calibration/adjustment (4 point for analog, set point for switches) rising and falling
 - e. Checkoffs/signoffs for the loop
 - 1) Panel interface terminations
 - 2) I/O interface terminations
 - 3) I/O signal operation
 - 4) Inputs/outputs operational: received/sent, processed, adjusted
 - 5) System graphic response
 - 6) Total loop operation
 - 7) Process Controller Scaling and Adjustment
 - f. Space for comments
- 4. The CSI shall maintain the Loop Status Reports sheets at the job site and make them available at any time.
 - 5. These inspections, calibrations, and tests do not require witnessing. However, the District shall review Loop Status Sheets and spot-check the test process periodically. Any deficiencies found shall be corrected by the CSI and Contractor prior to commencement of the Functional Acceptance Test.
- C. Functional Acceptance Test (FAT).
- 1. General: Prior to startup, the entire installed instrument and control system shall be certified that it is ready for operation. A witnessed FAT shall be performed on the complete system to demonstrate that it is operating and in compliance with these Specifications. All preliminary testing, inspection, and calibration shall be complete as defined in the Operational Readiness Test.
 - 2. Each specified function and process control shall be demonstrated on a paragraph-by-paragraph, loop-by-loop, and site-by-site basis.
 - 3. CSI shall perform system communication and network testing for each segment. Testing shall include performance and error tracking using standard network administration software.

4. Loop-specific and non-loop-specific tests shall be the same as specified under Factory Tests except that the entire installed system shall be tested from field device to the HMI and all functions demonstrated using live field based data to the greatest extent possible.
5. Updated versions of the documentation specified to be provided for during the Factory Tests shall be made available at the job site during the tests. In addition, one copy of all O & M Manuals shall be available for reference at the job site during testing.
6. Following initial startup, the entire process control system shall operate for a continuous 100 hours without failure before this test will be started. Failure includes device/component failure, process control logic failure, nuisance alarms, network operation failure, etc. Network testing and performance testing shall be on-line and monitoring network operation throughout the 100-hour period to confirm system functionality throughout the testing procedure.
7. Punchlist items and resolutions noted during the test shall be documented on the Punchlist/Resolution form. In the event of rejection of any part or function test procedure, the CSI and Contractor shall perform repairs, replacement, reprogramming, and/or retest within 10 days.

D. 30-Day Acceptance Test

1. After completion of the Operational Readiness and Functional Acceptance Tests, the Contractor shall be responsible for operation of the entire system for a period of 30 consecutive days, under conditions of full plant process operation, without a single non-field repairable malfunction. The 30-day control system acceptance test may occur concurrently with the FAT. Network performance monitoring shall continue throughout the 30-day test period.
2. During this test, District and CSI/Contractor personnel shall be present as required. Provide personnel for this test who have an intimate knowledge of the hardware and software of the system. Off-shift emergencies shall be fully supported by the Contractor's CSI. Provide staff with cell phones or other mobile communication devices to ensure that support staff is available by phone and on-site within 4 hours following a reported problem from operations staff.
3. While this test is proceeding, the District shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. The plant operations shall remain the responsibility of District and the decision of plant operators regarding plant operations shall be final. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes.
4. Any malfunction during the tests shall be analyzed and corrections made by the Contractor/CSI. The District will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.
5. Any malfunction, during this 30 consecutive day test period, which cannot be corrected within 24 hours of occurrence, or more than two similar failures of any duration, will be considered as a non-field-repairable malfunction.
6. Upon completion of repairs the test shall be repeated as specified herein.
7. In the event of rejection of any part or function perform repairs or replacement within 10 days.

8. All computer equipment, network equipment, controllers, data base, process controller logic, and graphical interface system errors must be functioning as required per the specifications prior to the start of each test period. The 30 day test will not be considered successful until all data base points and logic functions are tested and verified to be correct.
9. The total availability of the system shall be greater than 99.5 percent during this test period. Availability shall be defined as:

$$\text{AVAILABILITY} = (\text{TOTAL TIME} - \text{DOWN TIME}) / \text{TOTAL TIME}$$

10. Down times due to power outages or other factors outside the normal protection devices or backup power supplies provided, shall not contribute to the availability test times above.
11. Upon successful completion of the 30-day operation test and subsequent review and approval of complete system final documentation, the system shall be considered substantially complete.

3.04 TRAINING (NOT USED)

END OF SECTION

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APPENDIX 13401-A

REFERENCE DRAWINGS

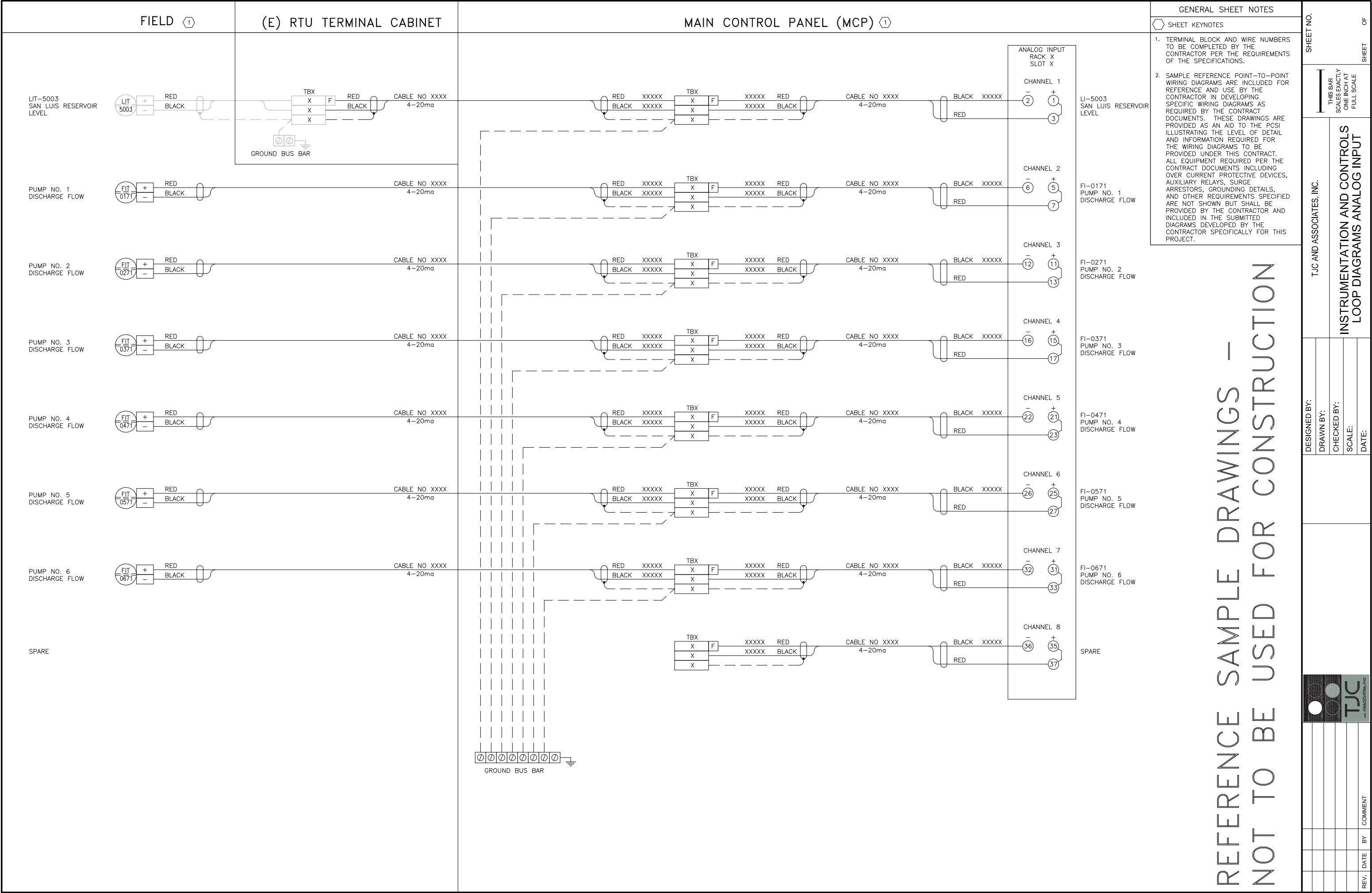
SAMPLE ELECTRICAL SCHEMATICS AND LOOP DIAGRAM

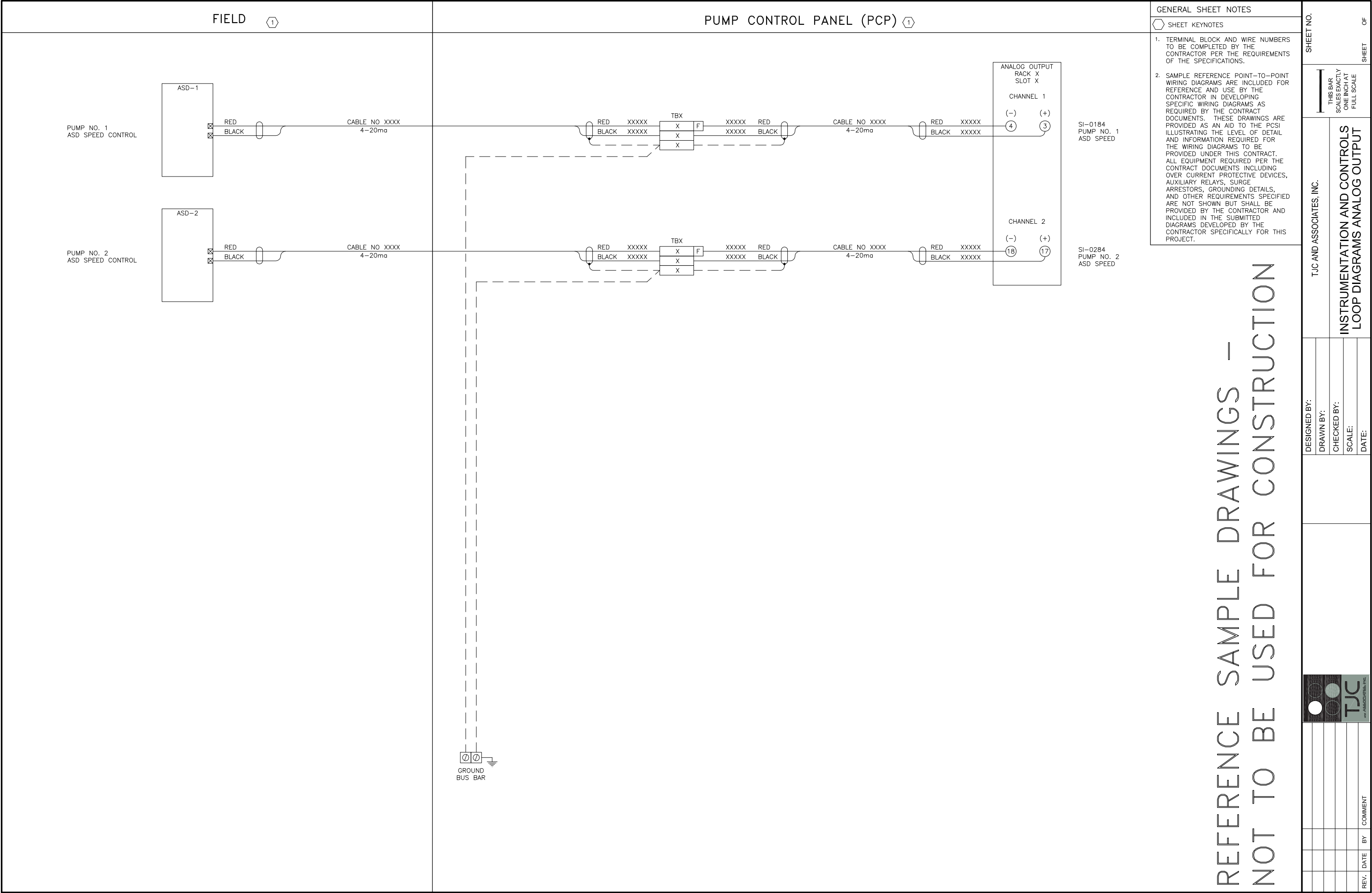
Sample reference electrical schematics and loop diagrams are incorporated into the Drawing set. These sample drawings are included in the Contract Documents for reference and use by the CSI in developing project specific electrical schematic diagrams as specified herein. These drawings are provided as an aid to the CSI illustrating the level of detail and information required for the electrical schematic diagrams to be provided under this Contract.

INDEX OF SAMPLE ELECTRICAL LOOP DIAGRAMS

NO	DWG NO.	DESCRIPTION
1	AI	Instrumentation and Control Loop Diagrams Analog Input
2	AO	Instrumentation and Control Loop Diagrams Analog Output
3	DI	Instrumentation and Control Loop Diagrams Discrete Input
4	DO	Instrumentation and Control Loop Diagrams Discrete Output

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APPENDIX 13401-B

PAC INPUT/OUTPUT (I/O) LIST

The I/O List is included for reference only. The determination of the exact number and type of I/O points shall be the responsibility of the CSI based on the Process Control Loop Descriptions of Appendix 13401-D, auxiliary device requirements, and spare requirements as shown on the Drawings and specified herein.

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Item # (1st Entry Order)	Control Panel ID	Rack	Slot	Point Or Chann el	I/O Type	Device Tag	Signal Tag Number	Use Description	Process Description	Low Range	High Range	Engineering Unit	Alarm Units	P&ID Drawing	Termination Location	Remarks	Clarifications
Rack 25, Slot 1																	
1	CC-RHB	25	1	0	DI	MOV-710-1	HIS-710-1	Third Stage Treatment Unit 1 Inlet Valve MOV-710-1 Remote	Third Stage Treatment Units					7I-1	MOV-710-1		
2	CC-RHB	25	1	1	DI	MOV-710-1	ZSO-710-1	Third Stage Treatment Unit 1 Inlet Valve MOV-710-1 Opened	Third Stage Treatment Units					7I-1	MOV-710-1		
3	CC-RHB	25	1	2	DI	MOV-710-1	ZSC-710-1	Third Stage Treatment Unit 1 Inlet Valve MOV-710-1 Closed	Third Stage Treatment Units					7I-1	MOV-710-1		
4	CC-RHB	25	1	3	DI	MOV-710-2	HIS-710-2	Third Stage Treatment Unit 1 Outlet Valve MOV-710-2 Remote	Third Stage Treatment Units					7I-1	MOV-710-2		
5	CC-RHB	25	1	4	DI	MOV-710-2	ZSO-710-2	Third Stage Treatment Unit 1 Outlet Valve MOV-710-2 Opened	Third Stage Treatment Units					7I-1	MOV-710-2		
6	CC-RHB	25	1	5	DI	MOV-710-2	ZSC-710-2	Third Stage Treatment Unit 1 Outlet Valve MOV-710-2 Closed	Third Stage Treatment Units					7I-1	MOV-710-2		
7	CC-RHB	25	1	6	DI	M-7002	YS-7002	Third Stage Treatment Unit 1 Rapid Mixer Running	Third Stage Treatment Units					7I-1	STR-7002		
8	CC-RHB	25	1	7	DI	M-7002	HIS-7002	Third Stage Treatment Unit 1 Rapid Mixer Remote	Third Stage Treatment Units					7I-1	STR-7002		
9	CC-RHB	25	1	8	DI	M-7002	YA-7002	Third Stage Treatment Unit 1 Rapid Mixer Fail	Third Stage Treatment Units					7I-1	STR-7002		
10	CC-RHB	25	1	9	DI	M-7003	YS-7003	Third Stage Treatment Unit 1 Flocculator Running	Third Stage Treatment Units					7I-1	STR-7003		
11	CC-RHB	25	1	10	DI	M-7003	HIS-7003	Third Stage Treatment Unit 1 Flocculator Remote	Third Stage Treatment Units					7I-1	STR-7003		
12	CC-RHB	25	1	11	DI	M-7003	YA-7003	Third Stage Treatment Unit 1 Flocculator Fail	Third Stage Treatment Units					7I-1	STR-7003		
13	CC-RHB	25	1	12	DI	M-7004	YS-7004	Third Stage Treatment Unit 1 Sludge Rake Running	Third Stage Treatment Units					7I-1	STR-7004		
14	CC-RHB	25	1	13	DI	M-7004	HIS-7004	Third Stage Treatment Unit 1 Sludge Rake Remote	Third Stage Treatment Units					7I-1	STR-7004		
15	CC-RHB	25	1	14	DI	M-7004	YA-7004	Third Stage Treatment Unit 1 Sludge Rake Fail	Third Stage Treatment Units					7I-1	STR-7004		
16	CC-RHB	25	1	15	DI	FIT-710	FQIT-710	Flow to Third Stage Treatment Totalizer	Third Stage Treatment Units					7I-1	FIT-710		
Rack 25, Slot 2																	
17	CC-RHB	25	2	0	DI	MOV-711-1	HIS-711-1	Third Stage Treatment Unit 2 Inlet Valve MOV-711-1 Remote	Third Stage Treatment Units					7I-1	MOV-711-1		
18	CC-RHB	25	2	1	DI	MOV-711-1	ZSO-711-1	Third Stage Treatment Unit 2 Inlet Valve MOV-711-1 Opened	Third Stage Treatment Units					7I-1	MOV-711-1		
19	CC-RHB	25	2	2	DI	MOV-711-1	ZSC-711-1	Third Stage Treatment Unit 2 Inlet Valve MOV-711-1 Closed	Third Stage Treatment Units					7I-1	MOV-711-1		
20	CC-RHB	25	2	3	DI	MOV-711-2	HIS-711-2	Third Stage Treatment Unit 2 Outlet Valve MOV-711-2 Remote	Third Stage Treatment Units					7I-1	MOV-711-2		
21	CC-RHB	25	2	4	DI	MOV-711-2	ZSO-711-2	Third Stage Treatment Unit 2 Outlet Valve MOV-711-2 Opened	Third Stage Treatment Units					7I-1	MOV-711-2		
22	CC-RHB	25	2	5	DI	MOV-711-2	ZSC-711-2	Third Stage Treatment Unit 2 Outlet Valve MOV-711-2 Closed	Third Stage Treatment Units					7I-1	MOV-711-2		
23	CC-RHB	25	2	6	DI	M-7022	YS-7022	Third Stage Treatment Unit 2 Rapid Mixer Running	Third Stage Treatment Units					7I-1	STR-7022		
24	CC-RHB	25	2	7	DI	M-7022	HIS-7022	Third Stage Treatment Unit 2 Rapid Mixer Remote	Third Stage Treatment Units					7I-1	STR-7022		
25	CC-RHB	25	2	8	DI	M-7022	YA-7022	Third Stage Treatment Unit 2 Rapid Mixer Fail	Third Stage Treatment Units					7I-1	STR-7022		
26	CC-RHB	25	2	9	DI	M-7023	YS-7023	Third Stage Treatment Unit 2 Flocculator Running	Third Stage Treatment Units					7I-1	STR-7023		
27	CC-RHB	25	2	10	DI	M-7023	HIS-7023	Third Stage Treatment Unit 2 Flocculator Remote	Third Stage Treatment Units					7I-1	STR-7023		
28	CC-RHB	25	2	11	DI	M-7023	YA-7023	Third Stage Treatment Unit 2 Flocculator Fail	Third Stage Treatment Units					7I-1	STR-7023		
29	CC-RHB	25	2	12	DI	M-7024	YS-7024	Third Stage Treatment Unit 2 Sludge Rake Running	Third Stage Treatment Units					7I-1	STR-7024		
30	CC-RHB	25	2	13	DI	M-7024	HIS-7024	Third Stage Treatment Unit 2 Sludge Rake Remote	Third Stage Treatment Units					7I-1	STR-7024		
31	CC-RHB	25	2	14	DI	M-7024	YA-7024	Third Stage Treatment Unit 2 Sludge Rake Fail	Third Stage Treatment Units					7I-1	STR-7024		
32	CC-RHB	25	2	15	DI	FIT-711	FQIT-711	Third Stage Decant Flow Totalizer	Third Stage Treatment Units					7I-1	FIT-711		
Rack 25, Slot 3																	
33	CC-RHB	25	3	0	DI	MOV-712-1	HIS-712-1	Third Stage Treatment Unit 3 Inlet Valve MOV-712-1 Remote	Third Stage Treatment Units					7I-1	MOV-712-1		
34	CC-RHB	25	3	1	DI	MOV-712-1	ZSO-712-1	Third Stage Treatment Unit 3 Inlet Valve MOV-712-1 Opened	Third Stage Treatment Units					7I-1	MOV-712-1		
35	CC-RHB	25	3	2	DI	MOV-712-1	ZSC-712-1	Third Stage Treatment Unit 3 Inlet Valve MOV-712-1 Closed	Third Stage Treatment Units					7I-1	MOV-712-1		
36	CC-RHB	25	3	3	DI	MOV-712-2	HIS-712-2	Third Stage Treatment Unit 3 Outlet Valve MOV-712-2 Remote	Third Stage Treatment Units					7I-1	MOV-712-2		
37	CC-RHB	25	3	4	DI	MOV-712-2	ZSO-712-2	Third Stage Treatment Unit 3 Outlet Valve MOV-712-2 Opened	Third Stage Treatment Units					7I-1	MOV-712-2		
38	CC-RHB	25	3	5	DI	MOV-712-2	ZSC-712-2	Third Stage Treatment Unit 3 Outlet Valve MOV-712-2 Closed	Third Stage Treatment Units					7I-1	MOV-712-2		
39	CC-RHB	25	3	6	DI	M-7042	YS-7042	Third Stage Treatment Unit 3 Rapid Mixer Running	Third Stage Treatment Units					7I-1	STR-7042		
40	CC-RHB	25	3	7	DI	M-7042	HIS-7042	Third Stage Treatment Unit 3 Rapid Mixer Remote	Third Stage Treatment Units					7I-1	STR-7042		
41	CC-RHB	25	3	8	DI	M-7042	YA-7042	Third Stage Treatment Unit 3 Rapid Mixer Fail	Third Stage Treatment Units					7I-1	STR-7042		
42	CC-RHB	25	3	9	DI	M-7043	YS-7043	Third Stage Treatment Unit 3 Flocculator Running	Third Stage Treatment Units					7I-1	STR-7043		
43	CC-RHB	25	3	10	DI	M-7043	HIS-7043	Third Stage Treatment Unit 3 Flocculator Remote	Third Stage Treatment Units					7I-1	STR-7043		
44	CC-RHB	25	3	11	DI	M-7043	YA-7043	Third Stage Treatment Unit 3 Flocculator Fail	Third Stage Treatment Units					7I-1	STR-7043		
45	CC-RHB	25	3	12	DI	M-7044	YS-7044	Third Stage Treatment Unit 3 Sludge Rake Running	Third Stage Treatment Units					7I-1	STR-7044		
46	CC-RHB	25	3	13	DI	M-7044	HIS-7044	Third Stage Treatment Unit 3 Sludge Rake Remote	Third Stage Treatment Units					7I-1	STR-7044		
47	CC-RHB	25	3	14	DI	M-7044	YA-7044	Third Stage Treatment Unit 3 Sludge Rake Fail	Third Stage Treatment Units					7I-1	STR-7044		
48	CC-RHB	25	3	15	DI	FIT-712	FQIT-712	Third Stage Flow to Thickened Solids Storage Totalizer	Third Stage Treatment Units					7I-1	FIT-712		
Rack 25, Slot 4																	
49	CC-RHB	25	4	0	DI	P-725-1	YS-725-1	Sludge Recirc Pump 1 Running	Centrifuge Feed					7I-2	LCP-725-1		
50	CC-RHB	25	4	1	DI	P-725-1	HIS-725-1	Sludge Recirc Pump 1 Remote	Centrifuge Feed					7I-2	LCP-725-1		
51	CC-RHB	25	4	2	DI	P-725-1	YA-725-1	Sludge Recirc Pump 1 Fault	Centrifuge Feed					7I-2	LCP-725-1		
52	CC-RHB	25	4	3	DI	PSL-725-1	PAL-725-1	Sludge Recirc Pump 1 Low Inlet Pressure	Centrifuge Feed					7I-2	LCP-725-1		
53	CC-RHB	25	4	4	DI	TSH-725-1	TAH-725-1	Sludge Recirc Pump 1 High Temperature	Centrifuge Feed					7I-2	LCP-725-1		
54	CC-RHB	25	4	5	DI	P-726-1	YS-726-1	Centrifuge Feed Pump 1 Running	Centrifuge Feed					I-4	VFD-726-1		
55	CC-RHB	25	4	6	DI	P-726-1	HIS-726-1	Centrifuge Feed Pump 1 Remote	Centrifuge Feed					I-4	VFD-726-1		
56	CC-RHB	25	4	7	DI	P-726-1	YA-726-1	Centrifuge Feed Pump 1 Fault	Centrifuge Feed					I-4	VFD-726-1		
57	CC-RHB	25	4	8	DI	PSH-726-1	PAH-726-1	Centrifuge Feed Pump 1 High Discharge Pressure	Centrifuge Feed					I-4	VFD-726-1	Existing instrument replaced with new	
58	CC-RHB	25	4	9	DI	PSL-726-1	PAL-726-1	Centrifuge Feed Pump 1 Low Suction Pressure	Centrifuge Feed					I-4	VFD-726-1	Existing instrument replaced with new	
59	CC-RHB	25	4	10	DI	TSH-726-1	TAH-726-1	Centrifuge Feed Pump 1 High Temperature	Centrifuge Feed					I-4	VFD-726-1		
60	CC-RHB	25	4	11	DI	FIT-726-1	FQIT-726-1	Centrifuge Feed Pump 1 Discharge Flow Totalizer	Centrifuge Feed					I-4	FIT-726-1		

61	CC-RHB	25	4	12	DI	LSH-720-1	LSH-720-1	Thickened Solids Storage Tank 1 Level High	Centrifuge Feed						7I-2	LSH-720-1	
62	CC-RHB	25	4	13	DI			Spare Point									
63	CC-RHB	25	4	14	DI			Spare Point									
64	CC-RHB	25	4	15	DI			Spare Point									
Rack 25, Slot 5																	
65	CC-RHB	25	5	0	DI	P-725-2	YS-725-2	Sludge Recirc Pump 2 Running	Centrifuge Feed						7I-2	LCP-725-2	
66	CC-RHB	25	5	1	DI	P-725-2	HIS-725-2	Sludge Recirc Pump 2 Remote	Centrifuge Feed						7I-2	LCP-725-2	
67	CC-RHB	25	5	2	DI	P-725-2	YA-725-2	Sludge Recirc Pump 2 Fault	Centrifuge Feed						7I-2	LCP-725-2	
68	CC-RHB	25	5	3	DI	PSL-725-2	PAL-725-2	Sludge Recirc Pump 2 Low Inlet Pressure	Centrifuge Feed						7I-2	LCP-725-2	
69	CC-RHB	25	5	4	DI	TSH-725-2	TAH-725-2	Sludge Recirc Pump 2 High Temperature	Centrifuge Feed						7I-2	LCP-725-2	
70	CC-RHB	25	5	5	DI	P-726-2	YS-726-2	Centrifuge Feed Pump 2 Running	Centrifuge Feed						I-4	VFD-726-2	
71	CC-RHB	25	5	6	DI	P-726-2	HIS-726-2	Centrifuge Feed Pump 2 Remote	Centrifuge Feed						I-4	VFD-726-2	
72	CC-RHB	25	5	7	DI	P-726-2	YA-726-2	Centrifuge Feed Pump 2 Fault	Centrifuge Feed						I-4	VFD-726-2	
73	CC-RHB	25	5	8	DI	PSH-726-2	PAH-726-2	Centrifuge Feed Pump 2 High Discharge Pressure	Centrifuge Feed						I-4	VFD-726-2	Existing instrument replaced with new
74	CC-RHB	25	5	9	DI	PSL-726-2	PAL-726-2	Centrifuge Feed Pump 2 Low Suction Pressure	Centrifuge Feed						I-4	VFD-726-2	Existing instrument replaced with new
75	CC-RHB	25	5	10	DI	TSH-726-2	TAH-726-2	Centrifuge Feed Pump 2 High Temperature	Centrifuge Feed						I-4	VFD-726-2	
76	CC-RHB	25	5	11	DI	FIT-726-2	FQIT-726-2	Centrifuge Feed Pump 2 Discharge Flow Totalizer	Centrifuge Feed						I-4	FIT-726-2	
77	CC-RHB	25	5	12	DI	LSH-720-2	LSH-720-2	Thickened Solids Storage Tank 2 Level High	Centrifuge Feed						7I-2	LSH-720-2	
78	CC-RHB	25	5	13	DI			Spare Point									
79	CC-RHB	25	5	14	DI			Spare Point									
80	CC-RHB	25	5	15	DI			Spare Point									
Rack 25, Slot 6																	
81	CC-RHB	25	6	0	DI	P-725-3	YS-725-3	Sludge Recirc Pump 3 Running	Centrifuge Feed						7I-2	LCP-725-3	
82	CC-RHB	25	6	1	DI	P-725-3	HIS-725-3	Sludge Recirc Pump 3 Remote	Centrifuge Feed						7I-2	LCP-725-3	
83	CC-RHB	25	6	2	DI	P-725-3	YA-725-3	Sludge Recirc Pump 3 Fault	Centrifuge Feed						7I-2	LCP-725-3	
84	CC-RHB	25	6	3	DI	PSL-725-3	PAL-725-3	Sludge Recirc Pump 3 Low Inlet Pressure	Centrifuge Feed						7I-2	LCP-725-3	
85	CC-RHB	25	6	4	DI	TSH-725-3	TAH-725-3	Sludge Recirc Pump 3 High Temperature	Centrifuge Feed						7I-2	LCP-725-3	
86	CC-RHB	25	6	5	DI	P-726-3	YS-726-3	Centrifuge Feed 3 Running	Centrifuge Feed						I-6	VFD-726-3	
87	CC-RHB	25	6	6	DI	P-726-3	HIS-726-3	Centrifuge Feed 3 Remote	Centrifuge Feed						I-6	VFD-726-3	
88	CC-RHB	25	6	7	DI	P-726-3	YA-726-3	Centrifuge Feed 3 Fault	Centrifuge Feed						I-6	VFD-726-3	
89	CC-RHB	25	6	8	DI	PSH-726-3	PAH-726-3	Centrifuge Feed 3 High Discharge Pressure	Centrifuge Feed						I-6	VFD-726-3	
90	CC-RHB	25	6	9	DI	PSL-726-3	PAL-726-3	Centrifuge Feed 3 Low Suction Pressure	Centrifuge Feed						I-6	VFD-726-3	
91	CC-RHB	25	6	10	DI	TSH-726-3	TAH-726-3	Centrifuge Feed 3 High Temperature	Centrifuge Feed						I-6	VFD-726-3	
92	CC-RHB	25	6	11	DI	FIT-726-3	FQIT-726-3	Centrifuge Feed Pump 3 Discharge Flow Totalizer	Centrifuge Feed						I-4	FIT-726-3	
93	CC-RHB	25	6	12	DI			Spare Point									
94	CC-RHB	25	6	13	DI			Spare Point									
95	CC-RHB	25	6	14	DI			Spare Point									
96	CC-RHB	25	6	15	DI			Spare Point									
Rack 25, Slot 7																	
97	CC-RHB	25	7	0	DI	P-740-1	YS-740-1	Centrate Pump 1 Running	Dewatered Solids and Centrate Handling						I-6	VFD-740-1	Connect to new VFD
98	CC-RHB	25	7	1	DI	P-740-1	HIS-740-1	Centrate Pump 1 Remote	Dewatered Solids and Centrate Handling						I-6	VFD-740-1	Connect to new VFD
99	CC-RHB	25	7	2	DI	P-740-1	YA-740-1	Centrate Pump 1 Fault	Dewatered Solids and Centrate Handling						I-6	VFD-740-1	Connect to new VFD
100	CC-RHB	25	7	3	DI	PSH-740-1	PAH-740-1	Centrate Pump 1 High Discharge Pressure	Dewatered Solids and Centrate Handling						I-6	VFD-740-1	Existing instrument to be replaced with new
101	CC-RHB	25	7	4	DI	PSL-740-1	PAL-740-1	Centrate Pump 1 Low Suction Pressure	Dewatered Solids and Centrate Handling						I-6	VFD-740-1	Existing instrument to be replaced with new
102	CC-RHB	25	7	5	DI	TSH-740-1	TAH-740-1	Centrate Pump 1 High Temperature	Dewatered Solids and Centrate Handling						I-6	VFD-740-1	Connect to new VFD
103	CC-RHB	25	7	6	DI			Spare Point									
104	CC-RHB	25	7	7	DI			Spare Point									
105	CC-RHB	25	7	8	DI			Spare Point									
106	CC-RHB	25	7	9	DI			Spare Point									
107	CC-RHB	25	7	10	DI			Spare Point									
108	CC-RHB	25	7	11	DI			Spare Point									
109	CC-RHB	25	7	12	DI			Spare Point									
110	CC-RHB	25	7	13	DI			Spare Point									
111	CC-RHB	25	7	14	DI			Spare Point									
112	CC-RHB	25	7	15	DI			Spare Point									
Rack 25, Slot 8																	
113	CC-RHB	25	8	0	DI	P-740-2	YS-740-2	Centrate Pump 2 Running	Dewatered Solids and Centrate Handling						I-6	VFD-740-2	Connect to new VFD
114	CC-RHB	25	8	1	DI	P-740-2	HIS-740-2	Centrate Pump 2 Remote	Dewatered Solids and Centrate Handling						I-6	VFD-740-2	Connect to new VFD
115	CC-RHB	25	8	2	DI	P-740-2	YA-740-2	Centrate Pump 2 Fault	Dewatered Solids and Centrate Handling						I-6	VFD-740-2	Connect to new VFD
116	CC-RHB	25	8	3	DI	PSH-740-2	PAH-740-2	Centrate Pump 2 High Discharge Pressure	Dewatered Solids and Centrate Handling						I-6	VFD-740-2	Existing instrument replaced with new
117	CC-RHB	25	8	4	DI	PSL-740-2	PAL-740-2	Centrate Pump 2 Low Suction Pressure	Dewatered Solids and Centrate Handling						I-6	VFD-740-2	Existing instrument replaced with new
118	CC-RHB	25	8	5	DI	TSH-740-2	TAH-740-2	Centrate Pump 2 High Temperature	Dewatered Solids and Centrate Handling						I-6	VFD-740-2	Connect to new VFD
119	CC-RHB	25	8	6	DI			Spare Point									
120	CC-RHB	25	8	7	DI			Spare Point									
121	CC-RHB	25	8	8	DI	FIT-740	FQIT-740	Centrate Pumps Discharge Flow Totalizer	Dewatered Solids and Centrate Handling						7I-4	FIT-740	
122	CC-RHB	25	8	9	DI	LSHH-740	LSHH-740	Centrate Storage Tank Level High High	Dewatered Solids and Centrate Handling						I-6	LSHH-740	Existing instrument replaced with new
123	CC-RHB	25	8	10	DI	LSLL-740	LSLL-740	Centrate Storage Tank Level Low Low	Dewatered Solids and Centrate Handling						I-6	LSLL-740	Existing instrument replaced with new
124	CC-RHB	25	8	11	DI			Centrate Storage Tank Level High -- NOT USED									
								SPARE									
125	CC-RHB	25	8	12	DI			Centrate Storage Tank Level Low -- NOT USED									
126	CC-RHB	25	8	13	DI			Spare Point									
127	CC-RHB	25	8	14	DI			Spare Point									
128	CC-RHB	25	8	15	DI			Spare Point									
Rack 25, Slot 9																	
129	CC-RHB	25	9	0	DI	P-754-1	YS-754-1	Catfloc Metering Pump 1 Running	Third Stage Treatment Chemical System						7I-5	VFD-754-1	
130	CC-RHB	25	9	1	DI	P-754-1	HIS-754-1	Catfloc Metering Pump 1 Remote	Third Stage Treatment Chemical System						7I-5	VFD-754-1	
131	CC-RHB	25	9	2	DI	P-754-1	YA-754-1	Catfloc Metering Pump 1 Fault	Third Stage Treatment Chemical System						7I-5	VFD-754-1	
132	CC-RHB	25	9	3	DI	PSH-754-1	PAH-754-1	Catfloc Metering Pump 1 High Discharge Pressure	Third Stage Treatment Chemical System						7I-5	VFD-754-1	
133	CC-RHB	25	9	4	DI	P-755-1	YS-755-1	Centrifuge Polymer Metering Pump 1 Running	Third Stage Treatment Chemical System						I-7	VFD-755-1	
134	CC-RHB	25	9	5	DI	P-755-1	HIS-755-1	Centrifuge Polymer Metering Pump 1 Remote	Third Stage Treatment Chemical System						I-7	VFD-755-1	
135	CC-RHB	25	9	6	DI	P-755-1	YA-755-1	Centrifuge Polymer Metering Pump 1 Fault	Third Stage Treatment Chemical System						I-7	VFD-755-1	
136	CC-RHB	25	9	7	DI			Centrifuge Polymer Metering Pump 1 High Discharge Pressure -- NOT USED									
								SPARE									
137	CC-RHB	25	9	8	DI	P-756-1	YS-756-1	Third Stage Polymer Metering Pump 1 Running	Third Stage Treatment Chemical System						7I-5	VFD-756-1	
138	CC-RHB	25	9	9	DI	P-756-1	HIS-756-1	Third Stage Polymer Metering Pump 1 Remote	Third Stage Treatment Chemical System						7I-5	VFD-756-1	
139	CC-RHB	25	9	10	DI	P-756-1	YA-756-1	Third Stage Polymer Metering Pump 1 Fault	Third Stage Treatment Chemical System						7I-5	VFD-756-1	

Rack 25, Slot 14

17	CC-RHB	25	14	0	DO	MOV-711-1	HSO-711-1	Third Stage Treatment Unit 2 Inlet Valve MOV-711-1 Close Command	Third Stage Treatment Units					7I-1	MOV-711-1		
18	CC-RHB	25	14	1	DO	MOV-711-1	HSC-711-1	Third Stage Treatment Unit 2 Inlet Valve MOV-711-1 Open Command	Third Stage Treatment Units					7I-1	MOV-711-1		
19	CC-RHB	25	14	2	DO	MOV-711-2	HSO-711-2	Third Stage Treatment Unit 2 Outlet Valve MOV-711-2 Close Command	Third Stage Treatment Units					7I-1	MOV-711-2		
20	CC-RHB	25	14	3	DO	MOV-711-2	HSC-711-2	Third Stage Treatment Unit 2 Outlet Valve MOV-711-2 Open Command	Third Stage Treatment Units					7I-1	MOV-711-2		
21	CC-RHB	25	14	4	DO	SV-711	SV-711	Third Stage Treatment Unit 2 SV-711 Open Command	Third Stage Treatment Units					7I-1	SV-711		
22	CC-RHB	25	14	5	DO	M-7022	HS-7022	Third Stage Treatment Unit 2 Rapid Mixer Start/Stop Command	Third Stage Treatment Units					7I-1	STR-7022		
23	CC-RHB	25	14	6	DO	M-7023	HS-7023	Third Stage Treatment Unit 2 Flocculator Start/Stop Command	Third Stage Treatment Units					7I-1	STR-7023		
24	CC-RHB	25	14	7	DO	M-7024	HS-7024	Third Stage Treatment Unit 2 Sludge Rake Start/Stop Command	Third Stage Treatment Units					7I-1	STR-7024		
25	CC-RHB	25	14	8	DO	P-725-2	HS-725-2	Sludge Recirc Pump 2 Start/Stop Command	Centrifuge Feed					7I-2	LCP-725-2		
26	CC-RHB	25	14	9	DO	SV-725-2	SV-725-2	Sludge Recirculation Pump 2 SV-725-2 Open Command	Centrifuge Feed					7I-2	SV-725-2		
27	CC-RHB	25	14	10	DO	P-726-2	HS-726-2	Centrifuge Feed Pump 2 Start/Stop Command	Centrifuge Feed					I-4	VFD-726-2		
28	CC-RHB	25	14	11	DO	P-740-2	HS-740-2	Centrate Pump 2 Start/Stop Command	Dewatered Solids and Centrate Handling					I-6	VFD-740-2	Connect to new VFD	
29	CC-RHB	25	14	12	DO	P-754-2	HS-754-2	Catfloc Metering Pump 2 Start/Stop Command	Third Stage Treatment Chemical System					7I-5	VFD-754-2		
30	CC-RHB	25	14	13	DO	P-755-2	HS-755-2	Centrifuge Polymer Metering Pump 2 Start/Stop Command	Third Stage Treatment Chemical System					I-7	VFD-755-2		
31	CC-RHB	25	14	14	DO	P-756-2	HS-756-2	Third Stage Polymer Metering Pump 2 Start/Stop Command	Third Stage Treatment Chemical System					7I-5	VFD-756-2		
32	CC-RHB	25	14	15	DO			Spare Point									

Rack 25, Slot 15

33	CC-RHB	25	15	0	DO	MOV-712-1	HSO-712-1	Third Stage Treatment Unit 3 Inlet Valve MOV-712-1 Close Command	Third Stage Treatment Units					7I-1	MOV-712-1		
34	CC-RHB	25	15	1	DO	MOV-712-1	HSC-712-1	Third Stage Treatment Unit 3 Inlet Valve MOV-712-1 Open Command	Third Stage Treatment Units					7I-1	MOV-712-1		
35	CC-RHB	25	15	2	DO	MOV-712-2	HSO-712-2	Third Stage Treatment Unit 3 Outlet Valve MOV-712-2 Close Command	Third Stage Treatment Units					7I-1	MOV-712-2		
36	CC-RHB	25	15	3	DO	MOV-712-2	HSC-712-2	Third Stage Treatment Unit 3 Outlet Valve MOV-712-2 Open Command	Third Stage Treatment Units					7I-1	MOV-712-2		
37	CC-RHB	25	15	4	DO	SV-712	SV-712	Third Stage Treatment Unit 3 SV-712 Open Command	Third Stage Treatment Units					7I-1	SV-712		
38	CC-RHB	25	15	5	DO	M-7042	HS-7042	Third Stage Treatment Unit 3 Rapid Mixer Start/Stop Command	Third Stage Treatment Units					7I-1	STR-7042		
39	CC-RHB	25	15	6	DO	M-7043	HS-7043	Third Stage Treatment Unit 3 Flocculator Start/Stop Command	Third Stage Treatment Units					7I-1	STR-7043		
40	CC-RHB	25	15	7	DO	M-7044	HS-7044	Third Stage Treatment Unit 3 Sludge Rake Start/Stop Command	Third Stage Treatment Units					7I-1	STR-7044		
41	CC-RHB	25	15	8	DO	P-725-3	HS-725-3	Sludge Recirc Pump 3 Start/Stop Command	Centrifuge Feed					7I-2	LCP-725-3		
42	CC-RHB	25	15	9	DO	SV-725-3	SV-725-3	Sludge Recirculation Pump 3 SV-725-3 Open Command	Centrifuge Feed					7I-2	SV-725-3		
43	CC-RHB	25	15	10	DO			Spare Point									
44	CC-RHB	25	15	11	DO	P-752-1	HS-752-1	Polyblend System Start/Stop Command	Third Stage Treatment Chemical System					7I-5	LCP-752		
45	CC-RHB	25	15	12	DO	SV-752	SV-752	Polyblend System Valve Open Command	Third Stage Treatment Chemical System					7I-5	LCP-752		
46	CC-RHB	25	15	13	DO	P-726-3	HS-726-3	Centrifuge Feed Pump 3 Start/Stop Command	Centrifuge Feed					I-4	VFD-726-3		
47	CC-RHB	25	15	14	DO			Spare Point									
48	CC-RHB	25	15	15	DO			Spare Point									

Rack 25, Slot 16

49	CC-RHB	25	16	0	DO			Spare Point									
50	CC-RHB	25	16	1	DO			Spare Point									
51	CC-RHB	25	16	2	DO			Spare Point									
52	CC-RHB	25	16	3	DO			Spare Point									
53	CC-RHB	25	16	4	DO			Spare Point									
54	CC-RHB	25	16	5	DO			Spare Point									
55	CC-RHB	25	16	6	DO			Spare Point									
56	CC-RHB	25	16	7	DO			Spare Point									
57	CC-RHB	25	16	8	DO			Spare Point									
58	CC-RHB	25	16	9	DO			Spare Point									
59	CC-RHB	25	16	10	DO			Spare Point									
60	CC-RHB	25	16	11	DO			Spare Point									
61	CC-RHB	25	16	12	DO			Spare Point									
62	CC-RHB	25	16	13	DO			Spare Point									
63	CC-RHB	25	16	14	DO			Spare Point									
64	CC-RHB	25	16	15	DO			Spare Point									

Rack 26, Slot 1

1	CC-RHB	26	1	0	AI	AIT-720-1	AIT-720-1	Thickened Solids Storate Tank 1 Total Suspended Solids	Centrifuge Feed	0	20000	mg/L		7I-2	AIT-720-1	
2	CC-RHB	26	1	1	AI	LIT-720-1	LIT-720-1	Thickened Solids Storage Tank 1 Level	Centrifuge Feed	0	12.5	FT		7I-2	LIT-720-1	
3	CC-RHB	26	1	2	AI	FIT-726-1	FIT-726-1	Centrifuge Feed Pump 1 Discharge Flow	Centrifuge Feed	0	100	GPM		I-4	FIT-726-1	
4	CC-RHB	26	1	3	AI	P-726-1	SIO-726-1	Centrifuge Feed Pump 1 Speed Feedback	Centrifuge Feed	0	100	%		I-4	VFD-726-1	
5	CC-RHB	26	1	4	AI	P-740-1	SIO-740-1	Centrate Feed Pump 1 Speed Feedback	Centrate Flow	0	100	%		I-6	VFD-740-1	Connect ot new VFD
6	CC-RHB	26	1	5	AI			Spare Point								

Rack 26, Slot 2

7	CC-RHB	26	2	0	AI	AIT-720-2	AIT-720-2	Thickened Solids Storate Tank 2 Total Suspended Solids	Centrifuge Feed	0	20000	mg/L		7I-2	AIT-720-2	
8	CC-RHB	26	2	1	AI	LIT-720-2	LIT-720-2	Thickened Solids Storage Tank 2 Level	Centrifuge Feed	0	12.5	FT		7I-2	LIT-720-2	
9	CC-RHB	26	2	2	AI	FIT-726-2	FIT-726-2	Centrifuge Feed Pump 2 Discharge Flow	Centrifuge Feed	0	100	GPM		I-4	FIT-726-2	
10	CC-RHB	26	2	3	AI	P-726-2	SIO-726-2	Centrifuge Feed Pump 2 Speed Feedback	Centrifuge Feed	0	100	%		I-4	VFD-726-2	
11	CC-RHB	26	2	4	AI	P-740-2	SIO-740-2	Centrate Feed Pump 2 Speed Feedback	Centrate Flow	0	100	%		I-6	VFD-740-2	Connect ot new VFD
12	CC-RHB	26	2	5	AI			Spare Point								

Rack 26, Slot 3

13	CC-RHB	26	3	0	AI	FIT-710	FIT-710	Flow to Third Stage Treatment	Third Stage Treatment Units	0	1000	GPM		7I-1	FIT-710		
14	CC-RHB	26	3	1	AI	AIT-710-1	AIT-710-1	Third Stage Treatment Units Inlet Total Suspended Solids	Third Stage Treatment Units	0.00	200	NTU		7I-1	AIT-710-1		
15	CC-RHB	26	3	2	AI	AIT-710-2	AIT-710-2	Third Stage Treatment Units Inlet Total Streaming Current	Third Stage Treatment Units	-250	250	CHG		7I-1	AIT-710-2		
16	CC-RHB	26	3	3	AI	AIT-711	AIT-711	Third Stage Treatment Units Decant Total Suspended Solids	Third Stage Treatment Units	0	200	NTU		7I-1	AIT-711		
17	CC-RHB	26	3	4	AI	FIT-711	FIT-711	Third Stage Decant Flow	Third Stage Treatment Units	0	1000	GPM		7I-1	FIT-711		
18	CC-RHB	26	3	5	AI	FIT-712	FIT-712	Third Stage Flow to Thickened Solids Storage	Third Stage Treatment Units	0	1000	GPM		7I-1	FIT-712		
Rack 26, Slot 4																	
19	CC-RHB	26	4	0	AI	P-754-1	SIO-754-1	Catfloc Metering Pump 1 Speed Feedback	Third Stage Treatment Chemical System	0	100	%		7I-5	VFD-754-1		
20	CC-RHB	26	4	1	AI	P-755-1	SIO-755-1	Centrifuge Polymer Metering Pump 1 Speed Feedback	Third Stage Treatment Chemical System	0	100	%		I-7	VFD-755-1		
21	CC-RHB	26	4	2	AI	P-756-1	SIO-756-1	Third Stage Polymer Metering Pump 1 Speed	Third Stage Treatment Chemical System	0	100	%		7I-5	VFD-756-1		
22	CC-RHB	26	4	3	AI	FIT-726-3	FIT-726-3	Centrifuge Feed Pump 3 Discharge Flow	Centrifuge Feed	0	100	GPM		I-4	FIT-726-3		
23	CC-RHB	26	4	4	AI	P-726-3	SIO-726-3	Centrifuge Feed Pump 3 Speed Feedback	Centrifuge Feed	0	100	%		I-4	VFD-726-3		
24	CC-RHB	26	4	5	AI			Spare Point									
Rack 26, Slot 5																	
25	CC-RHB	26	5	0	AI	P-754-2	SIO-754-2	Catfloc Metering Pump 2 Speed Feedback	Third Stage Treatment Chemical System	0	100	%		7I-5	VFD-754-2		
26	CC-RHB	26	5	1	AI	P-755-2	SIO-755-2	Centrifuge Polymer Metering Pump 2 Speed Feedback	Third Stage Treatment Chemical System	0	100	%		I-7	VFD-755-2		
27	CC-RHB	26	5	2	AI	P-756-2	SIO-756-2	Third Stage Polymer Metering Pump 2 Speed	Third Stage Treatment Chemical System	0	100	%		7I-5	VFD-756-2		
28	CC-RHB	26	5	3	AI			Spare Point									
29	CC-RHB	26	5	4	AI	P-752	SIO-752	Polyblend System Speed Feedback	Third Stage Treatment Chemical System	0	100	%		7I-5	LCP-752		
30	CC-RHB	26	5	5	AI			Spare Point									
Rack 26, Slot 6																	
31	CC-RHB	26	6	0	AI	AIT-740	AIT-740	Centrate Storage Tank Total Suspended Solids	Dewatered Solids and Centrate Handling	0	200	NTU		I-6	AIT-740	Existing instrument replaced with new	
32	CC-RHB	26	6	1	AI	FIT-740	FIT-740	Centrate Pumps Discharge Flow	Dewatered Solids and Centrate Handling	0	100	GPM		7I-4	FIT-740		
33	CC-RHB	26	6	2	AI	LIT-740	LIT-740	Centrate Storage Tank Level	Dewatered Solids and Centrate Handling	0	3.5	FT		I-6	LIT-740	Existing instrument replaced with new	
34	CC-RHB	26	6	3	AI	LIT-750	LIT-750	Coagulant Bulk Storage Tank Level	Third Stage Treatment Chemical System	0	6	FT		7I-5	LIT-750		
35	CC-RHB	26	6	4	AI	WIT-751	WIT-751	Polymer Tote Weight	Third Stage Treatment Chemical System	0	5000	LBS		7I-5	WIT-751		Changed to Weight Transmitter
36	CC-RHB	26	6	5	AI	LIT-753	LIT-753	Polymer Day Tank Level	Third Stage Treatment Chemical System	0	4.53	FT		I-4	LIT-753	Existing instrument replaced with new	
Rack 26, Slot 11																	
1	CC-RHB	26	11	0	AO	P-726-1	SIC-726-1	Centrifuge Feed Pump 1 Speed Setpoint	Centrifuge Feed	0	100	%		I-4	VFD-726-1		
2	CC-RHB	26	11	1	AO	P-754-1	SIC-754-1	Catfloc Metering Pump 1 Speed Setpoint	Third Stage Treatment Chemical System	0	100	%		7I-5	VFD-754-1		
3	CC-RHB	26	11	2	AO	P-755-1	SIC-755-1	Centrifuge Polymer Metering Pump 1 Speed Setpoint	Third Stage Treatment Chemical System	0	100	%		I-4	VFD-755-1		
4	CC-RHB	26	11	3	AO	P-756-1	SIC-756-1	Third Stage Polymer Metering Pump 1 Speed Setpoint	Third Stage Treatment Chemical System	0	100	%		7I-5	VFD-756-1		
5	CC-RHB	26	11	4	AO			Spare Point									
6	CC-RHB	26	11	5	AO			Spare Point									
Rack 26, Slot 12																	
7	CC-RHB	26	12	0	AO	P-726-2	SIC-726-2	Centrifuge Feed Pump 2 Speed Setpoint	Centrifuge Feed	0	100	%		I-4	VFD-726-2		
8	CC-RHB	26	12	1	AO	P-754-2	SIC-754-2	Catfloc Metering Pump 2 Speed Setpoint	Third Stage Treatment Chemical System	0	100	%		7I-5	VFD-754-2		
9	CC-RHB	26	12	2	AO	P-755-2	SIC-755-2	Centrifuge Polymer Metering Pump 2 Speed Setpoint	Third Stage Treatment Chemical System	0	100	%		I-4	VFD-755-2		
10	CC-RHB	26	12	3	AO	P-756-2	SIC-756-2	Third Stage Polymer Metering Pump 2 Speed Setpoint	Third Stage Treatment Chemical System	0	100	%		7I-5	VFD-756-2		
11	CC-RHB	26	12	4	AO	P-752-2	SIC-752-1	Polyblend System Speed Setpoint	Third Stage Treatment Chemical System	0	100	%		7I-5	LCP-752		
12	CC-RHB	26	12	5	AO			Spare Point									
Rack 26, Slot 13																	
13	CC-RHB	26	13	0	AO	P-726-3	SIC-726-3	Centrifuge Feed Pump 3 Speed Setpoint	Centrifuge Feed	0	100	%		I-4	VFD-726-3		
14	CC-RHB	26	13	1	AO	P-740-1	SIC-740-1	Centrate Pump 1 Speed Setpoint	Centrate Flow	0	100	%		I-6	VFD-740-1	Speed control for new Centrate Pump VFD	
15	CC-RHB	26	13	2	AO	P-755-3	SIC-755-3	Centrifuge Polymer Metering Pump 3 Speed Setpoint	Third Stage Treatment Chemical System	0	100	%		I-7	VFD-755-3		
16	CC-RHB	26	13	3	AO			Spare Point									
17	CC-RHB	26	13	4	AO			Spare Point									
18	CC-RHB	26	13	5	AO			Spare Point									
Rack 26, Slot 14																	
19	CC-RHB	26	14	0	AO			Spare Point									
20	CC-RHB	26	14	1	AO	P-740-2	SIC-740-2	Centrate Pump 2 Speed Setpoint	Centrate Flow	0	100	%		I-6	VFD-740-2	Speed control for new Centrate Pump VFD	
21	CC-RHB	26	14	2	AO	P-755-4	SIC-755-4	Centrifuge Polymer Metering Pump 4 Speed Setpoint	Third Stage Treatment Chemical System	0	100	%		I-7	VFD-755-4		
22	CC-RHB	26	14	3	AO			Spare Point									
23	CC-RHB	26	14	4	AO			Spare Point									
24	CC-RHB	26	14	5	AO			Spare Point									

NOTES
1. EXISTING I/O IS SHOWN ITALICIZED WITH TAGS AND DRAWINGS REFERENCED TO PREVIOUS CONSTRUCTION CONTRACTS
2. NEW I/O, EITHER REWIRED OR PROVIDED UNDER THIS CONTRACT ARE SHOWN IN **BOLD** WITH DRAWING REFERENCES FOR THIS CONTRACT
3. ONLY NEW AND EXISTING HARDWIRED I/O IS SHOWN. NEW AND EXISTING I/O RESIDENT ON NETWORK LINKS IS NOT SHOWN.

APPENDIX 13401-C

FIELD INSTRUMENT LIST

Field Instrument List is included in Appendix 13401-C. The Instrument List is included for reference only. Only major instruments are included in the Instrument List and miscellaneous switches, relays, and auxiliary devices are not included. Providing all instruments and devices necessary for the a fully functioning system shall be the responsibility of the CSI based on the Process Control Loop Descriptions per Appendix 13401-D, auxiliary device requirements, and spare requirements as shown on the Drawings and specified herein.

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APPENDIX 13401-D

PROCESS CONTROL DESCRIPTIONS

Process Control Descriptions are included in Appendix 13401-D. Develop the control system applications to implement the operational control descriptions for all systems. All process automation controller (PAC) programming, communication networks, and Human Machine Interface (HMI) graphics and programming shall be performed by the CSI. This Appendix is provided to clarify control strategies to be used to program the system.

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APPENDIX 13401-D

PROCESS CONTROL DESCRIPTIONS

1.01 GENERAL

- A. Develop the control system applications to implement the operational control descriptions for all systems. All process automation controller (PAC) programming, communication networks, and Human Machine Interface (HMI) graphics and programming shall be performed by the CSI designated in Section 13400. This Section is provided to clarify control strategies to be used to program the system.
- B. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and Subcontractors to review all sections to insure a complete and coordinated project.
- C. The CSI is cautioned to read this section in its entirety prior to starting any programming. Many general control strategies and requirements are defined once in the body of this Section. The CSI shall implement these general strategies throughout the programming provided under this Contract unless specifically directed otherwise in the detailed Process Control Descriptions included in Appendix 13441-A.
- D. Loop and device tagging criteria shown on the Drawings shall be followed without exception.
- E. Programming approaches shall match existing District PLC system logic in place at the WTP to the greatest extent possible. Existing programs, programming standards, requirements shall be provided upon request following Notice to Proceed and at the specified coordination workshops.
- F. HMI and OIT equipment programming, configuration, graphical interfaces, appearance, color standards, and other features shall match existing District systems to the greatest extent possible to provide an identical look and feel to the existing.

1.02 GENERAL DESCRIPTION

- A. The loop descriptions included in Appendix 13441-A are sorted by loop/device number.
- B. The loop descriptions are broken into a hierarchical layer concept:
 - 1. There may be one layer or multiple layers per loop, depending upon the specific requirements and characteristics of that loop.
 - 2. An example of a multiple layered loop is as follows:
 - a. The lowest layer of control, local control, is at that piece of equipment or that piece of equipment's panel or drive.
 - b. The second layer of control is the Motor Control Center (MCC).
 - c. The third layer of control is at the Operator Interface Terminal (OIT) at the local area control panel.
 - d. The fourth layer of control is by the SCADA System with its associated operator workstations located at the treatment facility or via the operator's remote access.

3. HMI refers to the computer-based control computers configured with a graphical interface to the SCADA System for implementing all operator-required tasks as described herein. Functions labeled under the HMI shall be able to be implemented at all the SCADA HMI's and associated local OITs.

1.03 GENERAL PROGRAMMING REQUIREMENTS

- A. The requirements specified herein represent general programming and control loop requirements to be followed by the CSI for all programming efforts provided under this Contract. These general configuration and control requirements shall be used in conjunction with existing District programs, District interfaces, and the detailed process control loop descriptions included in this Appendix to provide the complete process control loop functionality. The detailed process control loop descriptions do not describe the common configuration and programming requirements and conversely, these general requirements do not address process control specifics unique to a specific loop. However, if conflicts occur between these general requirements and the detailed process control descriptions, the detailed requirements shall be followed.
- B. Not all I/O signals are specifically defined in the Control Descriptions that are included in this Appendix. Control programming, alarming handling, status displays, variable displays, and historical data collection, shall be implemented as specified herein, for all I/O points listed in Appendix 13400-B and shown on the Drawings.
- C. The Human Machine Interface (HMI) refers to the computer based graphical interface for implementing all operator required tasks as described in these Specifications. HMI for this project refers to both the SCADA workstation operator graphics, and the local panel-mounted Operator Interface Terminal (OIT) displays. The HMI sends and receives data to and from the PAC based control system. The PACs control and monitor the process equipment (pumps, valves, flowmeters, field sensors, etc.) through the input and output of electrical signals. In general, only loops requiring PAC and/or HMI programmed logic are described in the following control loops. Hardwired, relay-based control schemes, where required, are included on the schematic control diagrams included on the Drawings.
- D. Process controls and monitoring of the process equipment shall be implemented using a approaches and strategies presently used by the District. All program control logic and alarming functions shall be performed in the PAC using the SCADA programming environment as specified in Section 13401.
- E. PAC programs shall be configured for cyclic operation with all tasks and sections called on every scan.
- F. PAC programs shall be structured with tasks and program sections that are organized logically to match existing program structures.
- G. All processor programs shall be configured to allow modification of set points, timers, etc. readily by Owner personnel using the HMI as identified in the loop descriptions. Logic in the processor program shall be configured to allow modification using the programming devices and software either provided under this Contract and/or existing devices and software as described under Section 13401. All plant control and alarm logic shall be resident in the processors. The system shall continue to operate properly in automatic mode upon failure of the HMI servers.
- H. Any operator entered setpoint change shall include verification logic within the HMI that requires a second, positive selection of the action by the operator (such as an OKAY button) prior to

performing the command. Other operator-controlled operations (e.g., pump start/stop, open/close valve control) shall, in general, not require the second positive action. Selection of a control point shall also present the last valid set point or command sent to the device.

- I. Operator entered setpoints shall be limited to the reasonable operating range of the related process as verified by the District. Setpoints that are entered outside of the reasonable operating range shall be rejected and the setpoint shall return to its previous value. Reasonable operating ranges shall be determined based on Workshop discussions during the software development process.
- J. Incorporate failure of sequence logic to alarm upon incomplete or malfunction if the required operation does not occur within an adjustable time period, initially set at 5 seconds for electric motors, 30 seconds for diesel engines, and 90 seconds for gates and valves. Sequence failure alarm shall put the associated device(s) in FAIL mode if a control system command, either manual or automatic, is not verified by the appropriate action of the device. For example, if a valve is called to open and confirmation of the open valve is not received after the adjustable time period, issue a valve failure alarm; if a motor is called to run and confirmation of the running motor is not received after the adjustable time period, issue a motor fail to start malfunction alarm.
- K. When a power failure occurs, the systems shall fail OFF, OPEN, CLOSE, or other Engineer determined safe position as identified in the loop descriptions. PAC controlled equipment shall remain in the safe (off) condition until manual restart is initiated by the operator.
- L. Motors shall be programmed so if a motor stops for any reason, it shall not be re-started automatically until the problem with the motor has been resolved. Motor restart after stopping will occur only after the operator selects "OFF" twice to reset the failure condition then reinitiates the start command for that motor locally or at the HMI; or when that motor control at the starter and at the HMI is in "Auto" or "Remote" and the PAC through logic/interlocks calls for that motor to run.
- M. PAC based Proportional-Integral-Derivative (PID) controllers shall be tuned by the CSI during Operational Readiness Testing. Tuning of the controllers shall provide either critically-damped or over-damped response, as directed by the engineer, over the entire normal operating range of the control loop. All PID parameters required for tuning and controlling the behavior of the PID controller shall be available at the HMI and shall be accessible by Owner personnel that are authorized to modify PID functions. PID development shall include a setpoint alarm triggered when the process variable deviates from the setpoint by more than an adjustable deviation band for longer than an adjustable time period.
- N. All alarms shall display on a process control graphic and also be tabulated on a common alarm screen. All alarms must be acknowledged by the plant staff before they can be cleared. No alarm shall clear from the alarm summary automatically until it has been acknowledged by the operator. Include an individual alarm reset toggle to clear from the alarm list.
- O. Process alarms that are based on analog input signals shall be generated in PAC logic. The alarms required for each instrument are detailed in the specific Loop Descriptions below. Process alarm setpoints shall be adjustable at the HMI and shall be the same variable type as the process variable that they are associated with (e.g. REAL, INTEGER, etc.).
- P. All analog points brought into the process controller shall incorporate variable range alarms at the PAC with adjustable setpoints from the HMI. Set variable range alarms (low-low, low, high, and high-high) at 10%, 20%, 80%, and 90% of field instrument calibrated span unless specifically noted otherwise in the detailed loop descriptions or instrument list. All adjustable alarm set points shall be modifiable only by authorized users.

- Q. All analog inputs shall be configured for presentation on trend screens of related variables and stored in the historical data system.
- R. Capture when an analog signal goes outside the 4-20 mA range due to a failure at the instrument, controller I/O module, system wiring failure, or other means, and provide alarm and control logic per existing District approaches.
- S. All setpoints for controls, shutdown conditions, alarms, etc. derived from analog signals conditions shall be individually configured with adjustable time delays (initially set at 5 seconds) to avoid nuisance tripping and assist with system startup.
- T. Provide flow totalization as part of process controller logic for all flowmeter inputs to the process controller. Display the totalized flows (previous and current day) along with the instantaneous flow rate for each flowmeter at the HMI.
- U. Provide PAC resident equipment runtime totalization for all new and existing equipment where Running status is monitored. Provide equipment start counters for all new and existing equipment where Running status is monitored. Provide individual HMI based reset commands for both run times and start counters for each piece of equipment.
- V. Historical Data Collection - All analog inputs, operator process control setpoints, and discrete equipment ON/OFF status shall be collected and stored in the Historian database and incorporated on fixed trend screens of related variables conforming to existing District approaches.
- W. PAC-to-PAC communications shall be limited to data that is required for controls and interlocks.
- X. Monitor communications and performance of the network system between the SCADA servers and PACs, and between PACs.
- Y. Transfer shared data using the communication networking interfaces between PACs and other equipment platforms. Process control data acquired via the network links shall be polled between devices, PACs, and HMI processed and displayed in an identical fashion as traditional I/O.

1.04 PROCESS CONTROL DESCRIPTIONS

- A. The existing PAC CPU and I/O equipment, remote I/O equipment, as well as the facility's HMI and OIT systems are as shown on the Drawings and be updated to accommodate the new and modified centrifuge systems and allow both centrifuges to run concurrently. The plant SCADA system monitors the functions of the packaged centrifuge control system via a network link. Control of the centrifuge equipment are provided as part of the centrifuge package provided by the Centrifuge System Supplier as specified in Section 11363.
- B. Updated permissives and control interlocks from the plant processes shall be provided to both the new and existing (replaced and updated) centrifuge package controls via the network links as shown on the Drawings and as described in the detailed loop descriptions included in the following sections.
- C. System auxiliary pumps, chemical feed systems, control valves, and other ancillary systems are controlled by the existing plant PAC system as modified under this Contract via the existing Remote I/O racks and central PAC processors. Refer to the following sections for detailed loop descriptions for integration under this Contract.

- D. The existing plant HMI and OIT systems shall be updated to provide status monitoring, alarm monitoring, and remote operational control of the auxiliary systems and existing and new centrifuge systems by plant operators.

1.05 DETAILED LOOP SPECIFIC CONTROL DESCRIPTIONS

- A. Tagging and variable names including fields, variable naming schemes, memory maps, etc. shall match the existing programming scheme in use at the WTP. Existing programs to be modified under this Contract shall be provided to the CSI following Notice To Proceed upon request.

P&ID I-4

Centrifuge Feed System

General: System shall be modified to incorporate a new Centrifuge Feed Pump 3 (P-726-3). Existing Centrifuge Feed Pump 1 (P-726-1) controls shall be modified to serve Centrifuge 1 only. New Centrifuge Feed Pump 3 controls shall be developed to serve Centrifuge 2 only. New valving provided under this Contract shall be provided allow the existing Centrifuge Feed Pump 2 (P-726-2) to serve either Centrifuge 1 or Centrifuge 2. Coordinate with the Centrifuge system supplier to establish permissives and interlocks to ensure simultaneous operation of the Centrifuges is supported.

Provide permissive for Centrifuge 1 operation via network link:

P-726-1 Ready and Valve BFV-727 Closed

Or

P-726-2 ready and Valve BFV-727 Open and Valve BFV-728 Closed

Provide permissive for Centrifuge 2 operation via network link:

P-726-3 Ready and Valve BFV-728 Closed

Or

P-726-2 ready and Valve BFV-727 Closed and Valve BFV-728 Open

Loop 726-1 – Centrifuge Feed Pump 1

PLC: RIO-RHB, PLC-CC-1, PLC-CC-2

General:

New instruments PSL-726-1 and PSH-726-1 provided to replace existing instruments used for shutdown of existing Centrifuge Feed Pump 1 (P-726-1). Existing pump control logic to be modified to provide additional interlocks with Valves BFV-727 and BFV-728.

Controls:

Field:

Local E-Stop

Local (VFD-726-1):

PSL - Low Pressure Shutdown, replace existing

PSH - High Pressure Shutdown, replace existing

SCADA/PLC:

Modify existing control logic to incorporate interlock/permissive with Valve BFV-727 and Valve BFV-728 for feeding Centrifuge 1.

Alarms and Monitoring:

Field:

None

Local (VFD-726-1):

PAL - Low Suction Pressure Alarm, replace existing

PAH - High Pressure Pressure Alarm, replace existing

Other existing monitoring to remain

SCADA/PLC:

PSL - Low Suction Pressure Alarm, replace existing
PSH - High Discharge Pressure Alarm, replace existing
Other existing monitoring to remain

Interlocks:

- Modify pump operation to incorporate permissive with Centrifuge 1 controls provided by Centrifuge System Supplier.
- Interlock pump operation with Valve BFV-727 in closed position.

Fault Response:

Existing control logic to remain

Data Collection & Trending:

Existing logic to remain

Loop 726-2 – Centrifuge Feed Pump 2

PLC: RIO-RHB, PLC-CC-1, PLC-CC-2

General:

New instruments PSL-726-2 and PSH-726-2 provided to replace existing instruments used for shutdown of existing Centrifuge Feed Pump 2 (P-726-2). Existing pump control logic to be modified to provide additional interlocks with Valves BFV-727 and BFV-728 to allow P-726-2 to feed either Centrifuge 1 or 2 as selected by the operator

Controls:

Field:

Local E-stop

Local (VFD-726-2):

PSL - Low Suction Pressure Shutdown, replace existing
PSH - High Discharge Pressure Shutdown, replace existing

SCADA/PLC:

Modify existing control logic to incorporate interlock/permissive with Valve BFV-727 and Valve BFV-728 to allow P-726-2 to feed either Centrifuge 1 or Centrifuge 2 as selected by the Operator.

Alarms and Monitoring:

Field:

None

Local (VFD-726-2):

PSL - Low Suction Pressure Alarm, replace existing
PSH - High Discharge Pressure Alarm, replace existing
Other existing monitoring to remain

SCADA/PLC:

PSL - Low Suction Pressure Alarm, replace existing
PSH - High Discharge Pressure Alarm, replace existing

Other existing monitoring to remain

Interlocks:

- Modify pump operation to incorporate permissive with Centrifuge 1 and Centrifuge 2 controls provided by Centrifuge System Supplier
- Interlock pump operation with Valves BFV-727 and BFV-728 respective open and closed positions to allow feeding to either Centrifuge 1 or Centrifuge 2.

Fault Response:

Copy existing control logic used for P-726-1

Data Collection & Trending:

Use existing historical collection scheme in place for P-726-1

Loop 726-3 – Centrifuge Feed Pump 3

PLC: RIO-RHB, PLC-CC-1, PLC-CC-2

General:

New Centrifuge Feed Pump and VFD No. 3 (relocated and repurposed Centrate Pump P-740-1) and field instruments for control and operation. Existing Centrifuge Feed Pump control logic for P726-1 to be modified to control new pump and VFD to provide additional interlocks with Valve BFV-728.

Controls:

Field:

HS - Local Emergency Stop (LES)

Local (VFD-726-3):

PSL - Low Suction Pressure Shutdown
PSH - High Discharge Pressure Shutdown
TSH – High Temperature Shutdown
YS – VFD Fault
HS – Alarm Reset (Reset)
SIC – Manual Speed Control

SCADA/PLC:

Modify existing control logic for P-726-1 for use with P-726-3 to incorporate interlock/permissive with Valve BFV-728 for feeding Centrifuge 2.
Speed control based on control provided from Centrifuge 2 (Loop 732)

Alarms and Monitoring:

Field:

None

Local (VFD-726-3):

PSL - Low Suction Pressure Alarm, replace existing
PSH - High Discharge Pressure Alarm, replace existing
TAH – High Temperature Alarm
YLA – VFD Fault

SCADA/PLC:

PSL - Low Suction Pressure Alarm, replace existing
PSH - High Discharge Pressure Alarm, replace existing
TAH – High Temperature Alarm
YLA – VFD Fault

Interlocks:

- Modify pump operation logic to incorporate permissive with Centrifuge 2 controls provided by Centrifuge System Supplier.
- Interlock pump operation with Valve BFV-728 in closed position.

Fault Response:

Existing control logic for P-726-1 for P-726-3 to remain

Data Collection & Trending:

Modify and maintain existing historical collection for P-726-1 for P-726-3

Loop 727 – Control Valve BFV-727

PLC: RIO-RHB, PLC-CC-1, PLC-CC-2

General:

New pneumatic valve BFV-727 provided to allow either P-726-1 or P-726-2 to feed Centrifuge 1.

Controls:

Field:

Manual control of solenoid valve SV-727

Local:

None

SCADA/PLC:

Close (de-energize) SV-727 for directing P-726-1 flow to Centrifuge 1
Open (energize) SV-727 for directing P-726-2 flow to Centrifuge 1

Alarms and Monitoring:

Field:

None

Local:

None

SCADA/PLC:

ZSC – Valve Closed
ZSO – Valve Opened

Interlocks:

- Provide permissive for Centrifuge 1 controls provided by Centrifuge System Supplier.
- Interlock P-726-1 operation with Valve BFV-727 in Closed position.
- Interlock P-726-2 operation with Centrifuge 1 operation, Valve BFV-727 Opened, and

Valve BFV-728 Closed.

Fault Response:

None

Data Collection & Trending:

ZSC – Valve Closed

ZSO – Valve Open

Loop 728 – Control Valve BFV-728

PLC: RIO-RHB, PLC-CC-1, PLC-CC-2

General:

New pneumatic valve BFV-728 provided to allow either P-726-3 or P-726-2 to feed Centrifuge 2.

Controls:

Field:

Manual control of solenoid valve SV-728

Local:

None

SCADA/PLC:

Close (de-energize) SV-728 for directing P-726-3 flow to Centrifuge 2

Open (energize) SV-728 for directing P-726-2 flow to Centrifuge 2

Alarms and Monitoring:

Field:

None

Local:

None

SCADA/PLC:

ZSC – Valve Closed

ZSO – Valve Opened

Interlocks:

- Provide permissive for Centrifuge 2 controls provided by Centrifuge System Supplier.
- Interlock pump operation P-726-3 with Valve BFV-728 in closed position.
- Interlock P-726-2 operation with Centrifuge 2 operation, Valve BFV-727 Closed, and Valve BFV-728 Opened.

Fault Response:

None

Data Collection & Trending:

ZSC – Valve Closed

ZSO – Valve Open

P&ID I-5

Centrifuge 1 and Centrifuge 2

General: Centrifuge 1 and 2 shall be controlled by vendor provided control panels as specified in Section 11363. P&IDs provide minimum data exchange between centrifuge control panels and plant SCADA. Provide additional status monitoring and data exchange/data mapping to replicate centrifuge status monitoring and alarming to match the OIT displays provided by the Centrifuge System Supplier under this Contract.

Coordinate data exchange via the panel network link as shown on the Drawings to provide Supplier with plant equipment and system status monitoring for centrifuge operation in accordance with the Supplier's requirements.

Provide operating permissive based on feed pump and valve position (Loops 726-1, 726-2, 726-3, 727, and 728) as follows:

Provide permissive for Centrifuge 1 operation via network link:

P-726-1 Ready and Valve BFV-727 Closed

Or

P-726-2 ready and Valve BFV-727 Open and Valve BFV-728 Closed

Provide permissive for Centrifuge 2 operation via network link:

P-726-3 Ready and Valve BFV-728 Closed

Or

P-726-2 ready and Valve BFV-727 Closed and Valve BFV-728 Open

Provide operating permissive based on polymer feed systems (Loops 755-1, 755-2, 755-3, 755-4:

Provide permissive for Centrifuge 1 operation via network link:

P755-1 available

Or

P755-2 available

Provide permissive for Centrifuge 2 operation via network link:

P755-3 available

Or

P755-4 available

Loop 731 – Centrifuge 1 (LCP-731A) – By Centrifuge System Supplier

Loop 732 – Centrifuge 2 (LCP-732A) – By Centrifuge System Supplier

P&ID I-6

Centrate Pumps

General: System shall be modified to replace existing constant speed Centrate Pumps with new VFD controlled Centrate Pumps (P-740-1 and P-740-2).

Existing Centrate Tank (TNK-740) and associated field instrumentation shall be replaced in kind with existing plant monitoring to remain unchanged.

Loop 740 – Centrate Tank

PLC: RIO-RHB, PLC-CC-1, PLC-CC-2

General:

Replace existing TNK 740 and associated instrumentation with new.

Controls:

Field:

None

Local:

None

SCADA/PLC:

Provide interlock to inhibit Centrate Pump operation on Tank Low level (LT-740 or LSSL-740)

Alarms and Monitoring:

Field:

None

Local:

None

SCADA/PLC:

LI – TNK 740 Level
LSHH – TNK 740 High-High
LSSL -TNK 740 Low-Low

Interlocks:

- Provide interlock to inhibit Centrate Pump operation on Tank Low level (LT-740/LSH-740) or Tank Low-Low level (LSSL-740)
- Provide interlock (network link) to inhibit centrifuge operation (Loops 731 and 732) on Tank High level derived from LI-740 (LAH-740) or Tank High-High Level (LSHH-740)

Fault Response:

Shutdown Centrate pumps and centrifuges (network link failure)

Data Collection & Trending:

Reuse existing historical data collection logic for TNK-740 instrumentation

Loop 740-1 – Centrate Pump 1

PLC: RIO-RHB, PLC-CC-1, PLC-CC-2

General:

New Centrate Pump 1 (P-740-1) and VFD (VFD-740-1)

Controls:

Field:

HS - Local Emergency Stop (LES)

Local (VFD-740-1):

PSL - Low Suction Pressure Shutdown

PSH - High Discharge Pressure Shutdown

TSH – High Temperature Shutdown

YS – VFD Fault

SIC – Manual Speed Control

HS – Alarm Reset (Reset)

SCADA/PLC:

Provide PID feedback control loop (SC) based on operator entered setpoint for maintained centrate tank level (LIT 740). Modify District existing PID control module resident in District's existing PLC system for implementing the new VFD based centrate pump control logic.

Provide Duty/Standby pump operation with automatic standby operation on duty pump failure.

Provide automatic alternation of Duty/Standby pump upon user adjustable run time period (adjustable 1-24 hours)

Provide alternate centrate pump control upon failure of LIT-740 based on backup float switch control. Pumps shall turn on upon tank high level (LSH-740) and turn off upon tank low level (LSL-740). During alternate control scheme, provide manual VFD fixed speed control based on operator entered setpoint (adjustable 0-100%). Modify the current backup level control presently resident on the PLC.

Alarms and Monitoring:

Field:

None

Local (VFD-740-1):

PSL - Low Suction Pressure Alarm, replace existing

PSH - High Discharge Pressure Alarm, replace existing

TAH – High Temperature Alarm

YLA – VFD Fault

SCADA/PLC:

PSL - Low Suction Pressure Alarm, replace existing

PSH - High Discharge Pressure Alarm, replace existing

TAH – High Temperature Alarm

YLA – VFD Fault

Interlocks:

- Provide interlock to inhibit Centrate Pump operation on Tank Low level (LT-740/LAL-740 or LSSL-740)

Fault Response:

Shutdown Centrate pumps

Data Collection & Trending:

Reuse and modify existing historical data collection logic for P-740-1; include data collection and trending of pump P-740-1 Speed Feedback

Loop 740-2 – Centrate Pump 2

PLC: RIO-RHB, PLC-CC-1, PLC-CC-2

General:

Functionally identical to Loop 740-1

P&ID I-7

Polymer Feed System

General: Provide additional polymer feed systems for serving Centrifuge 2. New polymer System shall be identical to existing polymer system presently in operation at the facility

Provide permissive for Centrifuge 2 operation via network link based on availability of the new Polymer System.

Existing Polymer Day Tank (TNK-753) and associated field instrumentation shall be replaced in kind with existing plant monitoring to remain unchanged.

Loop 753 – Polymer Day Tank

PLC: RIO-RHB, PLC-CC-1, PLC-CC-2

General:

Replace existing TNK 753 and associated instrumentation with new.

Controls:

Field:

None

Local:

None

SCADA/PLC:

Use existing logic for interlocking polymer system operation with tank level.

Alarms and Monitoring:

Field:

LIT – Tank level local indication

Local:

None

SCADA/PLC:

LIT – TNK 753 Level

LSHH – TNK 753 High-High

LSLL -TNK 753 Low-Low

Interlocks:

- Use existing logic for interlocking polymer system operation with tank level.

Fault Response:

Shutdown Centrifuges 1 and 2 (network link), Loop 731 and 732

Data Collection & Trending:

Reuse existing logic for TNK-753 instrumentation

Loop 755-3 – Fourth Stage Polymer Metering Pump 3

PLC: RIO-RHB, PLC-CC-1, PLC-CC-2

General:

Provide new polymer feed system for Centrifuge 2 operation

Controls:

Field:

Local pump controller

Local (VFD 755):

Metering pump manual control via integral HMI

SCADA/PLC:

Metering pump Start/Stop and speed control provided from Centrifuge 2 control via network link

Provide interlock to inhibit Centrifuge 2 operation on Pump 755-3 and Pump 755-4 failure or when not Auto/Ready state.

Provide Duty/Standby pump operation with automatic standby operation on duty pump failure.

Provide automatic alternation of Duty/Standby pump upon user adjustable run time period (adjustable 1-24 hours)

Alarms and Monitoring:

Field:

None

Local:

Metering pump manual status and alarming via integral HMI

SCADA/PLC:

SI – metering pump speed

SC – metering pump speed control signal

YS – Running

HS 3A – In remote

YS - Fault

Interlocks:

- Provide interlock to inhibit Centrifuge 2 operation on P-755-3 and P-755-4 failure or when not in Auto/Ready state
- Provide interlock to stop polymer pump feed as controlled from Centrifuge Control Panel (LCP-732A) (via network link)

Fault Response:

Shutdown feed pump

Data Collection & Trending:

Match existing logic for existing pumps P-755-1 and P-755-2

Loop 755-4 – Fourth Stage Polymer Metering Pump 4

PLC: RIO-RHB, PLC-CC-1, PLC-CC-2

General:

Functionally identical to Loop 755-3

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SECTION 13446

ELECTRIC OPERATORS FOR VALVES AND GATES

PART 1 – GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install electric motor actuators (actuators) for valves and gates, as shown on the Drawings, as specified herein, and in Section 15207.
- B. Related Sections
 - 1. Section 15207 Centrifuge Slide Gate
 - 2. Process and Instrumentation Drawings (P&ID's)

1.02 SYSTEM DESCRIPTION

- A. All valve actuators shall be products of a single manufacturer.
- B. All electric actuators furnished shall be of the TYPE # as required by Section 15207. Remote Actuator Control Stations shall be provided for actuators as required by the Section 15207 or the Electrical Drawings. Actuator TYPE # is assigned based on the following general characteristics.

TYPE #	Open / Close or Modulating operation	Torque range	90 Degree operation
1A	Open / Close	Low	90 Degree

- C. The actuators furnished under this Section shall have all features and auxiliary components as specified in the paragraphs based on the TYPE specified.
- D. The torque requirements of the actuator shall be as required to operate the indicated valves or gates of the sizes and against the specified pressures in accordance with AWWA C540 standards.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with the Standard and Special Provisions.
- B. Submittals for actuators shall be identified with the actuator type as specified and cross-referenced to every valve and gate number as shown detailed on the Contract Documents.
- C. As a minimum, submittals shall include at least the following:
 - 1. Technical bulletins descriptive of the proposed actuators and all functions and available features. Clearly indicate those functions and features that will be provided for each valve actuator provided under this Contract.
 - 2. Provide a separate scaled drawing for each actuator type in each of the available configurations of the actuator with complete dimensions and locations of controls and all connection points indicated. Tabulated or generic drawings are not acceptable for this requirement.
 - 3. A complete bill of materials for each actuator.

4. Certified actuator torque sizing calculations detailing as a minimum the following:
 - a. Maximum required valve operating torque.
 - b. Maximum available actuator operating torque.
 - c. Torque rating of gearbox.
 - d. Sizing criteria.
 - e. Full stroke operating time for both opening and closing valve under the operating conditions included in the Contract Documents.
 - f. Name and organization preparing the calculations.
5. Certified factory test results for each actuator. Submittals shall include the following as a minimum for each actuator:
 - a. Test amperes for each phase
 - b. Torque production or confirmation of rating
 - c. Measured stroke time
 - d. Actuator serial number
6. Certified installation drawings showing details of the complete valve and actuator assembly including dimensions, weights and installation requirements.
7. Separate electrical and control drawing and details for each individual actuator showing the following as a minimum (standard catalogue cut sheets which show typical wiring diagrams are not acceptable):
 - a. Actuator horsepower and power requirements.
 - b. Control schematics (wiring diagrams) detailing all external interfaces.
 - c. Conduit access locations
 - d. Remote mount control station wiring diagrams and physical mounting requirements.
 - e. For all actuator parameters which will be software configured, the submittal shall indicate the initial configuration settings that will be implemented to comply with the project requirements.
 - f. Identification (project-specific valve number) of valve for which the actuator is proposed.
8. Submit data sheets and features of the handheld actuator configuration device
9. Submit field service reports for each actuator indicating the successful completion of and recording of all field startup and testing data.
10. Operating and maintenance manuals in accordance with Section 01730.
11. Training agenda and materials in accordance with Section 01715.

1.04 REFERENCE STANDARDS

- A. American Waterworks Association (AWWA):
 - 1. C540: AWWA Standard for Power Actuating Devices for Valves and Slide Gates

1.05 QUALITY CONTROL

- A. The manufacturer shall provide a full extended warranty against defects in workmanship and materials on the complete actuator, gearbox and appurtenances for a minimum of 5 years. The extended warranty shall cover parts, on-site labor, travel and per diem costs, and shall not be pro-rated. Acceptable manufacturers and models are noted with the descriptions of each type (1A, 1B, 2A, etc.) of actuator in this Section when in compliance with the requirements herein.
- B. Single source responsibility shall be provided for each electric motor actuator and valve assembly provided on this project. As a minimum, these responsibilities shall include the following: electric actuator sizing and selection, valve and electric actuator shop drawing preparation, factory mounting of the actuator and valve to adjust and test the complete assembly, field service, and warrantee of the complete electric actuator and valve assembly. Single source responsibility shall be provided by one of the following manufacturers or suppliers:
 - 1. The valve or gate manufacturer for valve sizes 12-inch nominal diameter and larger and all gates.
 - 2. The electric actuator manufacturer for valve sizes 10-inch nominal diameter and smaller.
 - 3. An authorized distributor and service facility for the valves (and gates) having at least 5 years' experience in the servicing of the equipment furnished for the valve and gate sizes to be provided.
 - 4. An authorized distributor and service facility for the electric actuator having at least 5 years' experience in the servicing of the equipment furnished for the 6-inch and smaller valve sizes.

1.06 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Operating and maintenance instructions, for each type of actuator, shall be submitted to the Engineer in accordance with Section 01730.
- B. Field startup and training of all actuators shall be performed by a field service technician employed by the actuator manufacturer. The field service technician shall be certified by the actuator manufacturer, shall be factory trained with complete knowledge of proper startup, installation, configuration and use of the handheld valve configuration device, operation and maintenance of the actuators furnished.

1.07 ACTUATOR TORQUE SIZING AND OPERATION

- A. The actuator manufacturer shall prepare and submit an affidavit of compliance for each actuator and gearbox indicating that the complete actuator and gearbox assembly complies with the applicable provisions of the AWWA Standards C504 and C540 and the requirements of this Specification regarding torque sizing. Affidavit shall also include confirmation of opening and closing stroke times in conformance with the applicable published documentation.
- B. The rated torque capability of each actuator assembly shall be at least 150% of the valve's maximum seating, un-seating, and dynamic torque. The valve's required torque shall be provided by the valve manufacturer and shall be defined as the torque required to seat, unseat, and rigidly hold the valve in any intermediate position and under the differential pressures and pipeline

velocities shown. Unless the valve is required to isolate flow in both directions, the valve's required torque shall be for installation in the preferred direction only.

1.08 MAINTENANCE

A. Spare parts:

1. Furnish five percent (minimum of one) of each type of valve actuator (open/close type or modulating type; each voltage level) specified in this Section. Provide additional spare parts required for normal operation and maintenance of the valve actuators as recommended by the actuator manufacturer in accordance with Section 15207.
2. Spares shall be delivered to Owner before final acceptance of the system. Packaging of spares shall provide protection against dust and moisture and shall be suitable for storage. Circuit boards and other electronic parts shall be enclosed in anti-static material. All packages shall be clearly marked with manufacturer's name, part number, date of manufacturer and approximate shelf life.

B. Maintenance Accessories:

1. Furnish a minimum of one handheld configuration devices for remote setting and configuration of the actuators. Provide rechargeable, battery powered handheld devices with graphical display and firmware that allows full actuator configuration, storage of configuration parameters, and ability to download specific valve configuration parameters to a laptop computer via USB or comparable cable connections.
2. Provide all necessary ancillary cables, terminations, and connectors necessary for performing typical actuator configuration procedures. Provide a minimum of four spare battery packs and standalone battery docking charger.

PART 2 – PRODUCTS

2.01 GENERAL ACTUATOR REQUIREMENTS

- A. Unless otherwise noted, all actuators shall have the following general features in addition to the special features required under the specific "ACTUATOR TYPE" paragraphs.
- B. All actuators shall include, but are not limited to, high torque reversible electric motor, worm gear reduction, mechanically and electrically interlocked reversing motor contactor, digital display for English characters and graphics, electronic torque sensor, absolute valve position encoder, hand wheel declutch lever, hand wheel, and local control switches as a self-contained unit. Electric valve actuators shall conform to AWWA C-540 except as modified herein.
- C. Motor ratings: 480 VAC, 3 phase, 60 Hertz power; horsepower rating shall be continuous duty. Motor insulation shall be NEMA Class "F" or "H" with thermal overloads-and service factor shall be a minimum of 1.0. Motor speed shall be 1800 rpm or 900 rpm.
- D. The actuators shall be powered by 115 VAC, 1 phase, 60 Hertz power as shown on the electrical Drawings. Provide thermal protection internal to the motor in all cases.
- E. Provide mechanical dial position indicator for local position indication with graduations in 0, 25, 50, 75 and 100%. Compression type terminal strips shall be supplied for all remote actuator power, control and indication connections and shall be manufactured by Phoenix Contact or equal. Control terminals shall be rated at 300 volts and accept an AWG 24-12 wire gauge range. 480VAC actuator power terminals shall be rated at 600 volts and accept an AWG 3-10 wire gauge range. The electrical compartment shall have a minimum of four 1-inch conduit entries for power, discrete control and instrumentation wiring. The termination compartment shall be sealed

separately from the internal actuator controls compartment to prevent the possibility of water intrusion into the actuator's control compartment from an open conduit or other means.

- F. The controls including the reversing motor starters, pushbuttons, control power transformer, and shall be housed in the actuator enclosure. The actuator gear housing shall be of aluminum alloy. The actuator controls housing shall be of high strength aluminum design. Housing construction shall be designed to meet NEMA 4X and 6P waterproof and submersible requirements.
- G. Where specifically shown on the valve index as subject to submergence, provide actuator housing rated IP 68-3 minimum. Provide additional corrosion resistance material and corrosion protection for the actuator, gearboxes and coupling compartments.
- H. Valve position shall be sensed by an optical, absolute position encoder with redundant position sensing circuits designed for built-in self-testing. Open and closed positions shall be stored in permanent, nonvolatile memory. The absolute position encoder shall be capable of resolving plus or minus 7 degrees or better of output shaft position over 10,000 output drive rotations.
- I. Reduction gearing and motor speed for valve actuators shall be selected by the actuator manufacturer to provide approximately a 60 second full stroke operating time per 12 inches of valve size unless noted otherwise on the Drawings or Specifications or recommended by the valve manufacturer.
- J. All external hardware and anchor bolts shall be type ASTM A276 304 stainless steel.
- K. Valve actuator shall be equipped with an adjustable electronic torque sensor that shall de-energize the motor if tripped. Functions shall be provided to prevent torque trip during initial valve unseating.
- L. The actuator shall be suitable for operation in ambient temperatures from -20°F to 104°F.
- M. The control system shall include provision for adjusting valve position in both opening and closing directions by "jogging". When the valve shall be operated to full open or closed, jogging shall not be required nor should it be a means of meeting open or close cycle times. Provide analog or discrete control as required by the Drawings as well as analog position and torque transmission.
- N. The actuator shall have a capability of both manual and motorized operation; a hand wheel with spindle shall be used for manual operation, which shall not rotate during motor operation. Manual actuators shall be capable of holding the valve in any position without creeping or fluttering. A permanently attached handwheel with spindle shall be provided for manual operation. The handwheel shall not rotate during electrical operation. The maximum torque required on the handwheel under the most adverse conditions specified herein shall not exceed 60 lb-ft, and the maximum force required on the rim of the handwheel shall not exceed 40 lb. An arrow and either the word "open" or "close" shall be indicated on the handwheel. A declutch mechanism shall be supplied for manual operation. The maximum rim pull force required for manual operation using handwheels or chain wheels shall be 40 pounds.
- O. Non-metallic or cast gearing shall not be allowed. Tapered roller bearings shall be used to provide smooth rotation of the worm. All gearing shall be grease lubricated. Electric actuator output speed changes shall be possible by removing the motor and changing the exposed helical gear set ratio with further disassembly of the electric motor. The actuator shall have a device incorporated in the power train located between the worm gear and actuator drive sleeve, to permit load impact under static efficiency conditions, with hammer-blow effect to allow the motor to reach full speed before engaging the load.
- P. The motor actuator and intermediary gear boxes shall have a minimum service life of 250,000 output turns of the motor actuator at 30% of rated torque plus rated torque seating 5,000 times in both directions.

- Q. An integrally mounted and NEC compliant fused control power transformer shall be provided to power the actuator controls at a maximum of 120 VAC for 480V rated actuators; 120 VAC, single phase actuators shall derive control power from dedicated, fuse protected control circuitry.
- R. Provide a space heater in the actuator housing to prevent condensation and moisture accumulation.
- S. Actuator Control Stations:
1. Provide control stations: LOCAL - OFF - REMOTE selector switch, OPEN - STOP - CLOSE pushbuttons and OPEN - CLOSE indicating lights integral with the actuator housing. The control station shall be capable of being easily field rotated in 90° increments to orient the control station in a “heads up” display direction and to allow remote configuration using the hand held configuration tool from finished floor, deck, or grade. Access to the actuator by a ladder for configuration shall not be acceptable.
 2. Remotely mounted control stations: Where shown on the Drawings, Section 13330, or when required to comply with the control station accessibility criteria, provide valve actuators with control stations suitable for mounting remotely from, but, in the vicinity of the actuator. Remote mounted control station shall include a LOCAL - OFF - REMOTE selector switch, OPEN - STOP - CLOSE pushbuttons and OPEN - CLOSE indicating lights.
 3. Control station actuators shall be heavy duty full-size devices mounted in a cast iron, cast aluminum, or stainless steel NEMA 4X enclosure suitable for wall or stanchion mounting. Pushbuttons and indicator lights shall be Allen-Bradley Bulletin 800H, or equal.
 4. Provide LOCAL - OFF - REMOTE selector switches with auxiliary contacts for remote indication of switch position.
 5. Provide LOCAL - OFF - REMOTE selector switches with provisions for padlocking in the OFF position.
 6. Provide LED type indicator lights.
 7. Remote control stations where shown on the Drawings, shall be furnished by the actuator manufacturer
- T. Provide actuators with contacts for remote control and position indication. Position and torque status contacts shall be independently adjustable. Provide position contacts in the quantity as shown on the Drawings with a minimum of four open position and four close position single pole, single throw contacts.
- U. Integral controls shall include a phase correction device to monitor incoming power to ensure proper motor direction corresponding to either an open or close command.
- V. Provide Bluetooth or equivalent wireless communication interface for remote access to and modification of actuator configuration parameters. Communication protocol shall be compatible with the battery powered handheld configuration devices as specified.
- W. Motor shall be 115 VAC enclosed, permanent split capacitor induction type. Speeds remain approximately constant regardless of the load. The motor is equipped with a thermal overload device that opens and resets automatically. The motor requires a 72-88 mfd capacitor to be supplied by Duff-Norton.
- X. Electrical Actuator shall be SPA Series as manufactured by Duff-Norton or approved equal.

2.02 TYPE 1A ACTUATOR (LOW TORQUE – OPEN/CLOSE -QUARTER TURN VALVE TYPE) FOR USE ON METALLIC VALVES OR GATES

- A. Actuators shall comply with all requirements of Paragraph 2.01 except as modified in this section.
- B. The actuator is not required to be microprocessor based.
- C. Actuators shall have a published running torque range from approximately 100 pound - inches to 1000 pound - inches.
- D. The motor shall be a 115 volt single phase split- capacitor type with integral auto - reset overload protection and class B insulation suitable for a minimum of 360 starts per hour.
- E. The unit shall have controls as specified for Open - Close actuators.
- F. Each actuator shall be furnished with a control enclosure, factory assembled and wired to the actuator. The control enclosure shall contain a motor power disconnect switch, open and close starter as detailed on the electrical drawings. The power disconnect shall be a horsepower rated fractional horsepower motor starter switch. The starters shall have replaceable contacts rated for the motor starting duty of the actuator. The control enclosure shall be rated NEMA 4X.
- G. Auxiliary contacts that are required to implement the control action shall be provided by the actuator manufacturer and may be either shaft driven limit switches or auxiliary control relay contacts. Control relays shall be housed in the actuator housing or in an auxiliary equipment enclosure. If an auxiliary enclosure is required for housing control relays, it shall be factory mounted and wired to the actuator enclosure. Auxiliary enclosures may be fabricated of sheet steel but shall have the same NEMA rating as the actuator housing.
- H. Torque switches need not have a field calibration indication mechanism if they are factory adjusted and sealed.
- I. Manual operation handwheels need not have a separate declutching lever if the actuator incorporates alternative design features to prevent injury to personnel during manual operation.
- J. Electric actuators shall be Rotork, Bettis, or equal.

2.03 ACTUATOR MOUNTING BRACKETS

- A. All actuator and valve assemblies shall be match marked during shop mounting with indelible markings to illustrate proper relative orientation and facilitate disassembly and reassembly in the field.
- B. Actuator mounting brackets shall be designed, fabricated and furnished by the actuator or valve supplier as identified in PART 1 of this Section.

2.04 FACTORY TESTING

- A. All actuators shall be inspected and tested at the factory by the actuator manufacturer. Results of these tests shall be submitted to the Engineer as specified.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. All electric actuators shall be properly supported, in addition to piping and valve supports, to minimize load on valve and piping system.

- B. Actuator supports shall allow access to all controls and internal components without removal of actuator support.
- C. Actuators shall be oriented so that the front LED panel is easily accessible for startup and configuration, and lettering is horizontal and not inverted.
- D. Where actuators must be mounted at locations that are not accessible from finished floor levels, orient actuators

3.02 COATINGS

- A. Actuators for gates and valves shall be industrially coated with coating systems suitable for exterior exposure in accordance with Section 09900.
- B. Field painting and coating shall include touch-up work to repair any damage to shop painting or coating.

3.03 SHIPPING, HANDLING, DELIVERY AND STORAGE

- A. Care should be taken in loading, transporting and unloading to prevent injury to the actuator. All equipment shall be examined before installation. Equipment that is found to be defective shall not be installed.

3.04 FIELD INSPECTION, ADJUSTMENT, STARTUP AND TESTING

- A. The actuator manufacturer's field service technicians shall inspect, adjust, startup and test all actuators furnish under this project. Services of a valve field service technician are not sufficient to meet this requirement. A separate field report shall be prepared and submitted for each actuator. Field service shall include the following as a minimum for each actuator:
 - 1. Adjust and record the setpoints for all position and torque sensors.
 - 2. Measure and record actuator operating voltage and amps during three full operating cycles of the valve.
 - 3. Confirm proper operation of all field interface signals.
 - 4. Confirm that all conduit openings into the actuator are sealed.
 - 5. Confirm that the actuator and gearbox are filled with the proper types of lubricant.
- B. Correction of deficiencies shall be in accordance with Section 15207.
- C. Submit all field test results to the Engineer within 10 calendar days of tests.

END OF SECTION

SECTION 15050

GENERAL PIPING REQUIREMENTS

PART 1 GENERAL

1.01 DESCRIPTION

This section includes the general requirements for selecting bolts, nuts, washers, and gaskets for flanges used in the various piping services in the Specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Standard Drawings.
- B. Record Drawings and Submittals: Section 01300.
- C. Painting and Coating: STD SPEC 09900.
- D. Cold Applied Wax Tape Coating: Section 09952.

1.03 SUBMITTALS

- A. Submit submittal packages in accordance with Section 01300.
- B. Submit affidavit of compliance with referenced standards (e.g., AWWA, ANSI, ASTM, etc.).
- C. Submit certified copies of mill test reports for bolts and nuts, including coatings if specified. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.
- D. Submit manufacturer's data sheet for gaskets supplied showing dimensions and bolting recommendations.

PART 2 MATERIALS

2.01 THREAD FORMING FOR STAINLESS STEEL BOLTS

Form threads by means of rolling, not cutting or grinding.

2.02 BOLTS AND NUTS FOR STEEL OR DUCTILE IRON FLANGES

- A. Bolts and nuts for Class 150 flanges (including AWWA C207, Class E) located indoors; outdoors above ground; in vaults and structures; or where buried and wrapped with polyethylene material shall be carbon steel, ASTM A 307, Grade B.
- B. Bolts and nuts for AWWA C207 Class F flanges and ANSI B16.5 and B16.47 Class 300 flanges located indoors; outdoors above ground; in vaults and structures; or where buried and wrapped with polyethylene material shall conform to ASTM A 193, Grade B7, with nuts conforming to ASTM A 194, Grade 2H.

- C. Bolts and nuts for Class 150 flanges and Class E flanges exposed to water or in direct contact with earth shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M, for bolts and ASTM A 194, Grade 8M, for nuts.
- D. Bolts and nuts for Class 300 flanges and class F flanges exposed to water or in direct contact with earth shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M, Class 2, for bolts and ASTM A 194, Grade 8M, for nuts.
- E. Bolts used in flange insulation kits shall conform to ASTM A 193, Grade B7. Nuts shall conform to ASTM A 194, Grade 2H.
- F. Provide washers for each nut. Washers shall be of the same material as the nuts.

2.03 BOLTS AND NUTS FOR FLANGES USED IN COPPER PIPE OR TUBE

- A. When both aboveground or buried adjoining flanges are bronze, use bronze bolts and nuts. Bolts shall conform to ASTM F 468, Grade C65100 or C63000. Nuts shall conform to ASTM F 467, Grade C65100 or C63000.
- B. When only one of the aboveground adjoining flanges is bronze, use Type 316 stainless steel bolts and nuts conforming to ASTM A 193, Grade B8M for bolts and ASTM A 194, Grade 8M for nuts.
- C. Connect to buried ferrous flanges with flange insulation kits. Bolts used in flange insulation kits shall conform to ASTM B 193, Grade B7. Nuts shall comply with ASTM A 194, Grade 2H. If the adjoining buried flange is bronze, use bronze bolts and nuts as described above, without a flange insulation kit.
- D. Provide washers for each nut. Washers shall be of the same material as the nuts.

2.04 LUBRICANT FOR STAINLESS STEEL BOLTS AND NUTS

Lubricant shall be chloride free and shall be TRX-Synlube by Ramco, Anti-Seize by Ramco, Husk-It Husky Lube O'Seal, or District approved equal.

2.05 GASKETS FOR FLANGES USED IN STEEL PIPING FOR WATER SERVICE

Gaskets for flat face and raised face flanges shall be 1/8-inch thick and shall be one of the following nonasbestos materials:

- A. Cloth-inserted rubber with a Shore "A" hardness of 75 to 85. Gaskets shall be suitable for a working pressure of 200 psi at a temperature of 180°F. Products: Garlock Style 19 or District approved equal.
- B. Acrylic or aramid fiber bound with nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or District approved equal. Gaskets shall be suitable for a pressure of 500 psi at a temperature of 400°F.

2.06 GASKETS FOR FLANGES USED IN STEEL PIPING FOR SEWAGE SERVICE

Gaskets shall be full face, 1/8-inch thick, and shall be one of the following nonasbestos materials:

- A. Buna-N having a hardness of 55 to 65 durometer. Gaskets shall be suitable for a working pressure of 200 psi at a temperature of 180°F. Products: Garlock Style 9122 or District approved equal.
- B. Acrylic or aramid fiber bound with nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or District approved equal. Gaskets shall be suitable for a water pressure of 500 psi at a temperature of 400°F.

2.07 GASKETS FOR FLANGES USED IN DUCTILE-IRON PIPING AND FITTINGS FOR WATER SERVICE

Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, with a Shore "A" hardness of 75 to 85. Gaskets shall be suitable for a working pressure of 200 psi at a temperature of 180°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ANSI B16.21. Products: Garlock Style 19 or District approved equal.

2.08 GASKETS FOR FLANGES USED IN DUCTILE-IRON PIPING AND FITTINGS FOR SEWAGE SERVICE

Gaskets shall be full face, 1/8-inch thick, Buna-N having a hardness of 55 to 65 durometer. Gaskets shall be suitable for a working pressure of 200 psi at a temperature of 250°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ANSI B16.21. Provide Garlock Style 9122 or District approved equal.

2.09 GASKETS FOR FLANGES USED IN COPPER PIPE OR TUBE

Gaskets shall be full face, 1/8-inch thick, and shall be one of the following nonasbestos materials:

- A. Cloth-inserted rubber with a Shore "A" hardness of 75 to 85. Gaskets shall be suitable for a working pressure of 200 psi at a temperature of 180°F. Products: Garlock Style 19 or District approved equal.
- B. Acrylic or aramid fiber bound with nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or District approved equal. Gaskets shall be suitable for a pressure of 500 psi at a temperature of 400°F.

PART 3 EXECUTION

3.01 RAISED FACE AND FLAT FACE FLANGES

- A. Where a raised face flange connects to a flat-faced flange, remove the raised face of the flange.

3.02 INSTALLING ABOVEGROUND OR EXPOSED PIPING

- A. Provide pipe hangers and supports as detailed in the Drawings and the Specifications.
- B. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

3.03 INSTALLING FLANGED PIPING

- A. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Before bolting up, align flange faces to the design plane within 1/16-inch per foot measured across any diameter. Align flange bolt holes within 1/8-inch maximum offset.
- B. Clean bolts, nuts, washers and flange faces by wire brushing before installing gasket and adjoining flange. Inspect gasket seating surfaces, gasket, each bolt, nut, washer, and facing on which the nuts will rotate. Replace any damaged item.
- C. Lubricate threads of carbon steel bolts and nuts with oil and graphite prior to installation. Assemble all bolts, nuts, and washers in the flange, then tighten nuts in a progressive diametrically opposite sequence, and torque with a calibrated torque wrench. All clamping torque shall be applied to the nuts only.
- D. Bolt lengths shall extend completely through their nuts. Any which fail to do so shall not be considered acceptably engaged.
- E. Do not use more than one gasket between contact faces in assembling a flanged joint.
- F. Place washers under all nuts. Place washers under bolt heads where the flanges have been fusion bonded epoxy coated. Do not damage coated surfaces during installation.
- G. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight. Replace galled, cracked, or distorted bolts and nuts.
- H. After testing, coat exposed surfaces of bolts, nuts, and washers to be buried with primer for wax tape coating per Section 09952.
- I. Wrap flanges which connect to buried valves or other buried equipment with polyethylene sheet per Standard Specification Section 09954. Extend the polyethylene material over the flanges and bolts, and secure it around the adjacent pipe circumference with plastic adhesive tape.

3.04 INSTALLING BLIND FLANGES

- A. At outlets not indicated to be connected to valves or to other pipes and to complete the installed pipeline hydrostatic test, provide blind flanges with bolts, nuts, washers, and gaskets.
- B. Coat the inside face of blind flanges per Standard Specification Section 09900, System No. 5.

3.05 INSTALLATION OF STAINLESS STEEL BOLTS AND NUTS

Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

END OF SECTION

SECTION 15051

PROCESS PIPING - GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies the basic administrative requirements for piping. Specific piping materials, systems and related installation and testing requirements are specified in other Sections of Division 02 and 15.

1.02 RELATED WORK

- A. Process piping materials and systems (including valves) are included in other sections of Divisions 02 and 15.
- B. Piping specialties in included in Section 15120.

1.03 SUBMITTALS

- A. General submittals for piping and piping systems are listed below. Submittals shall be in accordance with Section 01300 and individual specifications. It is not intended that all submittals listed below be provided for all piping materials and systems. Refer to individual System or Piping Sections for specific submittals.
- B. Shop Drawings and Product Data
 - 1. Piping layouts in full detail.
 - 2. Location of pipe hangers and supports.
 - 3. Location and type of backup block or device to prevent joint separation.
 - 4. Large scale details of wall penetrations and fabricated fittings.
 - 5. Schedules of all pipe, fittings, special castings, couplings, expansion joints, and other appurtenances.
 - 6. Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners, and other accessories.
 - 7. Brochures and technical data on coatings and linings and proposed method for application and repair.
- C. Samples
- D. Design Data

E. Test Reports

1. Four copies of certified shop tests showing compliance with appropriate standard.
2. Four copies of all field test reports, signed by CONTRACTOR and ENGINEER.

F. Certificates

1. Copies of certification for all welders performing work in accordance with ANSI B31.1.
2. Copies of manufacturer's certification that materials meet or exceed minimum requirements as specified.

G. Manufacturers Installation (or application) instructions.

H. Statement of Qualifications

I. Manufacturers Field Report

J. Project Record Document

K. Operation and Maintenance Data in accordance with Section 01730.

L. Warranties

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

B. American National Standards Institute (ANSI)

1. ANSI B16.5 - Pipe Flanges and Flanged Fittings
2. ANSI B31.1 - Power Piping

C. American Welding Society (AWS)

1. AWS B2.1 - Standard for Welding Procedure and Performance Qualifications

D. American Water Works Association (AWWA)

1. AWWA Manual M11 - Steel Pipe - A Guide for Design and Installation

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. All materials shall be new and unused.
- B. Install piping to meet requirements of local codes.
- C. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified. Reference to standards such as ASTM and ANSI shall apply to those versions in effect at the time of bid opening.
- D. Coordinate dimensions and drilling of flanges with flanges for valves, pumps and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.
- E. Reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner and acid solder.
- F. Pipe-joint compound, for pipe carrying flammable or toxic gas, must bear approval of Underwriters' Laboratories or Factory Mutual Engineering Division.
- G. Unless otherwise specified, pressures referred to in all Piping Sections are expressed in pounds per square inch gage above atmospheric pressure (PSIG) and all temperature are expressed in degrees Fahrenheit.

1.06 DELIVERY, STORAGE AND HANDLING

- A. During loading, transportation and unloading, take care to prevent damage to pipes and coating. Carefully load and unload each pipe under control at all times. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to ensure no injury to pipe and lining.

1.07 PIPE SCHEDULES

- A. Piping shall be designed as specified in the individual piping specification or shown on the Drawings.
- B. Plant pipe (except buried where noted)
- C. For buried/yard/utility piping, refer to appropriate Division 2 Sections.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Specific piping materials and appurtenances are specified in the respective Piping or System Sections.

B. General installation materials shall be as specified below.

1. Unions shall be brass or bronze unions for joining nonferrous pipe; malleable brass or bronze-seated iron or steel unions for joining ferrous pipe; PVC unions for joining PVC pipe; CPVC unions for joining CPVC pipe (type 316 SS where buried).
2. Flanged Joints. Bolt and nuts, Type 304 stainless steel, bolt number and size same as flange standard; studs - same quality as machine bolts; 1/16-in thick rubber gaskets with cloth insertions; rust-resistant coatings.
3. Temporary Plugs shall be standard plugs or caps which are suitable for permanent service.
4. Flexible Connections shall be flanged spool type, 180 degree F maximum service, single filled arch with synthetic rubber tube and cover, steel-ring reinforced synthetic fiber carcass, with flanges drilled to 150-lb ANSI B16.5 Standard. Steel retaining rings, control rods and compression sleeves shall be provided where shown and as required for the working pressure of the system in which the joint is installed. All flexible joints shall be rated for the working pressure of the system in which they are installed.
5. Additional pipe specialties are in Section 15120, in other sections and on the Drawings.

PART 3 EXECUTION

3.01 GENERAL (ADDITIONAL INFORMATION IS IN INDIVIDUAL SPECIFICATION SECTIONS)

- A. All dirt, scale, weld splatter, water and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.
- B. All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint.
- C. Install piping in a neat manner with lines straight and parallel or at right angles to walls or column lines and with risers plumb. Run piping so as to avoid passing through ductwork or directly under electric light outlets and/or interference with other lines or extending beyond furring lines as determined by Architectural Drawings. All work shall be accomplished using recognized methods and procedures of pipe fabrication and in accordance with the latest revision of applicable ANSI Standards, ASME Codes, and Pipe Fabrication Institute Standards.
 1. Use full length of pipe except where cut lengths are necessary. Do not spring or deform piping to make up joints.
 2. Pipe shall be cut square, not upset, undersize, or out of round. Ends shall be carefully reamed and cleaned before being installed.
 3. Bending of pipe is not permitted. Use fittings for all changes in direction.

4. Do not use bushings except where specifically approved by the ENGINEER. Reducers shall be eccentric to provide for drainage from all liquid-bearing lines and facilitate air removal from water lines.
5. Verify the locations and elevations of any existing piping and manholes before proceeding with work on any system. Any discrepancies between the information shown on the Drawings and the actual conditions found in the field shall be reported at once to the ENGINEER. No claim for extra payment will be considered if the above provision has not been complied with.
6. Where lines of lower service rating tie into services or equipment of higher service rating the isolation valve between the two shall conform to the higher rating.
7. Metering of pipe to form elbow is not permitted.
8. All piping interiors shall be thoroughly cleaned after installation and kept clean by approved temporary closures on all openings until the system is put in service. Closures should be suitable to withstand the hydrostatic test.
9. End caps on pre-cleaned pipe shall not be removed until immediately before assembly. All open ends shall be capped immediately after completion of installation.

D. Test Connections

1. Provide ½-in female N.P.T. test connection equipped with ½-in brass plug on all pump suction and discharge lines. Where indicated on the Drawings, test connections should be equipped with bar stock valve and gage. Provide test connections at all steam traps. The connection shall be located on the discharge side of the trap between the trap and the first valve. It shall consist of a ½-in branch connection terminated with a gate valve.

E. Unions

1. Unions screwed or flanged shall be provided where indicated and in the following locations even if not indicated.
 - a. In long runs of piping to permit convenient disassembly for alterations or repairs.
 - b. In by-passes around equipment.
 - c. In connections to tanks, pumps and other equipment between the shut-off valve and the equipment.
 - d. In connections on both sides of traps, controls and automatic control valves.

F. Vents and Drains

1. Provide vents and drains in the following places:
 - a. Water Lines - Vents at high points and drains at low points.

b. Air Lines - Drains at low points.

3.02 UNIONS

- A. Use unions to allow dismantling of pipe, valves, and equipment.

3.03 WELDING

- A. Welding in accordance with ANSI Standard B31 and AWS B3.0.
- B. Install welding fittings on all welded lines. Make changes in direction and intersection of lines with welding fittings. Do not miter pipes to form elbows or notching of straight runs to form tees, or any similar construction. Do not employ welder who has not been fully qualified in above specified procedure and so certified by approved welding bureau or similar locally recognized testing authority.

3.04 FLANGED JOINTS

- A. Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped. Use number and size of bolts conforming to same ANSI Standard as flanges. Before flange pieces are assembled, remove rust resistant coating from machined surfaces, clean gaskets and smooth all burrs and other defects. Make up flanged joints tight, care being taken to prevent undue strain upon valves or other pieces of equipment.

3.05 SLEEVE COUPLINGS

- A. Install tierods, pipe clamps or bridles when sleeve type couplings or fittings are used in piping systems where indicated, and at changes in direction or other places as necessary, to prevent joints from pulling apart under pressure. Use bridles and tierods at least 3/4-in in diameter, except where tierods replace flange bolts of smaller size, in which case fit with nut on each side of pair of flanges. Joint harnessing shall conform, as a minimum, to the requirements for the bolts and tie bolt lugs as set forth in AWWA Manual M11.

3.06 WALL SLEEVE SEALS

- A. Use expandable rubber segmented sealing device with corrosion- resistant fasteners to make watertight the annular space between pipe and sleeve. Determine the required inside diameter of each individual wall opening or sleeve to fit the pipe and seal to assure a watertight joint as recommended by the manufacturer, before ordering, fabricating, or installing. Install pipe concentrically through wall sleeve. Install and tighten seal per manufacturer's instructions.

3.07 TESTING

- A. See Section 15052 for testing requirements.

3.08 DISINFECTION

- A. See Section 15052 for testing requirements.

END OF SECTION

SECTION 15052

PIPE TESTING - GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies the general requirements for testing the various piping systems shown on the Drawings and specified elsewhere in these specifications. Refer to Piping and System Section specifications for specific test parameters requirements.
- B. All safety requirements, including required safety equipment, are solely the CONTRACTOR's responsibility.

1.02 RELATED WORK

- A. Additional testing requirements, pipe, joints, piping systems, and appurtenances are specified in other Sections of Divisions 02 and 15.
- B. General piping requirements are in Section 15051.

1.03 SUBMITTALS

- A. Test Records
 - 1. Records shall be maintained of all tests performed.
 - 2. Test records shall include:
 - a. Date of Testing
 - b. Identification of Piping Tested
 - c. Test Fluid
 - d. Test Pressure
 - e. Signatures of CONTRACTOR and ENGINEER
 - 3. If leaks are found, they shall be noted, on the record. After correction, retest as specified for original test.
 - 4. Records of test shall be maintained by the CONTRACTOR and the specified number of copies furnished to the ENGINEER.

1.04 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. ANSI B31 - Code for Pressure Piping, B31 Interpretation.

- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.01 TEST FLUIDS

- A. Hydrostatic Test - Water should be used as the test fluid whenever possible. In those systems where water cannot be used the test fluid may be either the one to be used in the system or the one agreed upon by the ENGINEER and the CONTRACTOR.
- B. Service Pressure Test - The fluid for which the system is designed shall be the test fluid.
- C. Pneumatic Test - Compressed air shall normally be used. Other gases may be used when specified or directed by the ENGINEER. Test pressures shall be 110 percent of the anticipated maximum operating pressure, but not exceeding 100 psig for vapor pipes 1-inch in diameter and smaller, and not less than 5 psig at the highest point in the system. Any liquid pipes shall not be pneumatically tested, except for a maximum of 5 psi special test at joints only.
- D. Freon Test - Freon gas blended with compressed air or nitrogen.

2.02 TEST EQUIPMENT

- A. Hydrostatic Test
 - 1. Water - Of sufficient capacity to deliver the required test pressure.
 - 2. Strainer - On inlet side of the pump to prevent foreign matter from entering the system.
 - 3. Valves - Shall be provided on the suction and discharge side of the pump.
 - 4. Heater - To allow heating of the test fluid when elevated temperatures are required for test.
 - 5. Relief Valve - Set at a pressure to relieve at 20 to 25 percent above the required test pressure.
 - 6. Pressure Gage(s) - Capable of reaching 50 percent over the test pressure. These should be located at the pump discharge and any other place deemed convenient by the CONTRACTOR.
 - 7. Pressure gages and relief valves shall be checked for accuracy before use in test procedures.
- B. Service Pressure Test
 - 1. A pressure gage capable of registering 25 psi over the design pressure shall be installed down-stream from the supply shut-off valve if one is not included in the system.
- C. Pneumatic Test
 - 1. Provide a compressor capable of the required test pressure.

2. Valves shall be provided on the discharge side of the pump.
3. Relief valve to relieve at 10 to 15 percent over the test pressure.
4. Pressure gage(s) capable of reaching 50 percent over the test pressure. A gage shall be located on the pump discharge and other location as required.

D. Freon Test

1. Freon gas cylinder.
2. Source of oil-free compressed air, or, when specified, nitrogen gas.
3. Pressure Gage(s) - capable of reaching 50 percent over the test pressure.
4. Freon Leak Detector.

PART 3 EXECUTION

3.01 HYDROSTATIC TEST

- A. This test specification shall be used to hydrostatically test piping systems for structural integrity and leaks. The test shall be performed at ambient temperature unless otherwise specified.
- B. Preparation For Test
 1. Determine the fluid to be used for the test, and, if other than ambient temperature is required, what the test temperature will be.
 2. When a fluid other than water is used for a test, the equipment used for the test shall be of a material compatible with the test fluid. Normally this would be equal to the piping material.
 3. Vents shall be provided at the high points of the system and drains provided where means of venting or draining do not exist.
 4. Remove or block off, all relief valves, rupture discs, alarms, control instruments, etc. that shall not be subjected to the test pressure.
 5. All discs, balls, or pistons from check valves shall be removed if they interfere with filling of the system. Open all valves between inlet and outlet of the section to be tested.
 6. Connect pump and provide temporary closures for all of the external openings in the system. Use caution to insure that the closures are properly designed and strong enough to withstand the test pressure.
 7. All joints, including welds, are to be left uninsulated and exposed for examination during test.
 8. A joint previously tested in accordance with this specification may be covered or insulated.
 9. Piping designed for vapor or gas shall be provided with additional temporary supports, if necessary, to support the weight of the test liquid.

10. Expansion joints shall be provided with temporary restraint for additional pressure under test or shall be isolated from the test.
 11. Flanged joints, where blanks are inserted to isolate equipment during the test, need not be tested.
- C. The hydrostatic test pressure shall be 1-1/2 times the design pressure unless otherwise specified in the System Specification Section.
- D. Test Procedures
1. Allow the test fluid to enter the system. Open vents to allow displacement of all entrapped air. For all pipelines exceeding 500-ft in length, the maximum rate of filling shall be limited to that which produces a maximum nominal flow velocity of one foot per second in the pipe to be tested.
 2. Close vents and restrict personnel in the test area to those involved in the test.
 3. Raise the pressure slowly with the pump until the predetermined test pressure is reached. Maintain pressure for duration of time specified in System Specification Section, keeping personnel at a safe distance.
 4. Reduce the pressure about 20 percent and hold it at that point while the entire system is carefully inspected for leaks, cracks, or other signs of defects.
 5. If defects are found, the pressure shall be released, the system drained, the defects corrected, and the test repeated.
 6. After a satisfactory test has been completed, the line shall be drained.
- E. Flushing
1. Lines tested with water shall be completely drained.
 2. Lines shall be flushed, after test.
- 3.02 SERVICE PRESSURE TEST
- A. This test specification shall be used to test piping systems using service pressure and the fluid for which the system is used. It shall not be used to test piping systems conveying combustible or flammable liquids or systems that comply with ANSI B31 codes. Insulated lines shall have all joints left exposed until completion of the test.
- B. The test pressure shall be equal to the maximum pressure that the line will be subjected to under normal operating conditions as determined by the ENGINEER.
- C. Test Procedures
1. Liquids
 - a. See that all personnel not involved in the test vacate the area.

- b. Allow the system fluid to enter the system slowly while venting the air at the extreme far and uppermost points. For all pipelines exceeding 500-ft in length, the maximum rate of filling shall be limited to that which produces a maximum nominal flow velocity of one foot per second in the pipe to be tested.
 - c. When the system is full and all air is vented, close the vents.
 - d. Allow the pressure in the system to build up to the full line pressure.
 - e. Inspect entire system for leaks.
2. Gas or Vapor (Including Compressed Air and Steam)
 - a. See that all personnel not involved in the test vacate the area.
 - b. In systems that do not have a pressure gage near the main shut-off valve, a gage shall be installed.
 - c. Allow the system fluid to enter the system slowly until the full operating pressure is reached.
 - d. Shut off main supply valve. Observe the gage for 15 minutes. The pressure gage shall not drop during this time.
 - e. If the gage drops, indicating the presence of leaks, the systems shall be inspected visually and, if necessary, with soap suds or commercially available leak detectors to locate the leak(s).
3. If leaks are found, the lines shall be relieved of pressure, purged if necessary, and repaired. Tests shall be repeated for repaired sections.

3.03 PNEUMATIC TEST

- A. This procedure for a pneumatic test of piping systems shall be used only when acceptable to the OWNER and ENGINEER when water, or other liquid, cannot be introduced into the line, or as a supplement to a hydrostatic test.
- B. Safety
 1. All pneumatic tests shall be done under the supervision of CONTRACTOR and in the presence of the ENGINEER.
 2. New Construction: The ENGINEER's permission shall be secured before testing.
 3. Renovation Projects: The OWNER representative and the ENGINEER must be informed and their permission secured before testing.
 4. Only those people actively participating in the test shall be allowed in the test area.
 5. Safety glasses and hard-hats must be worn.
- C. Test Procedures

1. Increase the pressure in the line gradually, in steps, to the specified pressure. Checks shall be made at 25 psig and at 10 psig intervals until the test pressure is reached using sound, soap solution, or a drop in indicated pressure.
2. When the specified pressure for the test is reached, shut off the valve in the supply line from the pump.
3. Maintain the test pressure long enough to visually inspect all joints or a minimum of 10 minutes. There shall be no drop in the test pressure in this time.
4. Leaks shall be repaired and the line retested. All leaks shall be noted on the Test Record form.
5. After satisfactory completion of the test, vent the line and allow it to return to atmospheric pressure. Connection can then be made to the supply line.

END OF SECTION

SECTION 15062

STAINLESS STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and install, test, complete and ready for operation all stainless steel pipe, tubing, and fittings as shown on the Drawings and as specified herein.
- B. Where the word "pipe" is used it shall refer to pipe, tubing, fittings, flanges, hangers, supports, and appurtenances unless otherwise noted.
- C. The work includes, but is not necessarily limited to:
 - 1. Furnishing and installing stainless steel pipe, tubing, fittings and specials with screwed, welded, flanged, grooved, ring, shoulder, and plain ends.
 - 2. Furnishing stainless steel pipe sleeves and stainless steel pipe wall castings for interior and exterior wall and foundation wall penetrations.
 - 3. Furnishing buried stainless steel yard piping including all piping and fittings extending outward, upward, and downward into the ground from the outside face of all structures and all buried pipe designated to be stainless steel. Exterior pipe coating as specified herein shall begin at the outside face of the structure, regardless of where the yard pipe begins.

1.02 RELATED WORK

- A. Concrete work is included in Division 3.
- B. Field painting is included in Division 9.
- C. Process piping general requirements are included in Section 15051.
- D. Testing is included in Section 15052.
- E. Valves and appurtenances are included in Section 15100.
- F. Piping specialties are included in Section 15120.
- G. Pipe hangers and supports are included in Section 15140.
- H. Requirements for plumbing and HVAC pipe systems are in other sections of Division 15.

1.03 SUBMITTALS

- A. Shop drawings, including piping layouts and schedules, shall be submitted to the ENGINEER in accordance with Section 01300, including dimensioning, fittings, expansion joints, locations of

valves and appurtenances, joint details, wall penetration details, methods and locations of supports, and all other pertinent technical specifications for all piping to be furnished. Shop drawings shall include all data and information required for the complete piping systems. All dimensions shall be based on the actual equipment to be furnished. Types and locations of pipe hangers and/or supports shall be shown on the piping layouts for each pipe submittal. Not all dimensions will be checked by the ENGINEER, nor will detailed review be performed. CONTRACTOR shall be responsible for accurate dimensioning of piping systems.

- B. Prior to submitting shop drawings for yard piping, the CONTRACTOR shall expose and verify the exact location of all points of tie-in and all obstacles. The tie-ins and obstacles shall be surveyed into the coordinate system by the CONTRACTOR. Any deviations from the lines and grades shown on the Drawings shall be called out to the ENGINEER's attention in the piping submittal. With the survey information, proper alignment and/or grade will be confirmed by the ENGINEER before shop drawings are approved.
- C. Submit certifications that welders are qualified, in accordance with ANSI B31.1, Paragraph 127.5 for shop and project site welding of pipe work.
- D. Integrity and leakage test plan as specified in Section 15052.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A182 - Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - 2. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheets and Strip for Pressure Vessels.
 - 3. ASTM A262, Practice A - Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels.
 - 4. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - 5. ASTM A276 - Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
 - 6. ASTM A312 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipe.
 - 7. ASTM A530 - Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.
 - 8. ASTM A774 - Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
 - 9. ASTM A778 - Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

B. American National Standards Institute (ANSI)

1. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
2. ANSI B16.9 - Factory-Made Wrought Steel Buttwelding Fittings.
3. ANSI B31.1, Paragraph 127.5 - Power Piping.
4. ANSI B36.19 - Stainless Steel Pipe

C. American Water Works Association (AWWA)

1. AWWA C207 - Steel Pipe Flanges.
2. AWWA C606 - Grooved and Shouldered Joints.

D. American Society of Mechanical Engineers (ASME)

1. ASME B31.1 - Power Piping.
2. Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

E. American Welding Society (AWS)

F. Compressed Gas Association (CGA)

1. CGA Publication G-4.1, Cleaning Equipment for Oxygen Service.

G. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. Stainless steel pipe and fittings shall be furnished by a single manufacturer who is fully experienced, reputable, qualified, and regularly engaged for the last five (5) years in the manufacture of the materials to be furnished. The pipe and fittings shall be designed, constructed, and installed in accordance with the best practices and methods for the intended service and shall comply with these Specifications.

1.06 SYSTEM DESCRIPTION

- A. Piping shall be installed in those locations as shown on the Drawings so as to form a complete, smooth flow path.
- B. The equipment and materials specified herein are intended to be standard types of stainless steel pipe and fittings for use in transporting air and water.
- C. Stainless steel piping shall be designed for the conditions as specified in Section 15051.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe, tubing, and fittings. Pipe, tubing, and fittings shall not be dropped. Pipe and fittings shall be examined before installation and no piece shall be installed which is found to be defective. Openings shall be kept covered while pipe and fittings are stored.
- B. In handling the pipe, wide cushioned slings shall be used or other devices and methods compatible with the printed instructions of the pipe manufacturer. No uncushioned ropes, chairs, wedges, or levers shall be used in handling the pipe, tubing, fittings, and couplings.
- C. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe by the CONTRACTOR, at the CONTRACTOR's own expense. All pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until they are put into service.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

- A. All stainless steel pipe, fittings, and flanges shall be fabricated from stainless steel sheet and conform to ASTM A240, A778 Type 304L, A778 Type 316L, and ANSI B36.19 as indicated on the Drawings. Carbon content of 304L and 316L material shall be 0.03 percent maximum. Finish shall be No.1 or No.2B.
- B. Pipe shall be die-formed or rolled true to dimension and round. Tolerances for length, inside and outside diameter and straightness shall conform to ASTM A530. The two edges of sheet shall be brought to line so as not to leave a shoulder on the inside of the pipe. Ends of pipe and fittings shall be perpendicular to the longitudinal axis. Longitudinal seams on pipe and fittings shall be welded by either the tungsten gas or the metallic-gas method. The interior welds shall be smooth, even and shall not have an internal bead higher than 1/16-in. All pieces shall be marked with gauge and type of stainless steel and with the initials of the inspector marked on the inside of each piece, at each end.
- C. Fittings shall be as shown on the Drawings.
- D. Flanges for pipe 4-in and smaller shall be of the same type of stainless steel as the pipeline, and shall be welded directly to the pipe end, and shall be drilled to the 125 lb ANSI B16.1 standard. Flanges for pipe larger than 4-in shall have stub ends or rolled angle rings of the same type of stainless steel as the pipeline welded to the pipe end, with suitable gaskets between the mating surfaces and joined through the use of 125 lb rated back-up flanges, drilled to ANSI B16.1, and made of Type 316 stainless steel. Where the pipe stub is to pass through a sleeve during installation, a split-type back up flange shall be used. Bolts, washers, nuts, and other hardware for flange bolting shall be Type 316 stainless steel.
- E. Butt weld type fittings shall be manufactured in accordance with ASTM A774, A778, and ANSI B16.9 of the same raw material and in the same thicknesses as the pipe. Long radius elbows up to and including 18-in diameter shall be smooth flow; i.e., centerline to end of elbow radius shall equal 1.5 times the nominal pipe size. Reducers shall be straight tapered, cone type. Tees, crosses, laterals, and wyes shall be shop fabricated from pipe, and in addition, stainless steel

reinforcement pads shall be fully welded to the branch and run of the pipe to maintain the specified pressure rating of the system. Fittings shall be smooth curve type up to 18-in diameter and mitered type 20-in diameter and greater.

- F. Stainless steel pipe and fittings shall be supplied with wall thickness schedules per ANSI B36.19 as indicated on the Drawings.
- G. Gaskets for flanged connections shall be a minimum of 1/16-in thick and shall be Hypalon, Teflon, expanded PTFE, BUNA-N, or Viton.
- H. Shop fabricated multiple output headers may be used in lieu of individual flanged fittings, where approved by the ENGINEER.
- I. Wall pipes shall have integral shop welded wall stops.
- J. All stainless steel pipe and fittings shall be pickled at the point of manufacture, scrubbed and washed until all discoloration is removed. Pickling of piping with hydrochloric acid or other acid harmful to the base metal shall not be allowed. Pipe and fittings shall be sandblasted or cleaned with solvent or other means acceptable to the ENGINEER.
- K. Pipe ends shall be prepared for couplings or other type ends where required by transport and handling limitations, where required by the support layout requirements and where noted on the Drawings. Plain end pipe shall be coupled with grooved end couplings as manufactured by the Victaulic Co., or equal. Grooving (or built-up ends for Schedule 10S pipe) shall be of the coupling manufacturers standard type. CONTRACTOR is responsible for ensuring rigidity of joints where required. All normal pipe joints at valves, bends, etc, shall be flanged, drilling per ANSI B16.1, Class 125. Flanges shall be Type 316L stainless steel in Type 316L stainless steel pipe and Type 304L stainless steel in Type 304L stainless steel pipe.
- L. Unless otherwise shown, all joints in buried stainless steel pipe shall be circumferentially butt-welded in the field.
- M. Shop welding of fabrications shall be done according to the procedures and by welders certified per ASME Section IX. Welds shall be by an inert gas shielding process using only extra low carbon filler metals. Welds shall have a bead height of no more than 1/16-in. Butt welds shall have 100 percent penetration to the interior or backside of the weld joint. Cross-sectional thickness of welds shall be equal or greater than that of the parent metal.
- N. Where shown on the Drawings or where approved by the ENGINEER, plain end pipe shall be joined by all stainless steel flexible couplings. Sleeve type couplings shall be of Type 316L stainless steel and shall be Style 38 as manufactured by Dresser Manufacturing Division of Dresser Industries; coupling 411 as manufactured by Smith Blair, Inc., equivalent couplings manufactured by Depend-O-Lok Co., or equal.
- O. Where shown on the Drawings or where approved by the ENGINEER, flanged coupling adaptors shall be used to connect plain end pipe to equipment, fittings, and valves. Flanged coupling adaptors shall be of the Type 316L stainless steel and shall comply with AWWA C207. Flanged coupling adaptors shall be manufactured by Dresser Manufacturing Division of Dresser Industries; Smith Blair, Inc. or equal.

- P. All gaskets, glands, bolts, nuts, and other required hardware shall be provided for connection of piping and appurtenances. Bolts and nuts shall, except as otherwise specified or noted on the Drawings, be Type 316L stainless steel. Studs shall be of the same quality as machine bolts. All other hardware shall be of the size, type, and number as required and recommended by the piping or fitting manufacturer and as specified herein.

2.02 STAINLESS STEEL TUBE AND FITTINGS

- A. Tubing shall be seamless austenitic stainless steel in accordance with ASTM A269, TP316, with the following wall thickness:

<u>Tube Size (in.)</u>	<u>Wall Thickness (in.)</u>
1/8 and 3/16	0.035
1/4 thru 3/8	0.049
1/2 thru 5/8	0.065
3/4 thru 7/8	0.083
1	0.095
1-1/4 thru 1-1/2	0.134
2	0.188

- B. Fittings: Bar stock material for compression type fittings shall be in accordance with ASTM A276, Type 316 and forgings shall be in accordance with ASTM A182, Type 316. Material shall be in accordance with ASTM A262, Practice A. Assemblies shall consist of tubing, fittings, and components of one manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION OF PIPING

- A. All pipe and fittings shall be installed true to grade and alignment and pipe anchorage and/or restraint shall be provided where required. Manufacturer's instructions shall be strictly followed. All pipe shall be welded except where flanges, couplings, or flanged coupling adapters are shown on the Drawings.
- B. All pipe and fittings shall be protected from dirt, dust, oil, grease, and other foreign matter during installation to prevent damage to pipe and to assure no foreign matter is left in the piping.
- C. To assemble the joints in the field, the CONTRACTOR shall thoroughly clean all joint surfaces and gaskets, if any, with soapy water before assembly. Bolts shall be tightened alternately, evenly to the manufacturer's specified torques. Under no condition shall extension wrenches or pipe-over-handle ratchet wrenches be used to secure greater leverage. All electrical bonding or insulation shall be installed as joints are made up.
- D. Fittings, in addition to those shown on the Drawings, shall be provided if required. Due consideration shall be given to thermal expansion/contraction over a temperature range of 200 degrees F.
- E. Sleeves of the proper size shall be installed for all pipes passing through floors or walls as shown on the Drawings.

- F. Buried stainless steel pipe shall be concrete encased as shown on the Drawings.
- G. At all times when the work of installing buried pipe is not in progress, all openings into the pipe and the ends of pipe in the trenches shall be kept tightly closed to prevent entrance of animals and foreign materials. The CONTRACTOR shall take all necessary precautions to prevent the pipe from floating due to water entering the trench from any source, shall assume full responsibility for any damage due to this cause and shall at his/her own expense restore and replace the pipe to its specified condition and grade if it is displaced due to floating. The CONTRACTOR shall maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until its acceptance by the OWNER.
- H. When cutting of pipe is required, the cutting shall be done by machine neatly, without damage to the pipe. Cut ends shall be smooth and at right angles to the axis of the pipe.
- I. After installation, stainless steel pipe lines shall be washed clean with steam or hot water to remove any foreign material picked up during transport, storage, and installation.

3.02 INSTALLATION OF TUBING

- A. Cuts made on tubing shall be reamed. Bends in tubing shall be made with elbow fittings, except that a proper bending tool shall be used if a bend without a fitting is necessary and in cases specifically permitted by the ENGINEER.
- B. Stainless steel tubing lines shall be installed only by mechanics and pipe fitters skilled in their respective trades and with stainless steel accessories. Parallel lines shall be held truly parallel by means of an adequate number of supports. Waviness or sagging of the lines will not be permitted.
- C. Stainless steel tubing and connecting lines used for hydraulic service shall be flushed out with hydraulic fluid to ensure that tubing is free from obstructions, dirt, and foreign matter. Other stainless steel tubing shall be flushed out with appropriate fluid, as approved by the ENGINEER.

3.03 JOINING MECHANICAL AND RESTRAINED JOINTS

- A. Mechanical joints shall be in accordance with the "Notes on Methods of Installation" under AWWA C111 and the instructions of the manufacturer.
- B. Restrained joint pipe and fittings shall be installed in the locations shown on the Drawings and as acceptable to the ENGINEER.

3.04 JOINING FLANGED JOINTS

- A. Flanged joints shall be made with gasket, bolts and nut bolts stud with a nut on each end, or studs with nuts where the pipe is tapped. The number and size of bolts shall conform to the same standard specifications as the flange.

3.05 FIELD WELDING

- A. Welding in the field of exposed pipe shall be done only if approved by the ENGINEER and shall be kept to a minimum. Field welds shall be made by welders certified under ASME Section IX

and be equal in all respects to shop welds. After field welding has been done, all joints shall be thoroughly cleaned and buffed using stainless steel deburring and finishing wheels.

3.06 FIELD CLEANING

- A. Following installation, field clean all piping, tubing, fittings, equipment, etc., that will come in contact with air in accordance with CGA Publication G-4-1. Submit details of the procedure to be used to ensure hydrocarbon and welding residue decontamination of the System. The selected procedure shall be one that is used in the oxygen manufacturing industry. The CONTRACTOR shall provide services of a qualified specialty cleaning and decontamination contractor for this work. The name and qualifications of this specialty contractor shall be submitted to the ENGINEER 60 days prior to the start of cleaning procedures. Upon completion, the system shall be dried using dry nitrogen gas and inspected by the specialty cleaning contractor to ensure compliance with the cleaning procedure requirements. The CONTRACTOR shall pay for all cleaning and drying chemicals used for field cleaning.

3.07 FIELD PAINTING

- A. Final field painting is included in Division 9.

3.08 FIELD TESTING

- A. Field Testing of the pipe, including an integrity and leakage test, is specified in Sections 15052.

END OF SECTION

SECTION 15100

PLANT/PROCESS VALVES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install complete and ready for operation and test all valves as shown on the Drawings and as specified herein.
- B. This is a reference section, therefore all items noted may not be required. See individual drawings and other sections for exact items needed.
- C. Sections 15051 and 15052 also apply to this Section.
- D. The equipment shall include, but not be limited to, the following. However all items specified herein may not be included in this project.
 - 1. Valve Actuators - General
 - 2. Butterfly Valves
 - 3. Plug Valves
 - 4. Ball Valves
 - 5. Check Valves
 - 6. Globe Valves
 - 7. Plastic Valves, Chemical Systems, Sample Lines
 - 8. Needle Valves
 - 9. Pressure Regulating Valves (Pressure Control Valves)
 - 10. Solenoid Valves
 - 11. Corporation Stops
 - 12. Air and/or Air/Vacuum Valves - General
 - 13. Air Release Valves
 - 14. Mud Valves (Plug Drain Valves)
 - 15. Pressure/Vacuum Relief Valves
 - 16. Gas Valves
 - 17. Pinch Valves Gate Valves
 - 18. Knife Gate Valves

- 19. Injectors
- 20. Extension Stem and/or Bonnet

1.02 RELATED WORK

- A. Piping and disinfection for potable water systems is included in the respective Sections of Divisions 02 and 15.
- B. Pipeline appurtenances are included elsewhere in Divisions 02 and 15.
- C. Painting is included in Division 9.
- D. Pipe hangers, supports and restraints are included in Section 15140.
- E. Pipe hangers, supports and restraints are included in Section 15140.
- F. Electrical components supplied with valves are not specified herein, but are included in Division 16.
- G. Certain items similar to those specified in this Section may be specified with individual equipment or systems. In case of a conflict, individual equipment or system specifications shall govern.
- H. Additional buried items are in Division 02.
- I. Requirements for plumbing and HVAC valves are in other sections of Division 15.

1.03 SUBMITTALS

- A. Submit complete shop drawings required to establish compliance with these Specifications in accordance with Section 01300.
- B. Submit the following additional items:
 - 1. Certified drawings showing all important details of construction and dimensions.
 - 2. Descriptive literature, bulletins and/or catalogs of the valve assemblies.
 - 3. The total weight of each item.
 - 4. A complete bill of materials.
 - 5. Additional submittal data, where noted with individual pieces of equipment.
- C. Certificates
 - 1. For each valve specified to be manufactured, tested and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate standards, including certified results of required hydrostatic tests and certification of proper installation.
- D. Manufacturer's Installation and Application Data
- E. Operation and Maintenance Data
 - 1. Operation and maintenance instructions shall be furnished to the ENGINEER as provided in Section 01730. The instructions shall be prepared specifically for this installation and shall

include all required cuts, drawings, equipment lists, descriptions and other information required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
3. ASTM A159 - Standard Specification for Automotive Gray Iron Castings.
4. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
5. ASTM A276 - Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
6. ASTM A436 - Standard Specification for Austenitic Gray Iron Castings.
7. ASTM A536 - Standard Specification for Ductile Iron Castings.
8. ASTM B30 - Standard Specification for Copper-Base Alloys in Ingot Form.
9. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
10. ASTM B429 - Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

B. American Water Works Association (AWWA)

1. AWWA C111- Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
2. AWWA C500 - Gate Valves for Water and Sewage Systems.
3. AWWA C504 - Standard for Rubber-Sealed Butterfly Valves.
3. AWWA C507 - Ball Valves 6-in Through 48-in.
4. AWWA C508 - Standard for Swing-Check Valves for Waterworks Service, 2-in Through 24-in NPS.
5. AWWA C509 - Resilient-Seated Gate Valves for Water and Sewage Systems.
6. AWWA C511 - Reduced-Pressure Principle Backflow-Prevention Assembly.
7. AWWA C540 - Power-Actuating Devices for Valves and Sluice Gates.
8. AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.
9. AWWA C800 - Underground Service Line Valves and Fittings.

C. American National Standards Institute (ANSI)

1. ANSI B2.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).
2. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

3. ANSI B16.10 - Face-to-Face and End-to-End Dimensions of Valves.

D. American Iron and Steel Institute (AISI)

E. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)

1. MSS-SP-60 - Connecting Flange Joint Between Tapping Sleeves and Tapping Valves.

2. MSS-SP-61 - Pressure Testing of Steel Valves.

3. MSS-SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends.

4. MSS-SP-71 - Cast Iron Swing Check Valves, Flanges and Threaded Ends.

5. MSS-SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Services.

6. MSS-SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends.

7. MSS-SP-80 - Bronze Gate, Globe, Angle and Check Valves.

8. MSS-SP-82 - Valve Pressure Testing Methods

9. MSS-SP-98 - Protective Epoxy Coatings for the Interior of Valves and Hydrants.

F. Compressed Gas Association (CGA) Publication G-4.1 "Cleaning Equipment for Oxygen Service".

G. National Electrical Manufacturers Association (NEMA)

H. Underwriters Laboratories (UL)

I. Factory Mutual Insurance (FM)

J. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Valves and appurtenances shall be products of well established firms who have a minimum of 5 years continuous experience, are reputable and qualified in the manufacture of the particular products to be furnished.

2. Each product shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications as applicable.

3. All units of the same type shall be the product of one manufacturer.

B. Certifications

1. The manufacturers shall furnish an affidavit of compliance with Standards referred to herein as specified in Paragraph 1.03. Refer to PART 3 for testing required for certain items in addition to that required by referenced standards.

C. Provide the services of a qualified and factory-trained service representative(s) of the manufacturer(s) to provide operational and maintenance instruction, for a total one-day, eight hour period for all valve and valve components requiring operator maintenance or

adjustment. Training shall be in accordance with Section 01715.

- D. Inspection of the units may be made by the ENGINEER or other representative of the OWNER after delivery. The equipment shall be subject to rejection at any time due to failure to meet any of the Specification requirements, even though submittal data may have been accepted previously. Equipment rejected after delivery shall be marked for identification and shall be removed from the job site at once.

1.06 SYSTEM DESCRIPTION

- A. All of the equipment and materials specified herein is intended to be standard for use in controlling the flow of air, chemicals, filtered, and water, as noted on the Drawings.
- B. Valves, appurtenances and miscellaneous items shall be installed as shown on the Drawings and as specified, so as to form complete workable systems.
- C. Unless otherwise noted:
 - 1. Solenoid valves shall be 115 volt, single phase, 60 hz, NEMA 4X enclosure, with a conduit knockout continuous duty encapsulated Class F coils and manual operator.
 - 2. See other paragraphs for additional requirements.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Reference is made to Section 01600 for additional information.
- B. Packing and Shipping
 - 1. Care shall be taken in loading, transporting and unloading to prevent injury to the valves, appurtenances, or coatings. Equipment shall not be dropped. All valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Any damage to the coatings shall be repaired to a new condition.
 - 2. Prior to installation, the ends of all valves shall be acceptably covered to prevent entry of foreign material. Covers shall remain in place until installation.
 - a. All valves 3-in and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.
 - b. Valves smaller than 3-in shall be shipped and stored as above except that heavy cardboard covers may be used on the openings.
 - c. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until the valve is installed and put into use.
 - d. Any corrosion in evidence at the time of acceptance by the OWNER shall be removed and repaired, or the valve shall be removed and replaced.
- C. Storage and Protection
 - 1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping specifications and manufacturer's information for further requirements.

1.08 MAINTENANCE

- A. Special tools and the manufacturer's standard spare parts, if required for normal operation and

maintenance, shall be supplied with the equipment, as specified herein.

- B. Provide all special tools required for normal maintenance. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.
- C. Provide to the OWNER a list of all spare and replacement parts with individual prices and location where they are available.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT - GENERAL

- A. Reference is made to Section 01136 for additional requirements, including nameplates, provisions for temporary pressure gauges, protection against electrolysis and anchor bolts.
- B. The use of a manufacturer's name and/or model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- C. Valves and appurtenances shall be of the size shown on the Drawings or as noted and as far as possible equipment of the same type shall be identical and from one manufacturer.
- D. Valves and appurtenances shall have the name of the maker, nominal size, flow directional arrows, working pressure for which they are designed and standard referenced, cast in raised letters, or indelibly marked upon some appropriate part of the body.
- E. Unless otherwise noted, items shall have a minimum working pressure of 150 psig or be of the same working pressure as the pipe they are connected to, whichever is higher and suitable for the pressures noted where they are installed.
- F. Joints, size and material - unless otherwise noted or required by the ENGINEER:
 - 1. Except where noted, all joints referred to herein shall be of the same type, nominal diameter, material, and with a minimum rating equal to the pipe or fittings they are connected to.
 - 2. Unless otherwise noted on the Drawings, valves and appurtenances shall be of the same nominal diameter as the pipe or fittings they are connected to.
 - 3. All valves exposed to view, or in vaults.
 - a. 2-in and smaller - union ends
 - b. 3-in and larger flanged ends.
- G. Provide all special adaptors as required to ensure compatibility between valves, appurtenances, and adjacent pipe.
- H. Valves and actuators located outdoors; within a building below grade; within maximum 2-ft above liquid; in vaults; or where otherwise noted shall be especially designed for submerged service where water may completely submerge the valve and operator. All other units shall be as a minimum weather tight.

2.02 MANUAL VALVE ACTUATORS - GENERAL

- A. See the Paragraph 2.01 for submergence requirements.
- B. The valve manufacturer shall supply and rigidly mount all actuators, including any type of manual or powered actuators, on valves at the factory. The valves and their individual actuators

shall be shipped as a unit.

- C. Unless otherwise noted, valves shall be manually actuated; nonburied valves shall have an operating wheel, handle or lever mounted on the operator; buried valves and those with operating nuts shall have a non-rising stem with an AWWA 2-in nut.
- D. Except as otherwise shown on the Drawings or specified herein, all valves 3-in diameter or larger, with the valve center line located 7-ft or more above the operating floor, shall be provided with chain wheel operators complete with chain guides and hot dipped galvanized steel or zinc plated welded link chain, which loop within 4-ft of the operating floor.
- E. All actuators shall be capable of moving the valve from the full open to full close position and in reverse and holding the valve at any position part way between full open or closed.
- F. Each operating device shall have cast on it the word "OPEN" and an arrow indicating the direction of operation.
- G. Floor boxes for operating nuts recessed in concrete shall be standard cast iron type, cast-in-place, with fastening top by Clow or equal.
- H. Stem guides shall be of the adjustable wall bracket type, bronze bushed, with maximum spacing of 10-ft as manufactured by Clow; Rodney Hunt or equal. Extended operating nuts and/or stems shall have universal joints and pin couplings, if longer than 10-ft and a rating of at least five times the maximum operating torque. Stem adaptors shall be provided.
- I. Where required by the installation, or as specified, provide the following: extended stem; floor stand and handwheel; position indicator and etched or cast arrow to show direction of rotation to open the valve; resilient, moisture-resistant seal around stem penetration of slab. Handwheel diameters shall be at least 8 inches but not more than 24 inches.
- J. Gear Actuators
 - 1. Unless otherwise noted, gear actuators shall be provided for the following: all valves of larger than 8-in nominal diameter; all buried valves with operating shaft mounted horizontally (butterfly, plug, etc); where specified and/or indicated on the Drawings; where manual operator effort is greater than 80 ft-lbs rim pull.
 - 2. Gear actuators shall be of the worm or helical gear type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on the output shaft. Unless noted they shall conform to AWWA C504, but with the exception of butterfly valves, need not be certified.
 - 3. Actuators shall be capable of being removed from the valve without dismantling the valve or removing the valve from the line.
 - 4. Gearing shall be machine-cut steel designed for smooth operation. Bearings shall be permanently lubricated, with bronze bearing bushings provided to take all thrusts and seals and to contain lubricants. Housings shall be sealed to exclude moisture and dirt, allow the reduction mechanisms to operate in lubricant and be of the same material as the valve body.
 - 5. Manual operator input effort to the handwheel shall be a maximum of 40 ft-lbs for operating the valve from full open to full close, under any conditions. Gear actuators shall indicate valve position and have adjustable stops. Maximum handwheel size shall be 24-in diameter.
 - 6. Unless otherwise specified, all valves shall be left hand to open (counterclockwise). Each valve body or actuator shall have cast thereon the word "OPEN" and an arrow indicating the direction to open.

- K. Additional valve actuators are included with the individual valve types and as noted in Paragraph 1.02.
- L. All position indication and direction of opening arrows shall be embossed, stamped, engraved, etched or raised decals.
- M. Unless otherwise noted, all valves larger than 3-in nominal diameter shall be provided with position indicators at the point of operation.
- N. Where required on the Drawings, furnish position indicating switches on valves. Switches shall be pilot duty double pole, double throw, at either limit of open or close or both limits as shown. Switches shall be enclosed in a NEMA 4X enclosure and contacts shall be rated 10 amperes at 120 volts A.C.

2.03 BUTTERFLY VALVES

- A. All butterfly valves are Bray series 30/31 with ductile iron body, 316 stainless steel disc and shaft and EPDM rubber seats and bushing. No equal is allowed.
- B. Unless otherwise specified, all valves shall be left hand to open (counterclockwise). Each valve body or actuator shall have cast thereon the word "OPEN" and an arrow indicating the direction to open.
- C. Valve bearings shall be sleeve type, corrosion resistant, and self-lubricating. Bearing load shall not exceed 20 percent of the compressible strength of the bearing or shaft materials, and shall be secured in the trunion by a machined ledge. Ferrous bearings in the flow stream shall not be allowed.
- D. Shaft seals shall be of the chevron or O-ring type.
- E. Cartridge retained seats in the valve body are not acceptable.
- F. After each valve is completely assembled, including the actuator, it shall be operated several times in the factory to ensure it is in working condition. Each Class 150 valve shall be shop tested and certified for leakage with the disc in the horizontal plane, in accordance with AWWA C504.

2.04 PNEUMATIC CYLINDER OPERATORS FOR OPEN-CLOSE TYPE VALVES

- A. Pneumatic cylinder operators for open close type operation for butterfly valves shall be as manufactured by Bray International, series 92, aluminum body/end caps, zinc plated pinion. No Equal is allowed.
- B. Actuators shall be designed to operate from the compressed service air system when a minimum pressure of 40 psi and a maximum pressure of 140 psi is applied to the cylinder. The valve sizing pressure shall be based on 100 psi. The operator shall be of the double acting single cylinder actuator type, unless otherwise specified herein or required for proper operation of the valve. Double acting actuator end travel torque shall be at least 1.5 times the mid travel torque.
- C. The valve actuators shall be designed to operate in indoor and outdoor installations. The center body shall be of a fully enclosed design to preclude the possibility of injury to personnel during

operation. The center body shall be capable of being lubricated by oil or grease.

- D. The actuator shall be fitted with a visual position indicator easily understood and readable. Status indicator shall be Bray, Series 5A with high visibility indicator. No Equal is allowed.
- E. All actuators shall have a minimum safety factor on pressurized components of at least 4 to 1. The maximum safe working pressure shall be clearly indicated on the actuator.
- F. Each actuator shall have external, easily adjustable position stops. These stops shall be fully sealed to prevent leakage of oil from the center body. All materials of the actuator shall be suitable for normal operation over a temperature range of 4°F to 200°F.
- G. All components in rubbing contact with seals shall be electroless nickel plated. This is to ensure prolonged seal life and the maintain efficiency. Dynamic seals between the center body and the environment shall be of the double seal type to ensure integrity of the inner seal throughout the working life. An additional seal washer shall be provided on the torque plug to prevent ingress of particulate matter to the inner sealing surface.
- H. The center body cover shall be easily removable to allow for inspection of the center body without disassembling the entire unit or removing the unit from the valve.
- I. The body shall be a one-piece extruded aluminum alloy designed to maintain correct bearing alignment. A removable cover shall be provided to totally enclose the center body. This cover shall incorporate a weather tight vent. Sealing shall be provided to facilitate oil fill of the center body.
- J. Piston rods shall be turned, ground, and polished bar. Piston shall be die cast aluminum alloy. The yoke pin shall be capable of withstanding the high stresses inherent in this design.
- K. Cylinders shall be constructed of carbon steel to a finish of 16 micro inch RMS, or better. Cylinders are to be electroless nickel plated on all surfaces.
- L. The yoke shall be constructed of high yield ductile iron and all surfaces shall be corrosion protected after machining. Piston rod bushings shall be of bronze or similar corrosion resistant material. The actuator shall be designed so that it can be mounted in any position. Actuators shall be supplied with the center bodies pregreased at the factory.
- M. Full open and full closed limit switches shall be provided, each rated at 8 A minimum. Limit switches shall be wired to a terminal board for remote output.
- N. Pneumatic solenoids for Bray actuator series 92 shall be Automatic Valve model D20 (direct mount to actuator). Solenoids shall be fitted with Speedaire 1EJU3 exhaust port flow control valve and adjusted for actuator cycle time limit of 2 to 5 seconds in each direction.

2.05 BALL VALVES (NON-PLASTIC)

- A. Water Service smaller than 2 inches
 - 1. Ball valves for plant water piping 1-inch, 1.5-inch and 2-inch, shall be manual or manual and electric actuated shown on the Drawings, bronze, resilient seated, regular port, threaded two piece bolted body type valves. The body and cap shall be of brass, ASTM B30, the ball and stem of Type 316 stainless steel and the seats and seals of TFE. The valves shall have full port floating ball and shall be non-lubricated. Valve seats shall be easily accessible and

replaceable. Valves shall be rated to 150 psi and shall be as manufactured by Neles- Jamesbury; WKM; Worcester; or equal.

2. For 1/2-inch valves with working pressures from zero to 600 psi, use NIBCO T-580-BR, Stockham S-216-BR-R-T, or approved equal. Valves shall have threaded ends, two piece bronze body, standard port, bronze trim, chrome plated ball, and blowout proof stem. Use a lever handle for non-buried installations and a tee handle for buried installations.

2.06 PLASTIC VALVES

A. General

1. All valves shall be certified as completely compatible with the intended and specified service; compatibility shall apply to the material of the valve and internal components, including all seals, gaskets, O-rings and washers; solvents and primers used in valve joint make-up shall be specifically in conformance with the written instructions of the valve supplier. Service chemicals and service conditions are shown in the piping specifications in Division 15.
2. Except as otherwise specified valve ends shall be flanged.
3. Valve material shall be the same as the piping service except as specified.
 - a. PVC shall be Type 1, Grade 1, per ASTM D1784 classification, made from unplasticized polymer, and generally suitable for service to 120 degrees F.
 - b. CPVC shall be Type 4, Grade 1, per ASTM D1784, classification generally suitable for service to 180 degrees F.
 - c. Polypropylene (PP) shall conform to the material requirements of ASTM D4101 for copolymer polypropylene.
 - d. PVDF (polyvinylidene fluoride) shall be manufactured from high molecular weight polymers of vinylidene fluoride.
 - e. The manufacturer of the valves shall retain material source quality documentation and shall furnish it to the ENGINEER upon request.
4. Unless otherwise specified:
 - a. O-rings, valve seats and stem seals shall be PTFE, or PTFE encapsulated elastomer. Alternative materials may not be substituted without complete documentation provided to the ENGINEER of service suitability.
 - b. Gaskets shall be low torque, full face and have two concentric, convex, molded rings between the center hole and bolthole circle. Gaskets shall be PTFE, Low-Torque AV gaskets by Asahi of America, or equal.
 - c. Valve external hardware shall be Type 316 stainless steel. No internal metallic components shall be exposed to the service fluid.
 - d. No factory or field coatings shall be applied to the valves.
5. Valves specified as furnished with equipment, or equipment systems shall comply with these requirements.

B. Ball Valves

1. Ball valves 3" or greater shall be flanged, with full-port opening.
2. Provide 180 degree -turn manual valve operator and valve seat adjustability.
3. All PVC ball shall be Asahi Type 21/21A with FKM seal, no equal.

C. Check Valves

1. Check valves for centrifuge feed pumps discharge line (3") and centrate pumps discharge lines (4") should be Asahi PVC ball check valves, FKM elastomer, flanged end type, no equal.
2. Check valves for polymer system shall be diaphragm check type of same material as the pipe, double-union style with socket ends.

D. Pressure Relief Valves (Water Service)

1. Angle-pattern design, with adjustable relief pressure and locking nut. Spring-loaded, with pressure adjustable over range up to 100 psig.
2. The valve spring shall be elastomer-coated and isolated from the process flow. Provide teflon diaphragms.
3. Relief valves shall be piped as indicated, and if not indicated, the relief piping shall be directed to 6" above the floor or adjacent gutter or drain.
4. Pressure relief valve settings shall be set to a pressure as recommended by the pump or equipment supplier and adjusted at the time of equipment testing, inspection and start-up.

2.07 SURFACE PREPARATION AND SHOP COATINGS

- A. Notwithstanding any of the Specifications, all coatings and lubricants in contact with potable water shall be certified as acceptable for use with that fluid.
- B. If not specified herein, coatings shall comply with the requirements of Division 9. In case of a conflict, the requirements of this Section govern.
- C. If the manufacturer's requirement is not to require finished coating on any interior surfaces, then manufacturer shall so state and no interior finish coating will be required, if acceptable to the ENGINEER.
- D. The exterior surface of various parts of valves, operators, floor-stands and miscellaneous piping shall be thoroughly cleaned of all scale, dirt, grease or other foreign matter and thereafter one shop coat of an approved rust-inhibitive primer shall be applied in accordance with the instructions of the paint manufacturer or other primer compatible with the finish coat provided.
- E. Unless otherwise noted, interior ferrous surfaces of all valves shall be given a shop finish of an asphalt varnish conforming to AWWA C509, (except mounting faces/surfaces) or epoxy AWWA C550 with a minimum thickness of 4 mil.
- F. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating. Mounting surfaces shall be especially coated with a rust preventative.
- G. Special care shall be taken to protect uncoated items and plastic items, especially from environmental damage.

2.08 FACTORY MOUNTING OF OPERATORS AND VALVES

- A. All operator and valve assemblies shall be match marked during mounting with indelible markings to illustrate proper relative orientation and facilitate disassembly and reassembly in the field.

2.09 FACTORY INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

- A. Factory inspection, testing and correction of deficiencies shall be done in accordance with the referenced Standards and as noted herein.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. All valves and appurtenances shall be installed per the manufacturer's instructions in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to a new condition before they are installed.
- B. Install all brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Drawings, or otherwise required. Before setting these items, check all Drawings and figures which have a direct bearing on their location. The CONTRACTOR shall be responsible for the proper location of valves and appurtenances during the construction of the Work.
- C. All materials shall be carefully inspected for defects in construction and materials. All debris and foreign material shall be cleaned out of openings, etc. All valve flange covers shall remain in place until connected piping is in place. All operating mechanisms shall be operated to check their proper functioning and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to the OWNER.
- D. Where installation is covered by a Referenced Standard, installation shall be in accordance with that Standard, except as herein modified, and the CONTRACTOR shall certify such. Also note additional requirements in other parts of this Specification.
- E. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing the same procedures as specified under the applicable type connecting pipe joint and all valves and other items shall be installed in the proper position as recommended by the manufacturer. CONTRACTOR shall be responsible for verifying manufacturers' torquing requirements for all valves.

3.02 INSTALLATION OF MANUAL OPERATIONAL DEVICES

- A. Unless otherwise noted, all operational devices shall be installed with the units of the factory, as shown on the Drawings or as acceptable to the ENGINEER to allow accessibility to operate and maintain the item and to prevent interference with other piping, valves, and appurtenances.
- B. For manually operated valves 3-inches in diameter and smaller, valve operators and indicators shall be rotated to display toward normal operation locations.
- C. Floor boxes, valve boxes, extension stems, and low floor stands shall be installed vertically centered over the operating nut, with couplings as required and the elevation of the box top shall be adjusted to conform with the elevation of the finished floor surface or grade at the completion of the Contract. Boxes and stem guides shall be adequately supported during concrete pouring to maintain vertical alignment.

3.03 INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

- A. See also Divisions 1 and 2. Take care not to over pressurize valves or appurtenances during pipe testing. If any unit proves to be defective, it shall be replaced or repaired to the satisfaction of the ENGINEER.
- B. No testing shall be performed until the manufacturer's service engineer has provided written certification that the installed equipment has been examined and found to be in complete accordance with the manufacturer's requirements
- C. Functional Test: Prior to plant startup, all items shall be inspected for proper alignment, quite operation, proper connection, and satisfactory performance. All units shall be operated continuously while connected to the attached piping, without vibration, jamming, leakage, or overheating and perform the specified function.
- D. The various pipelines in which the valves and appurtenances are to be installed are specified to be field tested. During these tests any defective valve or appurtenance shall be adjusted, removed and replaced, or otherwise made acceptable to the ENGINEER.
- E. Various regulating valves, strainers, or other appurtenances shall be tested to demonstrate their conformance with the specified operational capabilities and any deficiencies shall be corrected or the device replaced or otherwise made acceptable to the ENGINEER.

3.04 CLEANING

- A. All items (including valve interiors) shall be cleaned prior to installation, testing, and final acceptance.

3.05 DISINFECTION

- A. Disinfection of valves and appurtenances on all potable water lines and where otherwise noted, shall be as noted in the Sections referenced in Paragraph 1.02.

END OF SECTION

SECTION 15120

PIPING SPECIALTIES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and install, test, complete and ready for operation all appurtenances as specified herein.
- B. The following piping system appurtenances are specified herein (additional pipe specialty items are included in Section 15051, Section 02640, other sections, and on the Drawings):
 - 1. Miscellaneous Adaptors
 - 2. Line Strainers
 - 3. Appurtenances and Miscellaneous Items
 - 4. Double ball flexible expansion joints.
 - 5. Insulating Fittings
 - 6. Coalescing filters for air service
 - 7. Protective wrapping.
 - 8. Flex (Sleeve) couplings.
 - 9. Flanged coupling adaptors.
 - 10. Service Clamps (Tapping Sleeves and Saddles)
 - 11. Chemical Diffusers
 - 12. Quick Connect Couplings
 - 13. Harnessing and Restraint

1.02 RELATED WORK

- A. Piping materials and systems as well as additional pipe specialties are included in other Sections of Divisions 02 and 15.
- B. Field painting is included in Division 9.
- C. Instrumentation is included in Division 13.
- D. Valves are included in Sections 15100 and 02640.

- E. Requirements for plumbing and HVAC pipe systems are in other sections of Division 15.

1.03 SUBMITTALS

- A. Submit complete shop drawings for all appurtenances and equipment supplied in accordance with Section 01300 and Section 15051, including dimensioning, fittings, locations of appurtenances, joint details, methods and locations of supports, and all other pertinent technical specifications.
- B. Provide manufacturer's product data for each type of flowmeter and appurtenances required demonstrating compliance with these specifications.
- C. Operation and maintenance data in accordance with Section 01730.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A36 - Standard Specification for Structural Steel.
 - 2. ASTM A183 - Carbon Steel Track Bolts and Nuts.
 - 3. ASTM A 278, Class 30 - Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650°F.
 - 4. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 5. ASTM A325 - Standard Specification for High-Strength Bolts for Structural Steel Joints.
 - 6. ASTM A575 - Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grade.
 - 7. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 8. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- B. American National Standards Institute (ANSI)
 - 1. ANSI A13.1 - Scheme for the Identification of Piping Systems.
 - 2. ANSI B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form)
 - 3. ANSI B2.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).
 - 4. ANSI B16.5 - Pipe Flanges and Flange Fittings
 - 5. ANSI B18.2 - Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws.
 - 6. ANSI B31 - Code for Pressure Piping, B31 Interpretation.
- C. American Society of Mechanical Engineers (ASME)

D. American Welding Society (AWS)

1. AWS B3.0 - Welding Procedure and Performance Qualifications

E. American Water Works Association (AWWA)

1. AWWA C-206 - Grooved and Shouldered Type Joints.
2. AWWA Manual M11 - Steel Pipe - A Guide for Design and Installation.

F. Compressed Gas Association, Inc. (CGA)

1. V-6-Standard Cryogenic Liquid Transfer Connections.
2. CGA Publication G-4-1, Cleaning Equipment for Oxygen Service.

G. International Organization for Standardization (ISO)

- H. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. All materials shall be new and unused.
- B. Install piping to meet requirements of local codes.
- C. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified. Reference to standards such as ASTM and ANSI shall apply to those versions in effect at the time of bid opening.
- D. Coordinate dimensions and drilling of flanges with flanges for valves, and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.
- E. Reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner, and acid solder.
- F. Pipe-joint compound, for pipe carrying flammable or toxic gas, shall bear approval of Underwriters' Laboratories or Factory Mutual Engineering Division.
- G. All materials and appurtenances of like kind shall be identical and furnished by one, reputable manufacturer.
- H. Unless otherwise specified, pressures referred to in all Piping Sections are expressed in pounds per square inch gauge above atmospheric pressure (psig) and all temperatures are expressed in degrees Fahrenheit (F).

1.06 DELIVERY, STORAGE AND HANDLING

- A. Delivery, storage, and handling shall be in accordance with Section 01600.

- B. During loading, transportation and unloading, take care to prevent damage to equipment. Carefully load and unload equipment under control at all times.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Specific piping materials and appurtenances are specified in the respective Piping or System Sections. The use of a manufacturer's name and/or model number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Equipment shall be of the size shown on the Drawings or as noted.
- C. Equipment shall have the name of the maker, nominal size, flow directional arrows (if applicable), working pressure for which they are designed and standard referenced specifications cast in raised letters or indelibly marked upon some appropriate part of the body.
- D. Unless otherwise noted, items shall have a minimum working pressure of 150 psig or be of the same working pressure as the pipe they connect to, whichever is higher and suitable for the pressures noted where they are installed.

2.02 MISCELLANEOUS ADAPTORS

- A. Between different types of pipe and/or fittings special adapters may be required to provide proper connection. Some of these may be indicated on the Drawings or specified with individual types of pipe or equipment. However, it is the CONTRACTOR's responsibility to ensure proper connection between various types of pipe, to structures and between pipe and valves, gates, fittings and other appurtenances. The CONTRACTOR shall provide all adapters as required, whether specifically noted or not.
- B. As required, these adapters shall be suitable for direct bury, with proper dielectric insulation and as a minimum, if metallic (not stainless steel or galvanized), with two coats of Coal Tar Epoxy.

2.03 LINE STRAINERS

- A. "Y" Type Strainers
 - 1. Manual strainers furnished for pipe diameters smaller than 2-in shall be "Y" type, capable of removing solids 0.01-in in diameter and larger. The strainer body shall be of brass or bronze for copper pipe and tubing and shall conform to the latest revision of ASTM A278, Class 30. The strainer body shall be Type 316L stainless steel for stainless steel pipe and tubing. Strainer elements, including woven wire mesh, shall be constructed of Type 316L stainless steel.
 - 2. The design of the strainer body shall be such that the cleanout plug and screen may be easily removed to permit inspection and cleaning without disassembly of the inlet and outlet piping. End connections shall be ANSI screwed pipe threads.
 - 3. Sufficient spare screens shall be furnished for replacement of all "Y" type units at least once. The strainers shall be designed for a maximum operating pressure of 150 psig. They shall be as manufactured by GA Industries Inc., Pittsburgh, PA or equal.

2.04 APPURTENANCES AND MISCELLANEOUS ITEMS

- A. Special protective tape shall be fabric reinforced petroleum tape as manufactured by Denso Inc., Houston, TX, or equal. Petroleum tape shall not be used with air.

- B. Mist Eliminator Pads

(Not Used)

- C. Automatic Liquid Drain Traps

- 1. Automatic liquid drain traps shall be installed as shown on the Drawings and specified herein. The liquid drain trap shall be of the float type. Body shall be stainless steel, and valve mechanism shall be stainless steel with hardened working surfaces designed to retain a water seal at all times. An NPT tapping shall be provided for a balance pipe. All internal parts are to be renewable and field serviceable. Drain trap shall be as manufactured by Spirax Sarco FA-150, Armstrong 11-CD, or equal.

2.05 DOUBLE BALL FLEXIBLE EXPANSION JOINT

- A. Double ball flexible expansion joints shall be manufactured of ductile iron conforming to the material properties of ANSI/AWWA C153/A21.53. All such joints shall be capable of deflecting and expanding or contracting simultaneously without leakage. Each ball joint shall be capable of deflecting not less than 15 degrees in any direction.
- B. All pressure containing or wetted parts shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the requirements of ANSI/AWWA C213 and shall be holiday tested with a 1500 volt spark test conforming to ANSI/AWWA C213.
- C. Double ball flexible expansion joints shall be capable of the expansion and contraction ranges shown on the Drawings. If not noted on the Drawings, provide 4 inches of expansion capacity for double ball flexible expansion joints 12 inches in diameter and smaller; provide 8 inches of expansion capacity for double ball flexible expansion joints 14 inches in diameter and larger. End configurations shall be flanged unless otherwise noted on the Drawings.
- D. Double ball flexible expansion joints shall be Flex-Tend by EBAA Iron Inc. or equal.

2.06 INSULATING FITTINGS AND COUPLINGS

- A. Fittings shall be of type to provide control of electrolysis and equal to "Dielectric" as manufactured by Watts Regulator Co., or equal.
- B. For working pressures from zero to 300 psi, use insulating couplings to avoid galvanic or electrolytic corrosion wherever dissimilar metals are connected. Couplings shall be steel; lined with an inert, non-conductive, linen impregnated laminate material; both ends female iron pipe threads; and rated to 300 psi working pressure at 225°F. Exterior surface of coupling is uncoated, bare steel. Couplings shall be Lochinvar V-Line as supplied by Corrosion Control Products Company or District approved equal.

2.07 PROTECTIVE WRAPPING

- A. Protective wrapping for flanged joints, flex couplings, flanged adapter couplings, valves, and other exposed appurtenances and joints below final grade shall be protected by a primer, mastic, wrapping, and overwrapping system, Denso or equal.

2.08 FLEX (SLEEVE OR DRESSER) COUPLINGS

- A. Standard and insulated flex couplings shall be rated at the working pressure of the pipe joined or at a minimum of 150 psi, whichever is greater. Couplings shall also be designed for the actual soil loads for each installation condition if buried. Couplings 12-inches in diameter and smaller shall have steel sleeves 7 inches long. Couplings 14-inches to 36-inches in diameter shall have steel sleeves at least 10 inches long. Couplings larger than 36-inches in diameter shall have steel sleeves at least 18 inches long. Sleeve type couplings shall not have pipe stops. All couplings shall be factory cleaned and shop painted with the manufacturer's standard rust-inhibiting coating system. Anchor studs shall be provided if indicated on the Drawings. Insulating sleeve type couplings shall have an insulating rubber boot adequate to stop the flow of electrical current across the coupling and piping. Standard sleeve type flex couplings shall be Dresser 411, JCM 201, Romac 400, or equal. Insulated sleeve type couplings shall be Dresser 416 or equal.

2.09 FLANGED COUPLING ADAPTORS (FCAs)

- A. Flanged adapter couplings shall be rated at the working pressure of the joining piping or 150 psi, whichever is greater. Couplings shall also be designed for the actual soil loads for each installation condition if buried. Anchor studs shall be supplied when indicated on the Drawings. All couplings shall be factory cleaned and painted with the manufacturer's standard rust-inhibiting coating system. Non-insulated flanged coupling adapters shall be Dresser 913, JCM 303, Romac FC400, or equal. Insulated flanged coupling adapters shall be Dresser 933 or equal.

2.10 SERVICE CLAMPS (Tapping Sleeves and Saddles)

- A. Service saddles for outlet sizes 4-in through 12-in where the outlet size is not greater than half the size of the main pipe shall have ductile iron bodies and a neoprene circular cross section O-ring gasket confined within the body. Outlet shall be AWWA C110 flange or AWWA C111 mechanical joint as required for the application. Straps shall be alloy steel, minimum 1/4-in by 1-1/2-in in cross section and fabricated with 3/4-in threaded ends. Outlet flange shall conform to MSS-SP-60 dimensions. Service clamps shall be by American Cast Iron Pipe Company or equal.
- B. Tapping Sleeves
 - 1. Perform wet taps on existing asbestos cement pipe, ductile iron pipe, and PVC pressure pipe with working pressures 150 psi or less. Provide tapping sleeves that have been specifically designed to fit the type, size and class of pipe of the installation.
 - 2. Tapping sleeves shall be of Type 304 stainless steel construction with two half sleeves and flanged outlet. Sleeve halves shall be bolted together with stainless steel bolts and nuts. Gaskets shall completely surround the pipe to be tapped and be the same length as the sleeves. Gaskets shall be SBR conforming to ASTM D 2000. Flanged outlet shall be flat faced conforming to ANSI B16.5, Class 150. Use tapping machines and cutting tools that have been specifically designed for the type of pipe to be tapped.

3. Tapping sleeves for use on pipe with working pressures 150 psi or less shall be Ford Stainless Tapping Sleeve Style FTSS, Romac Industries FTS420, Smith-Blair 665 Stainless Steel Tapping Sleeve, or District approved equal.

2.11 CHEMICAL DIFFUSERS

- A. Chemical diffusers shall be provided for the purpose of dispersing dilute hypochlorite solution into the process flow as indicated on the Drawings. Diffusers shall be constructed of Schedule 80 PVC or CPVC. Diffuser solution tube shall be sized to match pump discharge line or injection flow rate. An acceptable locking device must be included to prevent accidental release of the diffuser tube from the main while under pressure. A ball check valve shall be included to prevent backpressure from the main from entering chemical feed system. Pump discharge line connection to diffuser shall be flexible tubing or hose and must be capable of withstanding maximum pump discharge line pressure. Diffusers shall be by Saf-T-Flo or equal.

2.12 QUICK CONNECT COUPLINGS

- A. Couplings shall polypropylene and of the cam and groove type consisting of a male adapter conforming to MIL-C-27487. Male adapters shall be designed to receive a female coupler without requiring threading, bolting, or tools. Connections shall remain tight and leakproof under pressures up to 100 psig. Each adapter shall be furnished with a dust cap complete with a 18-in long security chain of corrosion resistant material. Units shall be "drip proof," providing totally dry connections and disconnections. Couplings shall be as manufactured by Dover Corporation; Ever-tite, or equal.
- B. Adapters shall be furnished as required by the installation.

2.13 HARNESSING AND RESTRAINT

- A. Where harnessed couplings or adapters are noted, they shall conform to AWWA Manual M11 except as modified by the Drawings or this Section.
- B. Unless otherwise noted, size and material for tie rods, clamps, plates, and hex nuts shall be as required in AWWA Manual M11. Manufactured restraining clamp assemblies shall be as manufactured by Stellar Corporation, Columbus, OH, or fabricated to the AWWA requirements.
- C. Restrained joints (such as welded, locking mechanical joints) shall be of the type specified with the individual type of pipe. If not specified, restrained (locking) mechanical joint pipe shall be of the manufacturer's standard design utilizing a locking device (ring or ears) integrally cast with the pipe.
- D. For up through 18-in diameter ductile iron pipe only, the following may be used as an alternative to other restraint system:
 1. The optional mechanical joint restraints shall be incorporated in the design of a follower gland. The gland shall be manufactured of ductile iron conforming to ASTM A536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts as specified with the pipe.
 2. The restraint mechanism shall consist of numerous individually activated gripping surfaces to maximize restraint capability. The gripping surfaces shall be wedges designed to spread

the bearing surfaces on the pipe. Twist-off nuts, sized same as tee-head bolts, shall be used to ensure proper actuating of restraining devices. When the nut is sheared off, standard hex nut shall remain.

3. The mechanical joint restraint device for ductile iron pipe shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1.
 4. The mechanical joint restraint devices shall be Megalug 1100 Series, by EBAA Iron, Inc., or equal.
- E. The CONTRACTOR shall be responsible for anchorage and/or restraints required for hydrostatic testing.

PART 3 EXECUTION

3.01 GENERAL

- A. All dirt, scale, weld splatter, water and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.
- B. All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint.
- C. Installation of Pipeline Appurtenances
 1. All pipeline appurtenances shall be installed as required and in accordance with the manufacturer's recommendations, as acceptable to the ENGINEER.
 2. Meters and similar in-line items shall be isolated from testing pressures in excess of the rated pressure of the assembly.
 3. Use Teflon tape on all screwed fittings.
- D. Apply protective wrapping to all flanged joints, flex couplings, flanged adapter couplings, valves, and other exposed appurtenances and joints below final grade in accordance with the manufacturer's written instructions. Apply primer to all surfaces. Fill void areas with mastic to produce a uniform surface for subsequent tape wrapping.

END OF SECTION

SECTION 15140
PIPE SUPPORTS

PART 1 GENERAL

1.01 THE REQUIREMENT

- A. Furnish all equipment, labor, materials, and design calculations required to provide pipe supports in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01350 – Seismic Anchorage and Bracing
- B. Division 3, Concrete – Appropriate and Related Sections
- C. Section 05010 – Metal Materials
- D. Section 05035 – Galvanizing
- E. Section 05050 – Metal Fastening
- F. Section 05061 – Stainless Steel
- G. Section 05120 – Structural Steel
- H. Section 05500 – Metal Fabrications
- I. Section 05830 – Bearing Devices and Anchoring
- J. Section 15000 – Basic Mechanical Requirements

1.03 SUBMITTALS

- A. Applicable and associated cut sheets and drawings for materials and support components shall be submitted with the Shop Drawings in accordance with or in addition to the submittal requirements specified in Section 01300 – Submittals, Section 15000 – Basic Mechanical Requirements, and other referenced Sections above.
 - 1. Catalog cut information on all system components such as pipe supports, hangers, guides, anchors, and channel type supports.
 - 2. Drawings of the piping support systems, locating each support, brace, hanger, guide, component and anchor. Identify support, hanger, guide and anchor type by catalog number and Shop Drawing detail number.
 - 3. With each piping support system Shop Drawing, the Contractor shall attach calculations prepared and sealed by a Professional Engineer licensed in the State where the project is located showing that the piping support system complies with the specified requirements,

including all building code and seismic code requirements pertaining to support of piping and other non-structural components. See Section 01350 – Seismic Anchorage and Bracing.

4. Table showing the manufacturer's recommended hanger support spacing for PVC, CPVC and FRP pipe for the services listed in Section 15390 – Schedules.

PART 2 PRODUCTS

2.01 GENERAL

- A. The Contractor shall be responsible for the design of all piping support systems, unless noted otherwise herein. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility of providing a pipe support design sealed by a Professional Engineer. Standard Details for pipe supports have been included on the Drawings to define minimum requirements as to the types of Contractor designed pipe supports that will be acceptable.
- B. Where a specific location or type of support is shown on the Drawings, the location and type shall be incorporated in the Contractor's pipe support design.
- C. Where special pipe support fabrications are required, products and execution shall be as specified in Section 05500 – Metal Fabrications and other related and referenced Sections of the Specifications.
- D. Existing piping support systems to support new piping shall only be used if the Contractor can show and demonstrate by submitting supporting calculations that they are adequate for the additional load imposed by the new piping, or if they are strengthened to support the additional load.
- E. Design Criteria for Piping Support Systems:
 1. Design pipe supports for dead loads imposed by the weight of the pipes filled with water, except for air and gas pipelines, plus the weight of insulation. If applicable by location, ice loads per code shall be applied as indicated in the governing building code.
 2. Design for the thermal expansion and contraction of the piping and its associated pipe support and pipe expansion systems and couplers.
 3. Design the pipe supports for all seismic loading requirements and conditions as specified in the governing building code and referenced seismic design codes. Refer to Section 01350 – Seismic Anchorage and Bracing and the structural code drawing for seismic design criteria to be used for this particular project.
 4. A minimum safety factor of 2 or as approved by the Engineer, based upon the yield strength of the support material, shall be used for pipe supports, braces, hangers, and guides as well as for beam and column members used in channel-type support systems.

5. The horizontal pipe hanger and/or floor support spacing shall be as recommended by the pipe and/or hanger manufacturer, but shall not exceed 10 feet on center unless indicated otherwise herein or on the Drawings.
6. Seismic and sway bracing shall be provided at maximum 10-foot centers.
7. The design, sizing and spacing of anchor bolts, including concrete anchors, shall be based on withstanding shear and pullout loads imposed by loading at each particular support. The minimum anchor bolt size shall be ½ inches in diameter. Refer to Section 05830 – Bearing Devices and Anchoring.
8. Pipe support design shall not utilize process equipment for thrust restraint or support of piping loads.

2.02 HANGERS AND SUPPORTS

- A. All piping shall be adequately supported and braced by means of steel hangers and/or supports, concrete piers, supplemental lateral bracing components, pre-fabricated brackets, or otherwise as may be required by the location and forces applied per governing code, including gravity and lateral forces from earthquake and/or wind (if exterior). Generally, concrete supports shall be used where pipe centerline is less than 3 feet above floor, and hangers above 6 feet unless specified or shown otherwise. Supports shall be not more than 10 feet on center for steel and cast iron, 5 feet on center for plastic unless otherwise shown on the Drawings or required by the specific manufacturer. All necessary inserts or appurtenances shall be furnished and installed in the concrete or structures for adequately securing hangers and supports to the structure. Refer to Standard Detail Drawings.
 1. Metal pipe support materials, where stainless steel pipe is supported, shall be Type 304 stainless steel meeting the requirements of Section 05061 – Stainless Steel.
 2. Metal pipe support materials, where carbon steel, ductile or other ferrous pipe is supported, shall be galvanized carbon steel meeting Section 05120 – Structural Steel and Section 05035 – Galvanizing unless indicated otherwise on the Drawings or in the specifications or by the Engineer.
 3. Metal pipe supports indicated as standard type pipe hangers are designed and detailed for gravity loading only. Resulting lateral loads from wind, earthquake, or other lateral loads per code, or special loading conditions during construction, shall be applied to the pipe in accordance with the governing building code. Supplemental lateral stiffening members (when necessary) shall be provided along pipe or at gravity supports using appropriate supplemental members and connections when required by calculations. The Contractor shall include design calculations and details with all pipe hanger and support submissions for review by the Engineer. The main structure and structural components that will support the pipe hangers and other appurtenant components of the facility have been designed to resist all resulting secondary lateral loading from pipe hangers and other non-structural members for gravity and resulting lateral loads.
- B. Hangers and supports shall conform to the following requirements:
 1. All fabricated metal hangers and supports shall be capable of adjustment after installation. Different types of hangers and supports along a pipe length, including bends, shall be kept

to a minimum.

2. Hanger rods shall be straight and vertical. Chain, wire, strap, or perforated bar hangers shall not be used. Hangers shall not be suspended from other piping.
 3. Vertical piping shall be properly supported at each floor and between floors by stays or braces to prevent rattling and vibration.
 4. Supports and hangers for plastic and FRP piping shall include wide saddles or bands as recommended by the manufacturer and approved by the Engineer to distribute load and thus avoid localized deformation of the pipe.
 5. Hanger and supports shall prevent contact between dissimilar metals by use of copper plated, rubber, vinyl coated or stainless-steel hangers.
 6. Ferrous pipes to be painted shall be painted in accordance with Section 09900 - Painting. Ferrous pipes that require painting or galvanizing shall be supported by galvanized hangers and supports. Stainless steel piping shall be supported by stainless steel saddles and straps (if required).
 7. Copper piping shall be supported by plastic coated or copper plated steel hangers and supports.
 8. Plastic piping shall be supported by plastic coated steel hangers and supports.
 9. Hangers and supports shall provide for thermal expansion throughout the full operating temperature range.
 10. Expansion and adhesive type anchors used for pipe hangers and supports shall be Type 304 stainless steel.
- C. Metallic hangers and supports may be standard make by Anvil International, Inc., "Witch" by Carpenter & Paterson, Ltd., B-Line Systems, Inc., or equal; and data on the types and sizes to be used shall be furnished to the Engineer for approval. Metallic support system brackets, rods, support clips, clevis hangers, hardware, etc. shall be cast iron or welded steel construction. All gravity type hangers and supports shall be restrained laterally to resist seismic loading and other loading as required by the governing code.
- D. Non-metallic support system shall be a heavy-duty channel framing system. Channel frames shall be manufactured by the pultrusion process using corrosion grade polyester or vinylester resins. All fiberglass construction shall include suitable ultraviolet inhibitors for UV exposure and shall have a flame spread rating of 25 or less per ASTM E84. Piping accessories, pipe clamps, clevis hangers, support posts, support racks, fasteners, etc., shall be constructed of vinylester or polyurethane resin. Non-metallic support systems shall be standard make Aickinstrut by Aickinstrut, Inc., Unistrut Fiberglass by Unistrut, Inc., Enduro Fiberglass Systems, or equal. The Contractor shall submit data on the types and sizes of approval. Unless otherwise shown or specified the Contractor shall provide support spacings in the conformance with the pipe and support system manufacturer's requirements.

2.03 PROCESS AIR PIPE SUPPORTS

- A. Unless specifically designed and detailed on the Drawings, process air piping shall be supported by slide bearings as manufactured by Fluorocarbon Company, Anaheim, California, Anvil International, Inc., Portsmouth, New Hampshire, or equal. Refer to Section 05830 – Bearing Devices and Anchoring for supplemental information and requirements.
- B. The slide bearing material shall be 3/32-inch-thick, 25 percent glass-fiber reinforced structural grade teflon. The bearing material shall withstand at least 1000 psi (compression) at 250°F with a coefficient of friction between 0.05 and 0.08. The performance of bearing and bonding materials shall be unaffected by continual immersion in wastewater containing domestic and industrial waste at a temperature of 210°F.
- C. Non-submerged slide bearing type supports shall be provided with a bearing material covering a 120° arc centered at the bottom of the pipe. The Teflon shall be at least 4 inches wide at the underside of the pipe and 8 inches wide at the top of the support. The Teflon material shall be hot press bonded to 10 ga. stainless steel plates for welding to the bottom of the pipe and securing to the top of the support.
- D. Submerged slide bearing type supports shall be provided with Teflon bonded to the underside of the hold down strap and the top of the pipe such that the sliding surface is formed between two sheets of Teflon. Each surface shall cover a 120° arc centered at the top of the pipe. On the underside of the strap the Teflon bearing shall be hot press bonded directly to the stainless-steel strap or to a 10 ga. stainless steel plate for welding to the strap. At the top of the pipe, the Teflon shall be bonded to a 10 ga. stainless steel plate for welding to the pipe.
- E. Pipe straps shall not tightly bind the pipe but shall provide 1/16-inch clearance over the top 180° of the pipe surface.
- F. Wall bracket supports shall be used where shown for pipe to be installed adjacent to a wall. Where it is not feasible to install hanger supports, adjustable pipe saddle supports may be used with the permission of the Engineer. Concrete pier supports shall be spaced at a maximum distance of 10 feet and shall be at least 12" wider than O.D. of pipe and 10 inches thick unless otherwise shown on the Drawings. Refer to the Standard Detail Drawings.
- G. Small diameter piping (6-inches in diameter or less) shall not be strapped or otherwise secured directly to walls. Suitable wall offset brackets of an approved type shall be used. Anchors shall not be attached using percussion fasteners.
- H. Sliding surfaces shall be protected from accumulation of dirt, grit, or other foreign matter.
- I. Slide bearings shall be capable of adequately supporting the design loads and shall be attached to pipe and supports as specified and recommended by the manufacturer.

- J. The slide bearings shall be installed in the locations shown or indicated on the Drawings, at required elevations, true to orientation and level, assuring that the correct half of each bearing is in its proper position. The Contractor shall store the bearings to protect them from mechanical damage prior to installation and shall protect the same during and after installation from contamination and damage due to placing of concrete and other materials. The Contractor shall clean the operating surfaces of bearings thoroughly before final assembly.
- K. The Contractor shall note that all pipe support locations are not shown on the Drawings and shall follow the Specifications herein in locating supports. Where deviations and modifications are required, they shall be made only with the permission of the Engineer. A detailed layout of pipe supports and hangers shall be submitted for approval.

PART 3 -- EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Support piping connections to equipment by pipe support and not by the equipment.
- B. Support large or heavy valves, fittings, flow meters and appurtenances independently of the connected piping.
- C. Support no pipe from the pipe above it.
- D. Support piping at changes in direction or in elevation, adjacent to flexible joints, expansion joints, and couplings, and where shown.
- E. The Contractor shall not install piping supports and hangers in equipment access areas or bridge crane runs.
- F. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing.
- G. Install pipe anchors (fixed supports and/or guides) where shown and/or as may otherwise be required to withstand expansion thrust loads and to direct and control thermal expansion. The Contractor may install additional pipe anchors and flexible couplings to facilitate piping installation, provided that complete details describing location, pipe supports and hydraulic thrust protection are submitted.

- END OF SECTION -

SECTION 15144

PRESSURE TESTING OF PIPING

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes pressure and leakage testing of pressure pipelines and appurtenances for transmission and distribution mains.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Standard Drawings.
- B. Submittals: Section 01300.

1.03 SUBMITTALS

- A. Submit submittal packages in accordance with Section 01300.
- B. Submit test bulkhead locations, pipe attachment details, methods to prevent excessive pipe wall stresses, blocking to overcome thrust conditions and design calculations.
- C. Submit request for use of water from waterlines of District 48 hours in advance.

PART 2 MATERIALS

2.01 TEST BULKHEADS

- A. Design and fabricate test bulkheads per Section VIII of the ASME Boiler and Pressure Vessel Code. Materials shall comply with Part UCS of said code. Design pressure shall be at least 2.0 times the specified test pressure for the section of pipe containing the bulkhead. Limit stresses to 70-percent of yield strength of the bulkhead material at the bulkhead design pressure. Include air-release and water drainage connections.

2.02 TEST OUTLETS AND TEMPORARY VALVES

- A. Provide additional outlets and temporary valves for releasing air or apply the test where automatic air valves or other outlets are available in the pipeline. Construct the outlets in the same manner as for a permanent outlet and after use, seal with a blind flange, pipe cap, or plug and coat equal to the adjacent pipe.

2.03 TEST FLUID AND TEMPORARY PIPING

- A. Use only potable water for the hydrostatic pressure test. Provide a reduced pressure backflow prevention assembly if source of potable water is from District waterlines. Provide temporary piping to convey and dispose of the test fluid used in the pipeline. Disconnect and remove temporary piping after complying with the allowable leakage.

2.04 TEST EQUIPMENT

- A. Provide calibrated pressure gauges, calibrated recorder, pipes, pumps, meters, and other equipment necessary to perform the hydrostatic test.

PART 3 EXECUTION

3.01 TESTING PREPARATION

- A. Subject the pipeline and appurtenances to a hydrostatic pressure test after the pipe has been laid and backfilled for required restraint. Allow concrete pipe anchors, collars, encasements and thrust blocks to cure for at least 7 days prior to pressure testing. Allow concrete structures to attain the specified 28-day compressive strength prior to testing. Existing facilities will be operated by or under direction of the District's Representative only.
- B. Provide any temporary piping needed to carry the test fluid to the piping that is to be tested. After the test has been completed and demonstrated to comply with the specifications, disconnect and remove temporary piping. Do not remove exposed vent and drain valves at the high and low points in the tested piping; remove any temporary buried valves and cap the associated outlets. Plug taps or connections to the existing piping from which the test fluid was obtained.
- C. Provide temporary drain lines needed to carry testing fluid away from the pipe being tested. Remove such temporary drain lines after completing the pressure testing.

3.02 CLEANING

- A. Before conducting hydrostatic pressure tests, flush pipes with water to remove dirt and debris. Maintain a flushing velocity of at least 3 fps for water testing. Flush pipes for time period as given by the formula:

$$T = \frac{2L}{3}$$

in which:

T = flushing time (seconds)

L = pipe length (feet).

3.03 TESTING AND DISINFECTION SEQUENCE

- A. Perform required disinfection after pressure testing, except when pipeline being tested is connected to a potable water pipeline.
- B. Locate and install test bulkheads, temporary valves and connections to existing pipelines, and other appurtenances in a manner to provide air gap separation between existing potable water pipelines and pipeline being tested. Disinfect water and pipeline being tested before pressure testing when connected to a potable water pipeline.

3.04 LENGTH OF TEST SECTION

- A. Test the pipeline in sections. In any one test, do not exceed more than 2,500 feet, the distance between closed valves, or as directed by the District's Representative.

3.05 INITIAL PIPELINE FILLING

- A. Maximum rate of filling with test fluid shall not cause water velocity in pipeline to exceed one foot per second. Expel air from the pipeline while filling and prior to testing. Provide necessary outlets to fill and test pipeline. Allow 72 hours for the water filled pipeline to soak and release entrapped air prior to testing.

3.06 TESTING NEW PIPE WHICH CONNECTS TO EXISTING PIPE

- A. Prior to hydrostatic pressure testing new pipelines which are to be connected to existing pipelines, isolate the new pipeline from the existing pipeline by means of test bulkheads, spectacle flanges, or blind flanges. After the new pipeline has been successfully pressure tested, continue with the disinfection and connection work.

3.07 PRESSURE AND DURATION OF TEST

- A. Base pipeline test pressures on the test hydraulic gradient elevation (HGL) as shown on the Drawings. Test pressure shall be the difference between the test HGL elevation and the invert elevation of the pipeline at the low point in the test section multiplied by 0.433 (psi). If no test HGL is shown, subject the pipeline at the low point in the test section to a hydrostatic test pressure which is 50 psi in excess of the rated class pressure of the pipe.
- B. Maintain the pipeline test pressure for the following duration and restore the test pressure whenever it drops 5 psi. Use a calibrated recorder during the test and provide a record of the test to the District.

<u>Nominal Pipe Size (inches)</u>	<u>Duration of Test (hours)</u>
18 and less	4
20 and greater	8

3.08 ALLOWABLE LEAKAGE

- A. Apply the test pressure with a positive displacement pump. Provide a snubber or dampener between the pump and the pipeline to reduce instantaneous pressure pulses to 10-percent of the test pressure. Draw test fluid from containers in which the volume of water can be readily measured or through a positive displacement meter.
- B. Leakage shall be considered as the total amount of water pumped into the pipeline during the test period. The allowable leakage for aboveground and buried piping having threaded, soldered, welded, flanged, push-on joint, mechanical joint, and rubber gasket joint shall be zero.

3.09 REPETITION OF TEST

- A. If the actual leakage exceeds the allowable, locate and correct the faulty work and repeat the test until the leakage does not exceed the allowable. Restore the work and all damage resulting from the leak and its repair. All visible leakage shall be eliminated.

3.10 BULKHEAD AND TEST FACILITY REMOVAL

- A. After a satisfactory pressure test and disinfection, drain the water; remove test bulkheads, temporary valves and piping, and other test facilities; connect to existing facilities; and restore the pipe coatings.

END OF SECTION

SECTION 15207

CENTRIFUGE DIVERTER GATE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish one (1) ALDEC-406 Diverter Gate for existing centrifuge and one (1) ALDEC 45 Diverter Gate for new centrifuge, with shop test, install, paint, adjust and make fully operational the diverter gates and actuators complete with all necessary supports, hardware, and accessories, as specified herein, shown on the Drawings and as required for a complete and operable system.

1.02 RELATED WORK

- A. Special Provisions are included in Section 01170.
- B. Miscellaneous metal used in fabrication are included in Section 05500.
- C. Mechanical piping, equipment and valves are specified in Division 15.
- D. Field painting is included in Section 09902.
- E. Instrumentation and controls provided in this section shall adhere to Instrumentation and Control Specifications Section 13401.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, Shop Drawings and product data for the equipment being furnished. Submittals shall include the following:
 - 1. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment.
 - 2. Certified Shop and installation Drawings showing all details of construction, dimensions and anchor bolt requirements.
 - 3. Complete bill of materials for the equipment.
 - 4. Spare parts list.
 - 5. Description of surface preparation and shop prime painting, including certification that the paint to be used to shop prime the equipment is compatible with the finish coat paint to be applied to the equipment.
 - 6. The weight of each component.
- B. Design Data
 - 1. Design calculations and/or other data demonstrating that the equipment process design requirements are met.

2. Design loads.

C. Operation and Maintenance Data

1. Submit operation and maintenance data in accordance with Section 01730.

1.04 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1. ANSI B16.5 - Pipe Flanges and Flanged Fittings

B. National Bureau of Standards (NBS)

1. NBS PS 15-69 Custom Contact-Molded Reinforced Polyester Chemical Resistant Process Equipment

1.05 QUALITY ASSURANCE

- A. All the equipment specified under this Section shall be furnished by a single manufacturer and shall be products of a manufacturer having at least 5 years of current and continuous experience in the design and production of such equipment. The manufacturer shall have the sole responsibility for the proper functioning of the equipment as furnished. The CONTRACTOR shall have sole responsibility for the proper installation of the equipment in accordance with the Manufacturer's recommendations.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide products manufactured by one of the following:
1. Clearwater SS, as included by Alfa Laval as part of the centrifuge unit

2.02 MATERIALS

- A. The diverter gate shall be of the knife/gate type with an electric actuator specifically designed for diverting liquid flow, as specified and/or wastewater sludge.
- B. Gate, frame and cover/bonnet shall be of all 304 stainless steel construction fabricated from structural shapes and plates
- C. Connecting pins and fasteners shall be of 18-8 stainless steel.
- D. Spray nozzle shall be 303 stainless steel fabrication.
- E. Gate seal shall be cloth inserted neoprene belting.
- F. Drainpipe coupling shall be PVC rubber.

- G. Sealing gasketing subject to sliding shall be self-lubricating.

2.03 DESIGN REQUIREMENTS

- A. Provide a standard, off the shelf actuator readily available.
- B. Provide a 1500 Ft lbs actuator.
- C. 2" x ¼" Neoprene rubber mounted above the gate to seal and divert the liquid flow. The gate slot allows 1/8 inch clearance (loose fit, metal to metal contact).
- D. The gate slots are covered when the gate is opened reducing the possibility of solids build up in the diverter. The Neoprene rubber seal partially covers the gate slot when the gate is opened.
- E. Wash water is not required on the gate itself. When the gate is opened, the liquid discharge pipe could build up with solids. A ½" coupling and nozzle are provided to clear the pipe when the gate is closed, if required.
- F. Diverter gates shall be centered beneath the centrifuge solids discharge.
 - 1. Gates shall be heavy duty, single blade diverter gates, with self-cleaning internals.
 - a. Gate wiping seals shall be made of neoprene and shall contact the top of the gate blade along the perimeter of the throat opening.
 - 2. Gates shall be capable of operating independently and each gate shall be provided with its own electromechanical linear actuator.
 - 3. The minimum thickness of the gates shall be 1/4 inch.
 - a. The diverter gate valve body shall be 3/16-inch minimum thickness.
 - b. General mounting width of the diverter gate valve shall fit within the available vertical and horizontal clearance between the existing centrifuge and the platform as well as the new centrifuge and the platform.
 - c. Upper flange bolt pattern shall match the flange on the centrifuge solids discharge chute furnished under Division 5.
- G. Diverter gate valves shall be designed to prevent wedging of sludge cake material between the gate edge and valve body.
 - 1. Diverter gate valve body shall be designed to withstand the thrust of the actuator.
- H. A fabricated, slope drain trough with flushing port and drain pipe connection shall be provided as an integral part of the valve.
 - 1. All leakage from the gate valve when closed shall be drained away.
 - 2. Designed with a material displacement pocket to aid in removing solids and prevent leaking while the gate is being closed.

- I. Flush Nozzle water supply line is ½" NPT.

Flush Nozzle Orifice Size and Angle

Supply Pressure	GPM	Orifice Size	Angle
20 PSI	7.07	.25	30 °
40 PSI	10	.25	30 °
100 PSI	15.8	.25	30 °

- J. The diverter gate normal position would be open to allow solids to pass through the gate. When the centrifuge loses "seal" during start-up/shutdown or operation, the solids discharge will allow liquid to pass through. In order to divert the liquid flow from the solids handling equipment/storage, the gate will close and divert the flow of liquid. Operation of the gate can be based on centrifuge back drive torque or manually operated (see accessories). Sealing of the gate is provided by a strip of Neoprene belting on top of the gate around the perimeter of the gate (three sides). The strip does not provide liquid holding abilities, only diversion. The side of the gate that collects and discharges liquid does not have a strip of Neoprene belting (only metal to metal contact). A flush nozzle is provided aimed down the collection vessel and piping to clear solids buildup during normal position (open). A sample port is provided on the side of the gate.
- K. Diverter gates shall be Model G2 45 ED110, manufactured by Clearwater SS, Inc., no approved equal.

2.04 ELECTRIC ACTUATORS

- A. Provide electric actuators for the diverter gate.
- B. Electric actuators are included in Section 13446 Electrical Operators for Valves and Gates.

2.05 SUPPORTS

- A. Contractor shall provide all supports for support of the gate and actuator. Type and location of supports shall be acceptable to Engineer. Supports shall be of the same material as the gate.

2.06 SAFETY

- A. All necessary safety equipment and guards to meet OSHA requirements shall be provided.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Diverter gates and actuators installation shall be as shown on the Drawings and in strict accordance with the manufacturer's instructions and recommendations.
- B. The CONTRACTOR shall supply all necessary accessories, temporary lifting equipment, labor and all other requirements for satisfactory installation.

3.02 FIELD TESTING

- A. Test all of the equipment to demonstrate that the equipment is installed correctly and is in proper operating condition and free from vibration and other defects or faults. Furnish all labor and incidentals required to conduct such tests and to correct to the full satisfaction of the ENGINEER all defects or deficiencies noted.

3.03 SPARE PARTS

- A. The manufacturer shall furnish all special tools necessary to disassemble, service, repair and adjust the equipment.
- B. The following spare parts shall be provided for each gate:
 - 1. One set of valve seals.
 - 2. Spare diverter gate actuator

3.04 PAINTING

- A. All non-stainless steel and non-plated surfaces shall be painted as specified in Section 09902, Painting.

END OF SECTION

SECTION 15290

POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials and installation of polyvinyl chloride (PVC) pipe and fittings with iron pipe size outside diameters for miscellaneous applications. Size range is 1/2- to 6-inch nominal size.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Standard Drawings.
- B. Submittals: Section 01300.
- C. Trenching, Backfilling and Compacting: Section 02223.

1.03 SUBMITTALS

- A. Submit submittal packages in accordance with Section 01300.
- B. Submit manufacturer's catalog data and descriptive literature for PVC, pipe, fittings, solvent, and miscellaneous materials. Show dimensions and materials of construction by specification reference and grade.

PART 2 - MATERIALS

2.01 PVC PIPE

- A. PVC pipe shall be Schedule 80, Type I, Grade I (Class 12454-B), conforming to ASTM D 1784 and D 1785. Provide PVC pipe with the schedule as shown on the Drawings.
- B. Pipe, fittings and solvent for use with potable water shall be certified by NSF in accordance with NSF Standard No. 14 and the seal shall be included on the pipe.

2.02 NIPPLES

- A. Short nipples shall be the same as the PVC pipe.

2.03 FITTINGS

- A. Provide fittings that have the same schedule as the PVC pipe.
- B. Fittings shall be Schedule 80 conforming to ASTM D 2464 for threaded type and ASTM D 2467 for socket type.

2.04 JOINTS

- A. Pipe and fitting joints shall be solvent welded except where threaded joints are required.

- B. Solvent cement for socket joints shall comply with ASTM D 2564 and F 656.

PART 3 EXECUTION

3.01 GENERAL

- A. Do not install PVC pipe when the temperature is below 40 degrees F or above 90 degrees F.
- B. Store fittings indoors in their original cartons.
- C. Store solvent cement indoors or, if outdoors, shade from direct sunlight exposure. Do not use solvent cements which have exceeded the shelf life marked on the storage container.
- D. Before installation, check pipe and fittings for cuts, scratches, gouges, buckling, kinking, or splitting on pipe ends. Remove any pipe section containing defects by cutting out the damaged section as a complete cylinder.

3.02 INSTALLATION

- A. Do not drag PVC pipe over the ground, drop it into the ground, or drop objects on it. Cut pipe ends square and remove all burrs, chips, and filings before joining pipe or fittings. Bevel solvent welded pipe ends as recommended by the pipe manufacturer.

3.03 SOLVENT WELDED JOINTS

- A. Prior to solvent welding, remove fittings and couplings from their cartons and expose them to the air for at least one hour to the same temperature conditions as the pipe.
- B. Wipe away loose dirt and moisture from the ID and OD of the pipe end and the ID of the fitting before applying solvent cement. Do not apply solvent cement to wet surfaces.
- C. Make up solvent welded joints per ASTM D 2855.
- D. Allow at least 8 hours of drying time before moving solvent welded joints or subjecting the joints to any internal or external loads or pressures.

3.04 INSTALLING BURIED PIPE

- A. See Section 02223 for earthwork requirements. Use imported sand in the pipe base and pipe zone.
- B. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.
- C. Grade the bottom of the trench to the line and grade to which the pipe is to be laid. Remove hard spots that would prevent a uniform thickness of pipe base material. Before laying the pipe, check the grade with a straightedge and correct any irregularities found.
- D. Do not backfill the pipe trench until the solvent welded joints have set. Support the pipe uniformly and continuously over its entire length on firm, stable bedding. Do not use blocking to change pipe grade or to support pipe in the trench.

END OF SECTION

SECTION 16000

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 DESCRIPTION

- A. Division 16, Electrical covers the work necessary for the complete electrical systems for the Olivenhain Municipal Water District Stage 4 Process Upgrades. Furnish all materials, labor, and equipment as specified herein, in other Division 16 Specification Sections as listed below, and the Drawings for a complete, operational, tested, and commissioned electrical system.
- B. The requirements of Division 16, Electrical in their entirety apply to all electrical work and equipment furnished on this project whether furnished or specified under this or other Divisions of these Specifications.
- C. The work shall include furnishing, installing, and testing the equipment and materials detailed in the following Sections. Where differences exist between the specific equipment Specification Sections of Division 16 and this Section, the specific equipment Specifications shall govern.
 - 1. 16002 – Electrical and Instrumentation Demolition and Modifications
 - 2. 16060 – Grounding and Bonding for Electrical Systems
 - 3. 16080 – Commissioning of Electrical Systems
 - 4. 16120 – Low Voltage Conductors and Cables
 - 5. 16130 – Raceways, Boxes, Fittings and Supports
 - 6. 16190 – Miscellaneous Equipment
 - 7. 16220 – Low Voltage Motors
 - 8. 16260 – Low Voltage Variable Frequency Drives
- D. The work shall include the following:
 - 1. Furnish and install complete operational systems functionally in accordance with the intent of these Contract Documents including but not limited to:
 - a. Centrifuge #2 package as specified in Section 11363,
 - b. Pneumatic diverter slide gate operators for existing Centrifuge #1 and new Centrifuge #2.
 - c. Modifications to the Centrifuge feed system including relocated centrate feed pump 1 motor installed as new Feed Pump #3 (P-726-3).
 - d. Modifications to the Centrifuge centrate system including new Centrate Pumps (P-740-1, P-740-2) and Centrate tank instrumentation

- e. Polymer Metering Pumps (P-755-3, P-755-4) system for Centrifuge #2 and Polymer day tank instrumentation.
2. Associated electrical infrastructure additions to support the specified process improvements including motor controllers, raceways, conductors, and ancillary equipment and appurtenances.
3. Short Circuit Study, System Protective Device Coordination Analysis, Arc Flash Calculations, and arc flash labels.
4. Testing of the electrical equipment and making final settings for the electrical protective devices.
5. Startup and commissioning of the electrical system and components.
6. Coordinate the details of equipment layouts and construction for all Specification Divisions which affect the work covered under Division 16, Electrical.
7. Furnish and install all incidental items not specifically shown or specified, but which are required by good practice and standards of the industry to provide complete functional systems.
8. Coordination and work associated with equipment provided under technical Divisions 2 through 15 of these Specifications including but not limited to: mechanical systems packaged with electrical equipment, motor operated valves with integral controls, pump motors with motor protection controls, and field instrumentation.
9. Coordination and work associated with Division 13 – Process and Instrumentation, for modifications to plant control system including but not limited to: control networks and media converters, control panels, conduit, wire, and terminations as required.
10. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other technical sections of these Specifications.
11. Conduit, wiring and terminations for all field-mounted instruments furnished and mounted under other Divisions, including process instrumentation primary elements, transmitters, local indicators, and control panels; lightning and surge protection equipment wiring at process instrumentation transmitters and analyzers; instrumentation disconnect switches; installation of vendor furnished cables specified under other Divisions.
12. A complete raceway system for the data highway cables and specialty cable systems. Install the data highway cables, and other specialty cable systems furnished under Division 13 in accordance with the system manufacturers' installation instructions. Review the raceway layout, prior to installation, with the control system supplier(s) and the cable manufacturer(s) to ensure raceway compatibility with the systems and materials being furnished.
13. Installation of variable frequency drives, reduced voltage starters, and other packaged motor control equipment, accessories, and appurtenances furnished under other Divisions.
14. Modifications to existing control systems including installation of auxiliary motor starter contacts, relays, switches, as required to provide the control functions or inputs as shown on the Drawings. Verify all existing wiring and connections for correctness. Trace the circuits in

the field and develop the wiring diagrams necessary for completion of the work. Document all changes made to the wiring diagrams and return a marked-up set of Record Drawings to the Owner after the work is complete.

15. Demolition of existing electrical equipment including but not limited to motor controllers, motor starters, motors, conduits, and instruments. Remove and demolish equipment and materials in such a sequence that the existing and proposed plant will function properly with no disruption of treatment and as specified under Section 16002.
 16. Modifications to existing motor control centers, panelboards, and motor controllers including installation of circuit breakers or disconnection of circuits as required to provide power supplies to new and existing equipment to maintain the plant in operation and as specified in Section 16002.
- E. Each bidder shall, before preparing their proposal, visit all areas of the existing buildings and structures in which work is to be performed and carefully inspect the present installation. The submission of a proposal by a bidder shall be considered evidence that the bidder has visited the facility, buildings, and structures; noted the locations and conditions under which the work will be performed; and incorporated these locations and conditions into their proposal with respect to the factors governing the work.
- F. Sequencing and Scheduling
1. Coordinate electrical equipment installation with other building components.
 2. Arrange for chases, slots, and openings in the building structures during the progress of construction to allow for the electrical installation.
 3. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
 4. Sequence, coordinate, and integrate the installation of electrical materials and equipment for efficient flow of the work. Coordinate the installation of large equipment requiring positioning prior to closing in the building.
 5. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

1.02 RELATED WORK

- A. All trenching, drilling, backfill, compaction, and surface restoration shall be as indicated on the Drawings and as required under Division 2 of these Specifications.
- B. All concrete and reinforcement shall be as indicated on the Drawings and as required in Division 3 of these Specifications. However, the responsibility of furnishing and installing the underground systems shall be included under this Section.
- C. Instrumentation and Controls are included in Division 13.

1.03 SUBMITTALS

A. General

1. Submit manufacturers' descriptive information and shop drawings for all equipment, material, and devices furnished under Division 16 Sections. Prepare and format submittals in accordance with Section 01300 and as specified herein.
2. Mark submittals to clearly identify proposed equipment including accessories, options, and features and to exclude information, products, options, or parts not applicable to the Project.
3. If the equipment installed during construction does not match the equipment that was approved by the Engineer during submittal review, the Contractor shall resubmit all documentation related to the installed equipment as specified. Should the unapproved equipment be found not to be in conformance with the Contract Documents, it shall be removed and replaced with suitable equipment at the Contractor's expense.
4. Review of submittal information by the Engineer shall not relieve the Contractor from responsibility for deviations from Drawings and Specifications, unless he has in writing at time of submission requested and received written approval from the Owner for specific deviations. Review of submittal information shall not relieve the Contractor from responsibility for errors and omissions in shop drawings or literature.
5. Where submittal documents are submitted in electronic format, the engineer reserves the right to request a hard copy of the package for review of complex drawings or shop drawing information. For large electronic packages over 50 pages in length, provide suitable electronic indexing or book marking to match the table of contents, tabulations, drawings, individual product material catalog cut sheets or other document types provided. Indexing or bookmarking shall be used to facilitate navigation and review of the document. Large electronic packages submitted without such indexing shall be returned to the Contractor unreviewed.
6. The Engineer's review of the submittal information shall only be for general conformance with the design concept and the information given in the Contract Documents. The Engineer's review does not relieve the Contractor from responsibility for errors or omissions in their submittal; Contractor's compliance with the Plans and Specifications, applicable laws, codes and regulations; or the Contractor's responsibility of addressing any deviations from the Contract Documents.
7. Review of a specific item in a submittal shall not constitute review of an assembly of which the item is a component.
8. The Contractor is responsible for: confirming and correlating all quantities, dimensions, details, tolerances, and clearances; for all information that pertains to the fabrication processes or to the means, methods, techniques, sequences, and procedures of construction; coordination of the Work with that of all other trades and for performing the Work in a safe and satisfactory manner. All dimensions shall be field verified at the job site and coordinated with the work of all other trades performing work under this Contract.
9. Material shall not be ordered or shipped until the submittal information or shop drawings have been approved. No material shall be ordered, or shop work started if shop drawings are marked "–MAKE CORRECTIONS NOTED," "AMEND AND RESUBMIT", or "REJECTED AND RESUBMIT."

B. Electrical Analyses Submittal

1. Prior to performing any studies:
 - a. Submit qualifications of firm or individual(s) proposed to perform the analytical studies confirming that the specified qualifications are met including professional engineering registration and experience requirements.
 - b. Submit details of software analytical software proposed for performing the studies including technical details illustrating compliance with referenced standards and protocols.
2. Submit electrical study reports including results for short circuit and coordination, arc flash, and harmonic analyses a minimum of twelve (12) weeks prior to scheduling any field testing.
3. Following submittal and favorable review of the studies, submit electronic copies of final reports and electronic copies of the final analytical databases in native format for the analytical package used for the analyses. Database shall be submitted on CD-ROM, thumb drive or other mass storage device. Final report shall include settings and results used to establish protective device field settings and content of arc flash labels provided for the Project.
4. Incorporate electrical study results as part of the O&M Manuals per Section 01730 and as required per NFPA 70E for Arc Flash Labeling documentation.

C. Operation and Maintenance Data

1. Submit operations and maintenance data for equipment furnished under this Division, in accordance with Section 01730. The manuals shall be prepared specifically for this Project. Include catalog data sheets, layout drawings, control drawings, equipment lists, functional descriptions, and bills of materials or parts lists with replacement part numbers.
2. The manual provided under this Section shall consist of the individual O&M information provided under the other technical sections of Division 16. Coordinate and organize this information into a single, comprehensive, electrical system O&M manual subject to the specified requirements.
3. Manuals shall include the following as a minimum:
 - a. A comprehensive index of the major equipment provided.
 - b. A functional description of the entire system with references to the individual system elements, schematic drawings, and instructions.
 - c. A complete "As-Built" set of approved shop drawings.
 - d. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.
 - e. A table listing sorted by equipment designation of the "as left" settings for all control, timing, and protective relays defining all timing, alarm, and trip setpoints.
 - f. System schematic drawings "As-Built," illustrating all components' electric connections of the systems supplied under this Section.

- g. Detailed service, maintenance and operation instructions for each item supplied.
 - h. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
 - i. Complete parts list with stock numbers, including spare parts.
- 4. Incorporate final versions of electrical analyses reports and studies as specified in this Section.
- 5. Incorporate final versions of electrical test reports as specified under Section 16080.

1.04 STANDARDS, CODES, PERMITS, AND REGULATIONS

- A. Electrical equipment, materials and installation shall comply with NFPA 70®, the National Electrical Code® (NEC®), 2023 edition, and the 2022 California Electrical Code (CEC). All references to the NEC included in the Contract Documents shall be interpreted to be referenced to this edition with the California Amendments as specified.
- B. Perform work; furnish, install, and test materials and equipment in full accordance with applicable rules, regulations, requirements, and specifications of the following. Where reference is made to one of the standards, the revision in effect at the time of bid opening shall apply.
 - 1. Local Laws and Ordinances
 - 2. State and Federal Laws
 - 3. State Building Codes
 - 4. State Fire Marshal
 - 5. Cal/OSHA – the California Division of Occupational Safety and Health (DOSH)
 - 6. Institute of Electrical and Electronics Engineers (IEEE)
 - a. IEEE C2 - National Electrical Safety Code (NESC)
 - b. IEEE 141 – “Recommended Practice for Electrical Power Distribution for Industrial Plants”
 - c. IEEE 242 – “Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems”
 - d. IEEE 399 – “Recommended Practice for Industrial and Commercial Power System Analysis”
 - e. IEEE 1584 – “Guide for Performing Arc-Flash Hazard Calculations”
 - 7. National Electrical Contractors Association (NECA)
 - a. National Electrical Installation Standards (NEIS)
 - 8. National Electrical Manufacturers Association (NEMA)

- a. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- 9. International Electrical Testing Association (NETA)
 - a. NETA ATS – Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
- C. Where conflicts may occur between the above items, the more stringent applicable requirements shall apply. Wherever the requirements of the Specifications or Drawings exceed those of the above items, the requirements of the Specifications or Drawings govern. Code compliance is mandatory. Construe nothing in the Contract Documents as permitting work not in compliance with applicable codes and standards.
- D. Underwriters Laboratories Inc. (UL) listing is required for all equipment and materials where such listing is offered by the Underwriters Laboratories Inc. Safety labeling and listing by other organizations such as Intertek's ETL Listed Mark, FM Approvals certification, or other nationally recognized entity may be substituted for UL labeling and listing if approved by the Engineer. Provide UL service entrance labels for all equipment required by the NEC to have such labels.
- E. Equipment, materials, and installation shall comply with the requirements of the local Authority Having Jurisdiction (AHJ). Obtain all permits and pay all fees required by any governmental agency or utility having jurisdiction over the work. Coordinate and arrange all inspections required by these agencies. On completion of the work, submit satisfactory evidence to the Engineer that the work is acceptable to the regulatory authorities having jurisdiction.

1.05 INTERPRETATION OF CONTRACT DOCUMENTS

- A. The Contract Drawings indicate the extent, general location, and arrangement of equipment. Duct bank and conduit runs are diagrammatic and may not show the exact locations for installation. Verify locations of conduit stub-ups based upon conduit entry space of equipment furnished from the manufacturer's certified shop drawings, by inspection of the actual equipment to be installed, and coordinated with other trades. Stub up conduits as near as possible to equipment terminal enclosures.
- B. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the Engineer. Obtain information relevant to the placing of electrical work including final equipment dimensions and installation criteria. In case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.
- C. Standard details are typical for all locations to which they apply regardless of whether a specific reference callout is shown on the Drawings.
- D. Confirm the incoming phase rotation (e.g., "ABC", "ACB") and adjust the phase sequencing at the main service equipment terminations to the facility to provide ABC rotation for new facilities. For existing facilities, Contractor shall confirm the existing rotation conditions and adjust the terminations of the incoming utility rotation to match. In no case shall the incoming utility rotation be different from the existing rotation conditions at the site.
- E. Schematics and wiring diagrams included in the Drawings are intended to show the functional requirements for equipment operation, interlocks, and alarming within the depicted circuits. The

contractor shall furnish and install all necessary wiring, relays, devices, and timers to provide a fully functional control circuit. At a minimum, circuits shall function as follows:

1. When energized, control circuits shall initialize to a functionally ready-to-operate condition, without requiring any operator intervention to reset or initialize the circuit.
 2. Emergency stop pushbuttons, when engaged, shall disable control circuits and prevent the associated equipment from operating under any modes or conditions.
 3. Safety interlocks and alarms, when active, shall prevent the associated equipment from operating under any modes or conditions, unless a specific override function is specified.
 4. Circuit elements with alarm contacts that are in the alarmed condition in their latent state, such as a low discharge pressure switch, shall include interlocking equipment status contacts and time-delay relays to prevent the alarm circuit from energizing when the equipment is not running.
 5. Reset functions for latched alarm conditions shall only reset the alarm circuit if the alarm condition has cleared.
- F. Unless otherwise approved by the Engineer, conduits shown exposed on the Drawings shall be installed surface mounted or suspended as applicable; conduits shown concealed on the Drawings shall be installed in walls, floor slabs, or ceilings as applicable.
- G. Install each 3-phase circuit in a separate conduit unless otherwise shown on the Drawings.
- H. Conduit routing, layouts, or “home runs” shown on the Drawings are not intended to show the number of fittings or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown.
- I. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.
- J. Number and size of wires which shall be installed in runs of conduit where not shown on the Drawings shall be determined from the single line diagram, schematics, connection, interconnection, and control diagrams of the actual equipment furnished.
- K. Raceways and conductors for lighting, switches, receptacles and other miscellaneous low-voltage power and signal systems specified are not shown on the Drawings. Raceways and conductors shall be provided as required for a complete and operating system.
1. Home runs, as shown on the Drawings, are to assist the Contractor in identifying raceways to be run exposed and raceways to be run concealed.
 2. Raceways installed exposed shall be routed near the ceiling or along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes, hoists, monorails, equipment hatches, doors, windows, and other similar equipment.
- L. Modifications or Substitution of Equipment
1. Where a specific material or equipment is listed in the Specifications or on the Drawings, it is understood and construed as meaning to indicate a standard of quality. Unless specifically

noted otherwise, such listing is not intended in any way to bar the use of any material or equipment that is of equal or better quality.

2. The Electrical Drawings have been prepared based on the equipment first named in the Specifications. The Contractor shall note that the second-named equipment, if given, is considered acceptable and equal equipment, but in some cases additional work or material may be required to accommodate the second-named equipment into the project. The Contractor desiring to use the second-named equipment or any equal equipment, is responsible for all costs including cost of any engineering, material, or installation incurred by using other than the first-named equipment.
3. Likewise, redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement of equipment and/or layout other than that shown on the Contract Documents, shall be performed at the Contractor's expense. The Contractor shall pay for all such changes including protective devices, bus ratings, conduit, wire, building modifications, and other similar items.
4. The Contractor shall be responsible for preparing any required engineering documents specified under Division 16. Where indicated, submit documents stamped and signed by a Professional Electrical Engineer currently registered in the State of California.
5. Changes from the layout shown to facilitate use of alternate equipment shall not be a basis for additional payment; neither shall changes in electrical controls, wiring or piping caused by the use of second-named or equal equipment be a basis for additional payment.

1.06 PROJECT/SITE REQUIREMENTS

- A. Elevation: Equipment shall be designed to operate at a ground elevation of approximately 100 feet above mean sea level.
- B. Temperature:
 1. Equipment located in exterior locations shall be suitable for operation at temperatures from 0° to 40°C ambient.
 2. Equipment located in internal areas shall be suitable for operation:
 - a. In conditioned spaces from 0° to +40°C ambient.
 - b. In unconditioned spaces from -20° to +50°C ambient
- C. Relative Humidity: Equipment located in air-conditioned spaces shall be suitable for 10 to 90 percent relative, non-condensing humidity. All other equipment shall be suitable for 0 to 100 percent relative, condensing humidity.
- D. Provide equipment and devices suitable for continuous operation at the temperatures and elevations at the site and at the facility installation locations shown on the Drawings.
 1. Provide equipment capable of continuous operation at the required rated output shown on the Contract Documents at the specified site conditions.

2. Provide any additional equipment such as passive thermal cooling, insulation, sunshades, heating, cooling equipment, or other means so that the rated performance requirements can be met. Such equipment shall be provided at no additional cost to the Owner.
3. Provide suitability derated equipment if required based on the site conditions. Derated equipment shall be provided with revised manufacturer's nameplates stating the equipment rating for continuous duty and the environmental conditions upon which the continuous rating applies. Deration of equipment shall only be allowed if the derated equipment rating conforms to the required equipment ratings as shown on the Contract Documents.
4. Provide supplementary equipment deration, if required, for both ambient temperature extremes and elevation as required by the manufacturer.

1.07 ENCLOSURE TYPES

- A. Unless otherwise indicated in the Contract Documents, electrical enclosures, conduit systems, and electrical installations shall conform to the following ratings:
 1. NEMA 12: indoor, above grade locations subject to non-corrosive, dry or damp process areas, or dusty conditions including but not limited to:
 - a. Dedicated non-conditioned electrical rooms
 - b. Process mechanical equipment rooms
 - c. Maintenance shops
 2. NEMA 4X: outdoor locations, below grade structures, and indoor locations subject to non-corrosive, wet, or dirty conditions including but not limited to:
 - a. Outdoor facilities
 - b. Hose down areas
 - c. Centrifuge platform area
 - d. Chemical feed or storage areas

1.08 UTILITY SERVICE AND METERING (NOT USED)

1.09 HANDLING AND SIZE OF EQUIPMENT

- A. Investigate each route at the facility through which electrical equipment must pass to reach its final installed location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the facility and within structures.
- B. The equipment shall be kept upright at all times during storage and handling. Should the equipment require tilting for passage through restricted height areas, brace the equipment to ensure that the tilting does not impair the structural or functional integrity of the equipment.

1.10 MAINTENANCE

- A. Spare Parts

1. Spare parts shall be as defined in the related technical specification sections. All spare parts shall be new and unused, provided in original packaging.
2. All spare parts shall be individually packaged and labeled with the part designation and the associated end use equipment tag designation as shown on the Contract Documents.
3. Provide one pint of touch-up paint, in one-quart containers for each type and color used for all cabinets, panels, consoles, and similar equipment, supplied under the related specification sections.
4. The spares listed above shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity, and temperature.

1.11 RECORD DRAWINGS

- A. As the work progresses, clearly and legibly record all field changes on a set of project contract drawings, hereinafter called the "record drawings set". The record drawing set shall conform to the requirements of Section 01720.
- B. The record drawing set shall be kept at the job site and readily available for review by the Owner or the Engineer.
- C. Record drawings shall be updated daily by the Contractor to provide an accurate record of the current condition of the work.
- D. The record drawing set shall accurately show the installed condition of the completed project. The record drawing set shall accurately document the final locations and conditions of the following items:
 1. One-line diagrams.
 2. Raceways and pull boxes.
 3. Conductor sizes and conduit fills.
 4. Lighting and distribution panelboard schedules.
 5. Control wiring diagrams.
 6. Underground electrical system raceway and duct bank routing shown on the plan drawings. Routing shall include final installation depths below finished grade. Final locations of handholes and manholes shall be documented using the project coordinate system.
 7. Plan views of switchboards, distribution transformers, substations, motor control centers and panelboards; include dimensioned outline of final installed location of the equipment.
 8. Grounding system including location of ground rods and routing of grounding electrode conductors and ground grid components.

PART 2 PRODUCTS

2.01 GENERAL

- A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer.
- B. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturers' latest standard design that conforms to these Specifications.

2.02 EQUIPMENT IDENTIFICATION

- A. Identify all equipment, disconnect switches, separately mounted motor starters, control stations, etc. furnished under Division 16 with the name of the equipment it serves unless otherwise noted. Motor control centers, control panels, panelboards, switchboards, switchgear, junction or terminal boxes, transfer switches, etc., shall have nameplate designations as shown on the Drawings.
- B. Nameplates shall be engraved, laminated plastic, not less than 1/16-in thick by 3/4-in by 2-1/2-in with 3/16-in high black letters on a background.
- C. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.

2.03 MARKINGS AND EQUIPMENT WARNING SIGNS

- A. Electrical Safety and Working Clearance Identification
 - 1. Provide a painted outline about electrical equipment to identify areas that are to be kept clear of storage and debris. The painted outline shall consist of a 3 inch wide, neatly painted line, utilizing safety yellow paint appropriate for the surface being painted.
 - 2. The nearest edge of the line shall be 48 inches in front of electrical equipment rated 600V and lower. Line shall extend to the edge of the equipment or 15 inches from the centerline of the equipment, whichever is greater.
- B. Provide arc flash warning labels on electrical power distribution equipment as specified in this Section.
- C. Provide high voltage warning labels and signage on electrical power distribution equipment in conformance with OSHA.
- D. Permanent warning labels shall be mounted at all mechanical equipment which may be started automatically or from remote locations. Labels shall be in accordance with OSHA regulations for personnel safety and shall be suitable for exterior use. The warning labels shall be self-adhesive or fastened with stainless steel screws or bolts as required by the equipment mounting surface. Locate and mount labels as approved by the Engineer. Warning sign shall display the following:

CAUTION
THIS EQUIPMENT STARTS
AUTOMATICALLY
BY REMOTE CONTROL

- E. Permanent warning labels shall be mounted at all electrical equipment enclosures where a voltage sourced from outside the enclosure is present. Labels shall be yellow colored Lamacoid or equal material, engraved with a minimum 1/4" lettering mounted on the front exterior of the panel approximately 5' above finished floor or grade. The warning labels shall be self-adhesive or fastened with stainless steel screws or bolts as required by the equipment mounting surface. Locate and mount labels as approved by the Engineer. Warning sign shall display the following:

CAUTION
FOREIGN VOLTAGES
PRESENT

2.04 FASTENERS

- A. Fasteners and anchors for securing equipment to walls and floors shall be either hot dip galvanized after fabrication or stainless steel unless noted otherwise.

PART 3 EXECUTION

3.01 GENERAL

- A. Install materials and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade and conforming to standards of the industry. Provide work which has a neat and finished appearance. Carry out work in accordance with NECA Standard of Installation unless otherwise shown in the Contract Documents.
- B. Coordinate electrical work with the Engineer and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the plant during construction.
- C. Check the approximate locations of light fixtures, electrical outlets, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify the Engineer in writing. The Engineer's decision shall govern. Make modifications and changes required to correct conflicts.
- D. Follow manufacturers' installation instructions explicitly, unless otherwise indicated on the Contract Documents. Wherever any conflict arises between the manufacturers' instructions, codes and regulations, and these Contract Documents, follow Engineer's direction. Keep copy of manufacturers' installation instructions on the jobsite available for review at all times.

3.02 PROTECTION DURING CONSTRUCTION

- A. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Throughout this Contract, follow manufacturers' recommendations for storage. Protect all equipment from the effects of weather.
- B. Prior to installation, store items in clean, dry, indoor or other locations suitably protected from the elements. Energize all integral equipment space heaters with temporary power as required. Provide temporary heating devices, sufficient to prevent condensation, for all other electrical equipment that does not have space heaters.
- C. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. When equipment intended for indoor installation is installed at

the Contractor's convenience in areas where it is subject to dampness, moisture, dirt, or other adverse atmosphere until completion of construction, ensure that adequate protection from these atmospheres is provided. Such protection methods shall be approved by the Engineer.

- D. Cap all conduit runs during construction with manufactured seals until installation of conductors is required. Keep openings in boxes or equipment closed during construction.

3.03 SERVICE CONTINUITY

- A. Maintain continuity of electric service to all functioning portions of the plant. Make no outages without prior written authorization of the Engineer. Include all costs for temporary wiring and overtime work required in the Contract price as required to meet the Project constraints defined in Section 01014. Remove all temporary wiring at the completion of the work.
- B. Provide temporary electric power used during construction including the use of standby generators for continuous operation as needed as required under Section 01500.

3.04 EQUIPMENT IDENTIFICATION

- A. Provide identification nameplates for all electrical and instrumentation equipment provided under this Contract. Provide nameplate designations as shown on the Drawings and as specified herein.
- B. Nameplates shall be screw mounted to NEMA 1 enclosures.
- C. Nameplates for all other enclosures shall be bonded to all the enclosure using an epoxy or similar permanent waterproof adhesive. Two-sided foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate the nameplate shall be fastened to the equipment using stainless steel wire or jack chain or permanently fastened to an adjacent mounting surface as directed by the Engineer.

3.05 EQUIPMENT SUPPORTS

- A. Provide equipment supports for all equipment in accordance with the mounting and anchorage requirements per manufactures requirements.
- B. Free standing panels and enclosures shall be mounted on concrete pads having plan dimensions shown on the Drawings or larger if required by the manufacturer's requirements.

3.06 SLEEVES AND FORMS FOR OPENINGS

- A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all slots for electrical work and form before concrete is poured.
- B. Identify precise locations for stubbing-up and terminating concealed conduit prior to commencing conduit layout work. Obtain shop drawings and templates from equipment vendors or other subcontractors and properly locate the concealed conduit before the floor slab is poured.
- C. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the Engineer may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.
- D. Seal all openings, sleeves, penetration and slots as specified in Section 16130.

3.07 CUTTING AND PATCHING

- A. Lay out work carefully in advance. Do not cut, drill, or notch any structural member or building surface without specific approval of Engineer. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment.
- B. Following cutting and patching work, restore surfaces to original finished condition. Include all patching and painting of the surfaces to match original. Use skilled craftsmen of the trades involved.

3.08 SHORT CIRCUIT AND PROTECTIVE DEVICES COORDINATION STUDY

- A. Provide a complete short circuit study and protective device coordination study for the power distribution system. The study shall include the following major components modified under this Contract including feeder and “upstream” devices that form part of the distribution serving the modified facilities as shown on the Drawings. The studies shall incorporate the following elements at a minimum:
 - 1. Utility protective device.
 - 2. 480V switchboards and motor control centers either serving the modified equipment or the equipment modified or altered under this Contract.
 - 3. Other equipment as necessary to comply with the coordination and arc flash requirements as specified herein.
- B. Analytical Tools
 - 1. All analyses in the study shall be performed using software specifically designed for electrical system analysis following . Software shall be SKM, ETAP, EasyPower or equal. The final approved study database shall be provided to the Agency in the native format of the software used for the analysis.
 - 2. The database for the study to be performed under this Contract shall match nomenclature and identification approaches used on the Drawings.
- C. The study shall be in full compliance with applicable ANSI and IEEE Standards and Recommended Practices including but not limited to IEEE 141, 242, 399, and 1584. Standards and Recommended shall be the current in effect at time of bid opening.
- D. The electrical analytical studies shall be performed by a registered professional electrical engineer in the state of California with a minimum of five years’ experience in the performance of such studies. Engineer shall have attended standard training sessions on the analytical package specified for use on this Project.
- E. The firm performing the study shall be responsible for obtaining any and all data required to complete the study and determine recommended settings. Data field work shall be performed and coordinated with the District to acquire all necessary equipment data. Data to be obtained shall include at a minimum:
 - 1. Available utility short circuit duty; utility protective device make, model, and settings
 - 2. All new and existing equipment characteristics and ratings; feeder sizes and lengths

3. All new and existing loads and motor characteristics
 4. All other input data necessary to complete the study per the requirements of this Section.
- F. The study shall include but shall not be limited to:
1. Electrical distribution single line diagram including utility, generators, transformers, cables, motor control centers, VFDs, or other source and end use equipment. The diagram shall identify each bus, transformer, reactor, and similar power distribution equipment by name and corresponding node number using the approved bus tagging scheme. The available fault currents, Thevenin impedance and X/R ratio for each node shall be indicated on the diagram. The single line diagram shall include cable sizes, lengths, transformer voltage, and transformer kVA.
 2. Available three phase and ground fault asymmetrical and symmetrical fault currents at each piece of electrical equipment, bus, transformer, and similar equipment.
 3. Overall system impedance diagram. The diagram shall include the power company's impedance and X/R ratio, circuit element impedances (e.g., transformers, generators, motors, VFDs, feeders, distribution buses).
 4. The available fault current at each bus within the limits of the study shall be identified and listed.
 5. The momentary and interrupting rating of all elements of the distribution system shall be listed. The maximum available fault current available at each element shall be calculated.
 6. Determine the adequacy of the electrical protective devices to withstand the maximum available fault at the terminals of the equipment. Provide an equipment list, the equipment rating (both momentary and withstand), the maximum available fault rating and the adequacy of the equipment to withstand the fault. Equipment that does not have adequate ratings shall be identified immediately and brought to the attention of the Engineer.
 7. Provide a complete set of time-current coordination curves on log paper. Limit the number of protective devices shown on any drawing to a maximum of four. A single line diagram depicting the portion of the distribution system under study shall appear with the curve. The minimum size log paper to be submitted shall be 11.5 x 18 inches.
 8. The time current plots shall include transformer ANSI damage and inrush points, cable damage curves, motor damage curves, capacitor damage curves, generator damage curves, circuit breaker and fuse ratings and settings, and any other information required by ANSI and good design practices. At a minimum provide curves for:
 - a. Utility protective device to service entrance main circuit breaker.
 - b. Each low voltage feeder down to 480 Volt main switchboard, motor control center, and variable frequency drives.
 - c. Each main and feeder circuit breakers located in the 480 Volt main switchboard and motor control center.
 - d. Each ground fault protective device provided for 480 Volt distribution systems and motor control center.

- e. Motor starting profile for the largest motor connected to the main distribution point.
 - f. A tabulation of all the settings for every overcurrent protective device, timer, power system relays (e.g., ANSI 25, 27, 32, and similar devices), circuit breaker, recommended fuse, and current transformer ratings, and similar devices.
 - g. Motor, generator, and cable damage curves in accordance with the manufacturer's recommendations.
 - h. A complete set of coordination curves for every circuit breaker, fuse, and relay serving or located in the electrical equipment furnished for the project including the utility protective devices.
9. Provide recommended settings for all protective devices.
10. Executive summary describing the distribution system, the procedures used to develop the study, utility related information furnished by the utility company including the name and telephone number of the individual supplying the information, identify all assumptions made in the preparation of the study, identified any problem areas and provide a definitive statement concerning the adequacy of the distribution system to interrupt and withstand the maximum possible fault current.
11. Computer printout of the input data.
12. Computer printouts for the three phase, single phase, and ground fault studies. Printouts shall indicate the fault current available at each major equipment, distribution bus within the low voltage (480 Volt) distribution systems.
13. Table listing all the electrical distribution and utilization equipment, the equipment interrupting and withstand ratings, the available fault current at the terminals of the equipment and the ability of the equipment to interrupt and/or withstand the fault.
- G. Provide a short circuit and system coordination report with the approved submitted equipment shop drawings. The report shall confirm equipment is being applied within design ratings and electrical protective devices will coordinate.
- H. The coordination study shall be submitted in PDF format or hardcopy bound in a standard 8-1/2 x 11-inch format, 3-hole punch binder. The selection of all protective relay types, current transformers, fuse types, and ratings shall be the responsibility of the equipment manufacturer or system integrator and shall be based on the preliminary draft of the coordination study.
- I. The coordination study shall be stamped and signed by a Professional Electrical Engineer currently registered in California. The complete study shall be favorably reviewed by the Engineer before any equipment is energized.

3.09 ARC FLASH HAZARD STUDY

- A. Perform an arc flash hazard study after the short circuit and protective device coordination study has been completed. The arc flash hazard study shall include operation during normal conditions alternate operations, emergency power conditions, and any other operations, which could result in maximum arc flash hazard.


- B. Perform the arc flash hazard analysis for all equipment (including 120V control panels) provided or modified under this Contract having a nominal operating voltage greater than 50 Volts AC to ground as required per NFPA 70E.
- C. The study shall be calculated by means of the same electrical system modeling tool used for the other system analyses specified herein. Pertinent data, rationale employed, and assumptions in developing the calculations shall be incorporated in the introductory remarks of the study.
- D. The study shall be in accordance with applicable NFPA 70E, OSHA 29-CFR, Part 1910 Sub part S and IEEE 1584 Standards.
- E. The study shall perform as a minimum but not limited to the following:
 - 1. Flash Hazard Protection Boundary
 - 2. Limited Approach Boundary
 - 3. Restricted Boundary
 - 4. Prohibited Boundary
 - 5. Incident Energy Level or Required Personal Protective Equipment Class/energy rating
- F. Submit Arc Flash Warning labels listing items above for all equipment analyzed in the study. Labels shall include the bus name and voltage. Provide permanent thermal transfer type, factory manufactured labels in conformance with NFPA 70E and ANSI Z535. Labels shall be made of high adhesion polyester and have electronic generated characters with no field markings. Labels shall be printed in color.
- G. Produce individual Bus Detail sheets for each location where an Arc Flash Warning label is provided. The sheets shall list the items identified above with the following additional items:
 - 1. Bus Name
 - 2. Upstream Protective Device Name, Type, and Settings
 - 3. Bus Line to Line Voltage
- H. Produce Arc Flash Evaluation Summary Sheet listing the following additional items:
 - 1. Bus Name
 - 2. Upstream Protective Device Name, Type, and Settings
 - 3. Bus Line to Line Voltage
 - 4. Bus Bolted Fault
 - 5. Protective Device Bolted Fault Current
 - 6. Arcing Fault Current
 - 7. Protective Device Trip / Delay Time

8. Breaker Opening Time
 9. Solidly Grounded Column
 10. Equipment Type
 11. Gap
 12. Arc Flash Boundary
 13. Working Distance
 14. Incident Energy
 15. Required Protective Fire Rated Clothing Type and Class
- I. The complete study and arc flash warning label design shall be submitted and approved by the Engineer at least 30 Days prior to energizing the electrical equipment.

3.10 ARC FLASH HAZARD LABELS

- A. Produce Arc Flash Warning labels for all equipment operating at voltage levels above 50V to ground as recommended by the manufacturer of the equipment provided under Division 16. Provide permanent thermal transfer type, factory manufactured labels in conformance with NFPA 70E and ANSI Z535. Labels shall be made of high adhesion polyester and have electronic generated characters with no field markings. Labels shall be printed in color and indicate at a minimum, in addition to any other labeling requirements of NFPA 70E, the following:
 1. Nominal system voltage
 2. Arc flash boundary
 3. At least one of the following:
 - a. Available incident energy and the corresponding working distance, or the arc flash PPE category per NFPA 70E Tables 130.7(C)(15)(a) or Tables 130.7(C)(15)(b) for the equipment, but not both.
 - b. Minimum arc rating of clothing.

- B. Submit the arc flash label design for approval. At a minimum, label shall contain details as shown in the Sample Arc flash label below or as submitted and favorably reviewed by the Engineer.

 WARNING			
Arc Flash and Shock Risks! Appropriate PPE Required. Failure to comply can result in Death or Injury!			
Arc Flash Boundary	Shock Risk	Arc Flash Incident Energy at 18 inches	39 inches 480 VAC 4.20 cal/cm^2
<small>Changes in Equipment Settings, System Configuration, or Utility Service may invalidate the calculated values and PPE Requirements.</small>			
<small>Note 1: Hazard levels are valid for Normal/Utility Operation only; Contact agency' safety officer prior to performing any energized work while under Generator Operation.</small>			
<small>Note 2: Follow agency' standard LOTO Operation procedures prior to performing any Work.</small>			
Location: DP-1 Prot. Device: BKR-DP-1			
Company Logo	Company Name:	Company Address:	Phone:
Job # 000001 -	Job Details	Label prepared By: _____	Date: Sep 25, 2018

3.11 TESTS

- A. Perform testing as specified in Section 16080.

3.12 CLEANUP AND PAINTING

- A. The Contractor shall be responsible for the removal and legal disposal of all debris and unused equipment which he introduces to the project site during the execution of the Contract.
- B. Painting shall be in accordance with Section 09900. Unpainted boxes, cabinets, and raceways mounted on walls that are painted or to be painted shall be painted the same color as the walls.
- C. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove all materials, scraps, and debris from premises and from interior and exterior of all devices and equipment.
- D. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. If extensive damage is done to equipment paint surfaces, refinish the entire equipment in a manner that provides a finish equal to or better than the factory finish, that meets the requirements of the Specifications, and that is acceptable to the Engineer.
- E. The interior of all electrical equipment, including windings of dry type transformers, shall be vacuumed and wiped free of dust, metal filings, and other debris. Cleaning shall be done prior to energization and again immediately before final inspection. De-energization of any equipment that is required to allow panel cleaning shall be approved in writing by the Engineer.
- F. Refer to Section 01710 and the individual equipment technical specifications of Division 16 for additional requirements.

3.13 MANUFACTURER'S SERVICE AND TRAINING

- A. Provide manufacturer's services for equipment installation, startup, and testing. Provide training of plant personnel in operation and maintenance of the equipment furnished under other Sections of Division 16 and as specified in Section 01715.

3.14 INSPECTION

- A. Allow materials, equipment, and workmanship to be inspected at any time by the Engineer and District or their representatives. Correct work, materials, or equipment not in accordance with these Contract Documents or found to be deficient or defective in a manner satisfactory to the Engineer.
- B. Before request for final inspection is made, the Contractor shall submit to the Construction Manager, in writing, a certificate stating that the Contractor has made his own thorough inspection of the entire project and that the installation is completed and in conformance with the applicable codes, and the contract plans and specifications.

END OF SECTION

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SECTION 16002

ELECTRICAL AND INSTRUMENTATION DEMOLITION AND MODIFICATIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Section Includes: All labor, materials, and incidentals required to demolish, modify and/or remove the electrical and instrumentation systems and equipment as shown on the Drawings and/or specified herein. Unless specifically noted as being reused, all conduit, wire, boxes, etc. detailed on the Drawings shall be new equipment installed under this Work.
- B. The electrical modifications and removals work shall generally consist of the following:
 - 1. Demolish the following electrical support structure, equipment, and instruments where shown on the Drawings:
 - a. Any electrically powered or controlled equipment indicated as being removed in this Contract and associated electrical appurtenances.
 - b. Existing electrical equipment or electrical equipment associated with mechanical or process equipment which must be removed or relocated due to conflicts with new construction.
 - c. Electrical control devices, starters, wiring, and other miscellaneous devices associated with equipment that will be modified or reused under this Contract.
 - d. Instrumentation and control equipment and related conduit and wire associated with equipment being modified or removed under this Contract.

1.02 RELATED WORK

- A. Section 02050 – Demolition and Renovation
- B. Section 16000 – Common Work Results for Electrical

1.03 SUBMITTALS

- A. Submit in accordance with Sections 01300 and 16000.
- B. Submit detailed time schedule for equipment which will be either modified or removed under this Work. Include details of work to be done, anticipated duration of the work, impact of the work on plant operations, and coordination with other trades, per the requirements of the overall project schedule per Section 01311.
- C. All modifications made to existing MCCs, and other panels shall be fully described in shop drawing submittals. The submittals shall include the following as a minimum:
 - 1. Panel elevation drawings clearly and unambiguously identifying the specific equipment that will be removed.

2. Revised panel wiring diagrams clearly and unambiguously indicating the specific modifications to the equipment internal and external circuiting of the new or modified devices.
3. Technical details and catalog cut sheets for the new equipment including electrical characteristics, physical sizing, and installation requirements.
4. Revised enclosure or housing dimensioned plan and elevation drawings clearly and unambiguously indicating the required alterations to the enclosure physical dimensions and characteristics.
5. Engraving schedule and details for all new nameplates, escutcheon plates, and equipment tagging.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MODIFICATIONS

- A. All MCCs, switchboards, and other panels requiring modification under this Work shall comply with the following general requirements:
 1. Equipment removed from service shall have suitable metallic covers placed over any unused exterior panel holes. Covers shall be painted to match the existing panel and shall be securely retained on the panel with stainless steel machine screws, nuts, and other hardware.
 2. Newly installed equipment shall be mounted, connected, and identified consistent with the other equipment in or on the panel. Nameplates shall also be provided for all new equipment mounted on the exterior of existing panels. At motor control centers, provide nameplates matching existing including nameplates for "SPARE" devices created by work under this Contract. Conform to the nameplate requirements of Section 16000.
 3. In lighting and distribution panels, the circuit card or listing shall be replaced with a newly typed, comprehensive circuit card showing the as-left condition (i.e. both changed and unchanged circuits) of the panel.
 4. All modifications made to panels shall be retrofit with components furnished by the original panel manufacturer to maintain all original UL and NEMA labeling and certifications. Devices installed in compartmentalized panels shall be provided with new doors and interior mounting pans as required to match the existing panel construction style and enclosure environmental ratings.
 5. Mounting holes required for new equipment shall be neatly cut and deburred. Take care to remove deposits of metal cuttings deposited inside of the modified panel.
 6. Interior panel wiring for newly added devices shall match the existing panel wiring type, mounting, and identification scheme.

3.02 EQUIPMENT TO BE REMOVED

- A. Only the major electrical and instrumentation equipment to be removed are shown or noted on the Drawings and failure to detail all equipment removal requirements exactly shall not relieve the

Contractor from the responsibility for its removal as directed by the Engineer. Removal items such as individual wire, conduit, junction boxes, etc. are in general not detailed on the Drawings.

- B. Where removal of electrical, instrumentation, or any other equipment with wired connections is called for, include the removal of the associated electrical hardware as specified herein unless noted otherwise.
- C. In general, all conductors shall be removed from the conduits; boxes and fittings and all exposed conduits shall be removed to the point of termination. Concealed conduits shall be cut flush with the floor, wall, or ceiling and plugged with non-shrink grout or other permanent material and as detailed on the Drawings.
- D. Electrical power, control, or instrumentation equipment, exposed conduit, wiring, etc. rendered inoperative by modifications to existing equipment under these Contract Documents shall be removed unless specifically noted that it is to be abandoned in place.
- E. Not all existing conduits are shown on the Drawings. In general, existing conduits are shown only where they may be reused; or where they potentially affect or may be affected by new work under this Contract; or for providing useful background information to the Contractor regarding the existing electrical installation.
- F. Where existing conduit or wire associated with removed equipment is to be reused, it will be specifically noted on the Drawings. Where portions of an existing conduit route to be reused (including buried or embedded portions) is clearly required to be removed or relocated due to new construction, it shall be included in work under this Contract even if not specifically detailed or noted as such on the Drawings.
- G. No existing conduits, wiring, or electrical appurtenances shall be removed, modified, or in any way damaged unless allowed by the provisions of this Section. Any existing conduits, conductors, or other electrical appurtenances that are encountered as an obstruction to new construction which are not covered by the provisions of the Contract Documents shall be brought to the attention of the Engineer.
- H. Where functions of existing cables and/or conduits are replaced by new cable and/or conduits because of additions of new panels, instruments, revision to control strategy, etc., the existing cables and exposed conduits shall be removed unless noted otherwise. Concealed conduits shall be retained and marked as spares unless noted otherwise.
- I. Equipment removed shall not be reused under this Contract unless specifically noted on the Drawings or Specifications.
- J. To minimize disruptions to the existing plant operations, the schedule for modifications and removal of existing equipment shall be submitted to, coordinated with, and approved by the Engineer.
- K. Where any existing circuits are disconnected due to abandonment or removal of existing equipment, the remaining motor starters or circuit breakers for these circuits shall be retagged as spares.

3.03 CIRCUIT RELOCATION

- A. Prior to relocation of circuits as required the Contractor shall trace all wires from the source to the destination. The wires shall be tagged to include an identification number to match existing. The

Contractor shall provide all testing equipment and hardware necessary to gain access and locate circuits to determine their source and origin. The conduit schedules provided in the Contract Documents were developed based on available as built documents and site investigations during design, however, the Contractor shall provide field verification of the conduits including their circuits prior to relocation.

- B. Excess slack conductor length shall be maintained where required to reuse the existing conductor for termination at a Terminal Junction Box where shown on the Drawings. Provide a minimum of 10-foot slack conductor length unless noted otherwise.

3.04 DEMOLITION

- A. The Contractor shall survey the existing electrical systems and equipment identified for removal with representatives from the other trades and the Engineer prior to performing any demolition work. Prior to removal, identify all conduit and equipment to be removed with tags or paint. Equipment to be removed shall be identified a minimum of three (3) weeks before demolition is scheduled to allow sufficient review time by the Engineer for possible salvage.
- B. Remove all electrical work associated with equipment scheduled for demolition except those portions indicated to remain or be reused. Where a piece of equipment is to be removed, all associated ancillary components (e.g. seal water solenoid valves, pressure switches, etc) and associated wiring and conduit shall also be removed.
- C. Remove exposed conduit and conductors to be demolished back to the point of concealment including abandoned conduit above accessible ceiling finishes. Completely remove demolished conductors in concealed conduits back to the source or nearest point of maintained usage.
- D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank covers per Section 16000 for abandoned outlet boxes which are not removed.
- E. Disconnect and remove abandoned panelboards, disconnect switches, control stations, distribution equipment, etc.
- F. Where electrical systems pass through the demolition areas to serve other portions of the premises, they shall remain or be suitably relocated and the system restored to normal operation.
- G. Coordinate outages in systems with the Engineer in accordance with Section 01014. Where duration of proposed outages cannot be allowed by the requirements of the Contract Documents provide temporary connections or power sources as required to maintain service.
- H. Trace out existing wiring that is to be relocated or removed and perform the relocation or removal work as required for a complete operating and safe system.
- I. Continuous service is required on all circuits and outlets affected by these changes, except where the Engineer will permit an outage for a specific time as defined in the Contract Documents. Obtain the approval of the Engineer before removing any circuit from continuous service.
- J. Patch surfaces and repaint to match existing as specified under Division 9.
- K. All equipment, materials, controls, motor starters, branch and feeder breakers, panelboards, transformers, wiring, raceways, etc, furnished and installed to temporarily keep circuits energized shall be removed when the permanent installation is fully operational. Any surfaces or finishes

damaged by the temporary installations shall be returned to its condition prior to the acceptance of the work.

3.05 DISPOSITION OF REMOVED MATERIALS AND EQUIPMENT

- A. The following removed items shall be retained by the District.
 - 1. Existing starters, motor circuit protectors, circuit breakers and other components removed or replaced in the existing MCC-5 as shown on the Drawings.
- B. In general, all the material and equipment indicated to be removed and disposed of by the Contractor shall, upon removal, become the Contractor's property and shall be properly disposed of off the site by the Contractor, unless otherwise directed by the Engineer. A receipt showing acceptable disposal of any legally regulated materials or equipment shall be submitted to the Engineer.

END OF SECTION

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SECTION 16060

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included:

1. Furnish all labor, materials, equipment, and incidentals required and install a complete grounding system in strict accordance with Article 250 of the NEC, as shown on the Drawings and as specified herein.
2. All raceways, conduits and ducts shall contain equipment grounding conductors sized in accordance with the NEC. Minimum sizes shall be No. 12 AWG.
3. Provide grounding bus bars where shown on the Drawings.

1.02 RELATED SECTIONS

- A. Section 16000 – Common Work Results for Electrical.
- B. Section 16080 – Commissioning of Electrical Systems.
- C. Section 16130 – Raceways and Boxes for Electrical Systems.

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01300 and Section 16000.
- B. Submit product data for the following:
 1. Mechanical and compression type grounding clamps including installation requirements and materials.
 2. Grounding hubs and fittings.
 3. Grounding bars
- C. Submit results of grounding and bonding resistance testing as specified herein

1.04 REFERENCES

- A. American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
 1. IEEE Std 142 – IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- B. American Society for Testing and Materials (ASTM).
 1. ASTM B 3 – Standard Specification for Soft or Annealed Copper Wire.

2. ASTM B 187 – Standard Specification for Copper Bar, Bus Bar, Rod, and Shapes.
 3. ASTM B 8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- C. California Code of Regulations.
1. Title 24, Part 3 – California Electrical Code (NEC), Article 250 (Grounding).
- D. Underwriters Laboratories (UL).
1. UL 467 – UL Standard for Grounding and Bonding Equipment.
 2. UL 224 – UL Standard for Extruded Insulating Tubing.
- E. InterNational Electrical Testing Association (NETA).
1. ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. All grounding and bonding products shall be UL listed.
- B. All exothermically welded or compression-type terminal lugs for buried or embedded connections shall use materials qualified in accordance with IEEE 837.

PART 2 PRODUCTS

2.01 GENERAL

- A. Direct-buried, concrete encased, and exposed grounding conductors.
 1. Bare concentric stranded copper conductors conforming to ASTM B-8 with Class B stranding, size as indicated on the Drawings.
 2. Acceptable manufactures:
 - a. Southwire
 - b. General Cable
 - c. Approved equal
- B. VFD-Driven motor ground straps
 1. Provide high frequency ground straps for all inverter driven motors provided under this Contract.

2. Provide flat-braided tinned-copper strap, with circular hole on one end sized as required for the motor frame foot mounting screw, and ring terminal on the other end. Length shall be as required based on the installation details.
3. Provide straps as recommended by the manufacturer for the driven motor frames provided under Section 16220.
4. Acceptable manufacturers:
 - a. AEGIS
 - b. Panduit
 - c. Approved equal

C. Grounding system connections

1. Accessible connections to equipment, connections to exposed structural steel (e.g. steel columns), connections to reinforcing steel, connections made to ground rods located in ground rod boxes, and all other locations where the connections are readily accessible to maintenance personnel after completion of construction.
 - a. Mechanical connections to ground rods, equipment, structural steel, and other accessible connections shall be made using heavy duty, U-Bolt or two hole bolted copper or bronze clamps as required for the cable size used. U-Bolt and cap screws shall be stainless steel.
 - b. Specific type of connectors shall be selected to match the specific connections to be made (water pipes, building steel, etc.).
 - c. Acceptable manufacturers:
 - 1) Harger
 - 2) Blackburn (Thomas & Betts)
 - 3) Burndy
 - 4) Approved equal

D. Electrical joint inhibitor compound

1. Use at all bolted grounding connections as a moisture and oxidizing seal.
2. Acceptable manufacturers:
 - a. Sanchem Inc., NO-OX-ID (A-Special Electrical Grade)
 - b. Approved equal

PART 3 EXECUTION

3.01 PREPARATION

- A. Do not allow water pipe connections to be painted. If the connections are painted, disassemble them and remake them with new fittings.

3.02 INSTALLATION

A. General

1. Grounding of the pipe systems shall be provided per the requirements of NEC and as shown on the Drawings.
2. Metal conduits stubbed into power distribution equipment, control panels, or other enclosure shall be terminated with insulated grounding bushings and mechanically bonded to the enclosure's ground bus. Size the bonding wire in accordance with the NEC, except that a minimum No. 12 AWG shall be used.
3. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and all other equipment and materials required by the NEC to be grounded, shall be grounded and mechanically bonded in accordance with the NEC.
4. Care shall be taken to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.
5. Liquid tight flexible metal conduit shall have bonding jumpers. Bonding jumpers shall be external, run parallel (not spiraled) and fastened with plastic tie wraps.
6. Install equipment grounding conductors with all feeders and branch circuits. Each circuit shall have a dedicated equipment grounding conductor from source to load without splicing or "tee tapping" (e.g., three different receptacle circuits in a common home-run conduit back to a lighting panelboard shall have three separate equipment grounding conductors back to the lighting panelboard).
7. Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with ground clamp connectors.

B. Ground connections

1. Electric Motors and Electrical Equipment
 - a. Grounding conductors for motors and electrical equipment shall be connected by a solderless terminal and a 5/16-inch, minimum, bolt tapped to the motor frame or equipment housing.
 - b. Paint, dirt, or other surface coverings shall be completely removed at the connection points of grounding conductors so that good metal-to-metal contact is made.
 - c. After grounding connections are made, areas around the connection point shall be prepared and the coating system repaired in accordance with Section 09900. Surfaces shall be restored to their original condition before the grounding connections are made.

- d. Ground connections to smaller motors or equipment may be made by fastening the terminal to a connection box.
 - e. Junction boxes shall be connected to the equipment grounding system with 0.375-inch silicon-bronze machine screws.
 2. VFD-driven motors
 - a. Install high frequency grounding straps for all inverter driven motors. Install high frequency grounding straps per manufacturer's instructions.
 - b. Grounding straps for motors shall be connected by a circular punched hole on one end for installation around foot mounting screw of NEMA- or IEC-frame motor, and by a ring terminal on the other end bolted to the nearby ground grid. Provide strap length as required based on the installation conditions.
 - c. Ensure metal-to-metal contact at both terminations by removing paint or corrosion at the motor foot and ground location.
 3. Ground instrumentation cable shields at a single point inside of the control panel at the signal grounding bus bar, unless grounding at the device is specifically required by the instrument manufacturer. Grounding of instrumentation shields shall conform to the requirements of Section 13300.
 4. Ground data highway and network cables as required by the manufacturer of the communication equipment and per the requirements of Section 13300.
 5. Seal exposed connections between different metals with electrical joint inhibitor compound. All buried connections shall be cleaned and coated with electrical joint inhibitor compound before backfilling.
 6. Bolted connections shall not be buried or embedded. For compression-type connectors, the tool for crimping shall emboss the die index number into the connector as the crimp is completed. Each compression-type connector shall have an inspection port for use in checking proper conductor insertion. Compression connections shall be installed in strict accordance with manufacturer's printed recommendations using tools and dies of the proper size and type for the conductors, lug, and grounding electrode.
 7. Where pipe flange or piping is grounded by means of a clamp or lug, the pipeline coating shall be repaired, except the grounding connection area, as shown on the project Drawings or as specified under Section 09900.
 8. Intersections: Intersections of grounding cables shall be bonded together.
- C. Grounding Conductors
 1. Unless otherwise specified, provide continuous, unspliced equipment grounding conductors.
 2. Lay all underground grounding conductors slack within 10 feet from the footing and, where exposed to mechanical injury, protect by PVC schedule 40 conduit or other approved physical protection. If guards are steel pipe, or other magnetic material, electrically connect conductors to both ends of the guard. Make connections as specified in this Section.

3. Conductors to equipment enclosures/tanks shall be neatly run along the face of concrete footings or structural steel, following surfaces closely to the point of connection. Conductors shall be supported and secured with cable fasteners at intervals no greater than 5 feet.
4. Conductors shall be mechanically bonded to metallic enclosures at each end and to intermediate metallic enclosures such as pullboxes.
5. Grounding conductors shall be connected to grounding bushings on raceways.
6. Where equipment contains a ground bus, grounding conductors shall be extended and connected to that bus. The enclosure of the equipment containing the bus shall also be connected to the bus.

D. Fasteners

1. Clean the connector and conductor surfaces with a wire brush or emery cloth to a shiny, bright surface. For plated surfaces, compatible solvent cleaning shall be used in order not to remove any portion of the plating.
2. Immediately after cleaning, apply an oxide-inhibiting compound with suspended copper particles on the threads of the connectors, ground plate, bolts, and other hardware used for making mechanical grounded connections.
3. All fasteners shall engage a minimum of four full threads for electrical connections and equipment mounting.
4. All bolts shall be coated with electrical joint inhibitor compound.
5. Torque fasteners to manufacturer's requirements and NETA specifications.

E. In addition to those items specified to be grounded above, the following metallic items shall also be grounded using a minimum of No. 2 AWG wire:

1. Hatch frames.
2. Stairs and ladders.
3. Door frames for person access doors and rollup doors.
4. Building sheathing and exposed vertical structural elements.
5. Fences enclosing electrical equipment.
6. Non-electrical metallic items in close proximity to exposed electrical equipment.
7. Equipment platforms that support electrical equipment. The support shall be bonded to the electrical equipment and the ground grid.
8. Frames and railings supporting push-button stations, receptacles, instrument cabinets, and raceways carrying circuits to these devices.
9. Handrails and guardrails: Handrails and guardrails shall be made electrically continuous with bond jumpers or welds at slip joints, as necessary.

3.03 INSPECTION AND TESTING

- A. Inspect the grounding and bonding system conductors and connections for tightness, proper installation, and proper application of electrical joint inhibitor compound.
- B. Testing shall be performed before energizing the distribution system. Refer to Section 16080.
- C. Notify the Engineer immediately if the resistance to ground for any building or system is greater than five ohms.

END OF SECTION

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SECTION 16080

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Test systems and equipment furnished under Division 16 and repair or replace all defective work and equipment. All new, modified, and existing protective devices shall be tested and adjusted per the requirements of this Contract Documents.
- B. The electrical subcontractor shall perform the tests specified in this Section.
- C. Field testing and commissioning shall be performed in accordance with the latest revisions of the following NETA Standards unless otherwise modified by this Section:
 - 1. ATS "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems"
- D. Submit field test reports for each component tested for the project record files. Test report forms shall be in compliance with NETA standards.
- E. It is the intent of the specified tests to assure that all electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications. Tests shall help determine suitability for energization.
- F. Provide all material, equipment, labor, and technical supervision to perform electrical acceptance testing.
- G. Adjust all protective devices to the settings recommended in the short circuit coordination study, arc flash study, and other analyses per Section 16000.
- H. The term "major electrical equipment" when used in this Section shall include all equipment operating above 480V and other equipment specified in this Section, including but not limited to:
 - 1. Existing and modified 480V MCC-5
 - 2. New and existing motors and drives.
 - 3. Other equipment as necessary to comply with the coordination and arc flash requirements as specified in these Specifications and as per applicable standards and industry recommended practices.
- I. Additional electrical distribution equipment testing is specified under the technical equipment specification Sections of Division 16.

1.02 RELATED SECTIONS

- A. Section 16000 – Common Work Results for Electrical
- B. Additional electrical distribution equipment testing is specified under the technical equipment specification sections of Division 16.

1.03 SUBMITTALS

- A. All submittals shall be in accordance with Sections 01300 and 16000.
- B. Submit proposed testing forms and signoff sheets to be used for all electrical equipment where testing is required.
- C. Submit commission and field test reports for each testing cycle containing each component tested. Reports shall include:
 - 1. Cover sheet with technician names performing the tests. Dates of the testing shall be included.
 - 2. Table of Contents organized by equipment type and tag name.
 - 3. Summary page explaining the purpose of the test, description of equipment, equipment identification tag matching the convention shown on the Drawings, technical specification reference of the equipment, and the specific testing requirement met by the test report. Individual equipment cross reference describing the equipment, location of the component and a report page sheet number on which the technical information is presented.
 - 4. Test data sheets with each piece of equipment or component on a dedicated, unique sheet; page number; the name of the component under test, the major piece of equipment in which the component is located.
 - 5. Opinion on whether the equipment being tested complies with the specification. Any discrepancies shall be noted in the concluding summary of the report. Test report forms shall be in compliance with NETA standards.
- D. Incorporate testing results as part of the O&M Manuals per Section 01730 and as required per NFPA 70E for Arc Flash Labeling documentation.

1.04 REFERENCE STANDARDS

- A. Testing required under this Section shall be per the guidelines specified in the NETA publication "Acceptance Testing Specification for Electric Power Distribution Equipment and Systems." Testing requirements in this Section are specifically referenced to the edition of this publication issued at time of bid opening.
- B. All inspections and tests shall be in accordance with the following codes and standards except as provided otherwise Specifications. Where reference is made to one of the standards, the revision in effect at the time of bid opening shall apply.
 - 1. InterNational Electrical Testing Association
 - a. NETA ATS – Acceptance Testing Specifications (latest edition)
 - 2. American National Standards Institute
 - a. ANSI C2 – National Electrical Safety Code
 - 3. National Fire Protection Association - NFPA
 - a. ANSI/NFPA 70: National Electrical Code

- b. ANSI/NFPA 70B: Electrical Equipment Maintenance
- c. NFPA 70E: Standard for Electrical Safety in the Workplace
- d. ANSI/NFPA 101: Life Safety Code
- 4. Occupational Safety and Health Administration - OSHA
 - a. OSHA 29-CFR, Part 1910 Subpart S - Electrical
- 5. Other applicable State and local codes and ordinances

1.05 FINAL SYSTEM DOCUMENTATION

- A. Incorporate final versions of electrical test reports into the project operations and maintenance manuals as specified under Section 16000.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL TESTING PROCEDURES

- A. The testing instruments shall be maintained in calibration per the requirements of NETA.
- B. The test reports shall be in accordance with NETA except that reports shall be completed no later than 30 days after completion of testing on each piece of equipment.
- C. Safety procedures as documented in CAL OSHA, NETA, and other applicable industry safety standards shall be adhered to.

3.02 FIELD TEST EQUIPMENT

- A. All test equipment shall be in good mechanical and electrical condition.
- B. Selection of metering equipment should be based on the waveform of the variable being measured. Digital multimeters shall be RMS sensing type unless another type is required to accurately measure the variable under test.
- C. Field test metering used to check power system meter calibration must have accuracy higher than that of the instrument being checked.
- D. Accuracy of metering in test equipment shall be appropriate for the test being performed.
- E. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.
- F. Test Instrument Standards
 - 1. All equipment used for testing and calibration procedures shall exhibit the following characteristics:
 - a. Maintained in good visual and mechanical condition.

- b. Maintained in safe operating condition.
- c. Portable multimeters shall be true RMS measuring.
- d. Test equipment should have operating accuracy equal to, or better than, the accuracy as recommended by NETA standards.

G. Test Instrument Calibration

- 1. The Contractor shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
- 2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.
- 3. Instruments shall be calibrated in accordance with the following frequency schedule:
 - a. Field instruments: 12 months maximum.
 - b. Leased specialty equipment: 12 months.
 - c. Dated calibration labels shall be visible on all test equipment.
 - d. Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.
 - e. Up-to-date instrument calibration instructions and procedures shall be maintained for each test instrument.
 - f. Calibrating standard shall be of higher accuracy than that of the instrument tested.

3.03 COMMISSION AND FIELD-TESTING APPROACH AND DOCUMENTATION

A. General Requirements

- 1. Testing and commissioning shall be performed in accordance with the latest revision of NETA Standard ATS "Acceptance Testing Specifications" for Electrical Power Distribution Equipment and Systems.
- 2. Testing shall be performed in two separate and totally independent steps.
- 3. Test reports:
 - a. A typed report shall be submitted after each testing step is completed. The report shall be submitted to the Engineer for review, comment and record purposes.
 - b. The report shall include a separate data sheet for each component (i.e. cable, circuit breaker, transformer, relay, etc.) tested. Each data sheet shall include the weather conditions at the time of the test (i.e. temperature, humidity, sunny, rain, etc), the tester's observation and findings, discrepancies, any remedial work performed or act to resolve problems, technical parameters obtained during the tests, as left settings of all devices, and a statement indicating the equipment is ready to be energized.

- c. The report shall be organized in a three-ring binder and provided with a table of contents and index.
 - d. The report shall contain a statement indicating the equipment was tested in accordance with the procedures outlined in the latest edition of The International Testing Association Acceptance Testing Specifications.
- B. Test sequence summary: The following describes the testing steps to be performed. The Engineer shall be notified in writing immediately of any and all components that have unsatisfactory test results. The notification shall be accompanied with a proposed remedy, remedy schedule, and impact to the project schedule.
- C. Step No. 1 – Preliminary Tests: Testing requirements to be performed by the Contractor before the equipment is energized:
 - 1. Inspect and mechanically operate all air interrupter switches, circuit breakers, power disconnect switches, switches supplied on transformers, and circuit breakers/disconnect switches installed within equipment furnished under other divisions of these specifications.
 - 2. Set, calibrate and test all protective devices including but not limited to, circuit breakers, protective relays, timing devices, motor overload, electrical protective devices located with equipment furnished under other Sections of these specifications.
 - 3. Verify that protective relay, current transformers, ground sensing devices, transformer grounding resistors, fuses, interrupter switches, transfer switches, transformers and motor starters furnished are in accordance with the approved shop drawings and the Short Circuit and Coordination Study and Arc Flash Hazard Study.
 - 4. Megger test all low voltage power system cables.
 - 5. Test transformer insulating oil, check connections and proper torque and tightness of cables and bushings and perform high potential testing.
 - 6. Verify that all power and control power fuses installed are in accordance with the manufacturer's approved shop drawings, the Short Circuit and Coordination Study and the NEC. Replace fuses found to be of the incorrect rating.
 - 7. Verify control circuits and functionality of the controls for all motors, automatic transfer systems, remote protective device (i.e. wiring for differential protection relays, alarm systems, safety interlocks, emergency stop controls, and motor, transformer and generator protective devices). The functionality shall be in accordance with the approved control schematics, wiring diagrams or functional descriptions.
 - 8. Check motor nameplates for correct phase and voltage; verify motor phase rotation.
 - 9. Verify the resistance to ground of all power distribution equipment is 5 ohms or less.
 - 10. Verify all terminations at the main switchboard, motors, and VFDs, are correctly made and properly torqued.
 - 11. Refer to the individual equipment and material specification sections for additional testing requirements.

12. Verify all circuit breaker ratings and settings are as required by the Contract Documents or as amended during shop drawing review. Advise the Engineer of discrepancies and make changes as directed by the Construction Manager.
13. Verify proper operation of accessories, devices and motor interlocks.
14. Submit comprehensive test report.

D. Step No. 2 – Commission Testing

1. Review test reports for preliminary testing along with the approved/corrected Short Circuit and Coordination Study and Arc Flash Hazard Study per Section 16051 and become familiar with the approach, conclusions, and recommendations. All potential discrepancies in the analytical studies shall be addressed before the testing begins.
2. Test all new and modified equipment, components, controls, systems, and hardware provided under this Contract.
3. Testing shall follow the specific NETA ATS procedures, including “optional” items, for the equipment being tested.
 - a. Testing shall follow all NETA procedures for the particular equipment or systems being tested.
 - b. Standard NETA test forms or equivalent shall be utilized in conformance with the favorably reviewed test plan.
 - c. All visual and mechanical inspections and electrical tests shall be performed in accordance with the latest edition of the NETA requirements.
 - d. Perform inspections and testing for all the equipment in conformance with NETA guidelines including all inspections and testing requirements listed as “optional”.
 - e. The NETA requirements for visual and mechanical inspections of equipment are considered the Contractor's responsibility under this Work. At the Contractor's discretion, however, the work may be included under this Section.

END OF SECTION

SECTION 16120

LOW VOLTAGE CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 DESCRIPTION

- A. Work Included: This section covers furnishing and installing low voltage cable systems as specified herein, complete, and in operating condition.
- B. Conduit Schedules indicating conductor number and minimum required conductor sizes are shown on the Drawings. The Schedules are prepared as a guide to the Contractor and additional circuits from home runs, specialty manufactured cables, and supplier specific wiring may require additional conductors not specifically included in the schedule. Such omissions in the Schedules shall not relieve the Contractor of the responsibility of furnishing and installing the necessary cables and raceways as required by the remainder of the Contract Documents for a fully functioning and operational system.

1.02 RELATED SECTIONS:

- A. Section 16000 – Common Work Results for Electrical.

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01300 and Section 16000.
- B. Submit catalog data indicating manufacturer, insulation designation, and ratings in sufficient detail to determine conformance with these specifications:
 - 1. Power, control, and instrumentation wire.
 - 2. Termination and splicing materials.
 - 3. Pulling lubrication compound.
 - 4. Circuit identification system.
- C. Submit catalog data and characteristics of fiber optic system as specified including fiber, connectors, patch panels, converters, and other equipment.
 - 1. Submit Fiber optic cable descriptive product information and specifications including transmission parameters, jacket properties, and physical attributes (maximum short term and long term tensile loads).
 - 2. Submit the fiber optic cable identification approach and scheme. The cable identification shall match the Owner's existing identification scheme and shall be per EIA/TIA 606.
- D. Submit results of field testing for new conductors provided under this Contract and for existing conductors tested under this Contract as noted on the Drawings and as specified in Section 16080.
- E. Submit completed fiber field testing forms and other results of field acceptance tests and installation tests. Submit separate fiber installation tests and final acceptance tests as specified.

1.04 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. B-3 - Standard Specification for Soft or Annealed Copper Wire.
 - 2. B-8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - 3. B-33 – Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
- B. Electronics Industry Association/Telecommunications Industry Association (EIA/TIA):
 - 1. EIA/TIA 568B - Commercial Building Telecommunications Cabling Standard.
 - 2. EIA/TIA 569A - Commercial Building Standard for Telecommunications Pathways and Spaces
 - 3. EIA/TIA 598A - Optical Fiber Color Coding.
 - 4. EIA/TIA TSB-72 - Centralized Optical Fiber Cabling Guidelines.
 - 5. EIA/TIA 455 – Fiber Optic Test Procedures (FOTPs)
- C. International Cable Engineers Association (ICEA).
 - 1. S-95-658 – Non-Shielded Power Cable Rated 2000V or less
- D. National Electrical Contractors Association (NECA)
 - 1. NECA 301 – Standard for Installing and Testing Fiber Optic Cables
- E. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA WC 7, Cross-Linked- Thermosetting- Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
- F. National Fire Protection Association (NFPA):
 - 1. NFPA 70 – National Electrical Code (NEC).
- G. Telecommunications Industry Association (TIA)
 - 1. EIA-568-B.2-1 – Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components
- H. Underwriters Laboratory (UL):
 - 1. Standard 444 – Communications Cables
 - 2. Standard 510 – Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.

3. Standard 1277 – Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
4. Standard 1581 – Reference Standard for Electrical Wires, Cables and Flexible Cords.
5. Standard 1666 – Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
6. Standard 1685 – Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

1.05 CONDUCTOR COLOR CODING

- A. Color coding of multiconductor control and instrumentation cable is specified in the individual cable type specification.
- B. For power conductors, provide all single conductors and individual conductors of multiconductor power cables with integral insulation pigmentation of the designated colors, except conductors larger than No. 6 AWG may be provided with color coding by wrapping the conductor at each end and at all accessible locations with vinyl tape. Where this method of color coding is used, wrap at least six full overlapping turns of tape around the conductor covering an area 1 1/2 to 2 inches wide at a visible location at all conductor termination and pulling points.
- C. Phase A, B, C implies the direction of positive phase rotation.
- D. Mark conductors using the following colors for power conductors.

System	Conductor	Color
All Systems	Equipment Grounding	Green
208Y/120 Volts, 3-Phase, 4-Wire	Phase A Phase B Phase C Grounded Neutral	Black Red Blue White
480Y/277 Volts, 3-Phase, 4-Wire	Phase A Phase B Phase C	Brown Orange Yellow

- E. All conductors carrying AC foreign voltage over 100 Vac into control panels, switchboards, and other enclosures shall be yellow. Multi-conductor cables carrying such foreign voltage shall be marked with yellow tape at each termination point.

1.06 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall inspect the reels as they are unloaded from the delivery truck, any visible damage shall be reported by the Contractor and the reel returned to the factory.
- B. The Contractor shall provide a crane, special lift truck or forklift suitably rated to unload the cable reels.

- C. Cables shall be packaged on spools or reels. Each package shall contain only one continuous length of cable. The packaging shall be constructed so as to prevent damage to the cable during shipping and handling.

1.07 QUALITY ASSURANCE AND QUALITY CONTROL

- A. Fiber optic products shall be manufactured by firms regularly engaged in manufacturing products described in this Section.
- B. Fiber optic cable splicing and terminating shall be performed by qualified electricians or technicians having at least 40 hours of formal training and a minimum of five years field experience in this type of work. Qualifications shall be submitted to the Engineer upon request.
- C. Fiber optic cable field acceptance and installation tests shall be performed by qualified persons having at least 40 hours of formal cable testing training and a minimum of five years of relevant fiber optic testing experience. Qualifications shall be submitted to the Engineer upon request.

PART 2 PRODUCTS

2.01 CONDUCTORS

A. General

1. All wire and cable conductors shall be annealed soft drawn copper with 98% conductivity. Aluminum conductors are not acceptable and shall not be used.
2. Provide Class B stranded conductors in all cases except that wiring for lighting and receptacle circuits may be solid.
3. Conductors shall be in accordance with applicable NEMA standard WC 70. All conductors shall be UL Listed.
4. All conductors installed in tray shall be tray rated (Type TC) and run without splices in and out of the cable trays.
5. All conductors shall have ampacity ratings at 90° C in dry locations and 75° C in wet location minimum in accordance with the NEC unless noted otherwise.
6. Conductor sizes shown on the Drawings or schedules shall be the minimum size provided regardless of the type of conductor used.
7. Wire smaller than No. 12 AWG shall not be used for power feeders. Wire smaller than No. 12 AWG shall only be used for control, signal and instrumentation circuits,

B. 600 Volt Single Conductor Power and Building Wire

1. Provide type XHHW/XHHW-2 insulation for power conductors No.12 and larger
2. Wire for lighting and receptacles not exceeding 150 Volts to ground shall be NEC type XHHN/XHHW-2.

3. Acceptable Manufactures:
 - a. Okonite, X-Olene
 - b. Southwire
 - c. General Cable
 - d. Approved equal
- C. Single Conductor Control, Status, and Alarm Wire
 1. Single conductor wiring shall be 600V, No.14 AWG NEC type XHHW/XHHW-2 and type MTW inside control panels as manufactured by the Okonite Co.; Carol Cable Co. Inc; Pirelli Cable Corp. or equal.
- D. 600 Volt, Twisted, Shielded Pair Instrumentation Cable:
 1. General: Type TC, single pair instrumentation cable designed for noise rejection for process control, computer, or data log applications. Suitable for installation in conduit, wireway, or other approved raceways. Minimum cable temperature rating shall be 90°C dry locations, 75°C wet locations.
 2. Individual Conductors: No. 16 AWG stranded bare annealed copper, Class B, 7 strand concentric per ASTM B-8, size as indicated on the drawings; 7 strand tinned copper drain wire.
 3. Insulation and Jacket: Each conductor 15 mil nominal PVC and 4 mil nylon insulation. Pair conductors pigmented black and red. Jacket flame retardant and sunlight and oil resistant PVC with 45 mil nominal thickness. Aluminum/polyester shield overlapped to provide 100 percent coverage.
 4. Acceptable Manufacturers:
 - a. Belden No. 9342
 - b. Alpha Wire Company
 - c. Okonite
 - d. Approved equal
- E. Category 6 Unshielded Twisted Pairs:
 1. General: industrial grade Category 6 Unshielded Twisted Pairs (UTP) suitable for use in harsh environments as industrial Ethernet cable, 600 MHz Enhanced Category 6, Gigabit Ethernet, 100BaseTX, NTSC/PAL Component or Composite Video, RS-422, RJ-45 compatible, suitable for outdoor use and installation in conduit and other approved raceways.
 2. Conductors: 4 pairs of conductors, 8 conductors total, 23 AWG solid bare copper conductors.
 3. Insulation and Jacket: polyolefin insulation, individual conductors colored white/green and green, white/orange and orange, white/blue and blue, and white/brown and brown, center

strength member, unshielded, industrial grade sunlight and oil resistant PVC jacket, outer jacket ripcord, 0.251 x 0.339 inch overall nominal diameter, 300 volts, -40 degrees C to +75 degrees C operating temperature.

4. Applicable Standards: NEC/UL CMR, UL Style 444, ANSI/TIA/EIA-568-B.2-1 CAT 6, UL Verified to Category 6, UL 1666 Riser Flame Test.
5. Acceptable Manufacturers:
 - a. Belden 7927A
 - b. Approved equal

2.02 FIBER OPTIC CABLE

A. General

1. The cable shall be loose tube design. The loose buffer tube shall be a water-blocking material. The water blocking material shall be non-nutritive to fungus, electrically non-conductive and homogenous. Cable shall also be free from dirt and foreign matter and shall be readily removable with conventional nontoxic solvents.
2. The cable shall be non-armored and stranded. The fibers shall not adhere to the inside of the buffer tube. The cable shall be gel-free design using water-swallowable yarns and tapes for easier cable termination and splicing. Each fiber shall be distinguishable by means of color coding according per TIA/EIA-598-A. Cable jackets shall be marked with manufacturers' name, sequential meter or foot markings, the year of manufacture, and a telecommunication handset symbol, as required by the National Electrical Safety Code (NESC). The actual length of the cable shall be within $\pm 1\%$ of the length markings.
3. Buffer tubes shall be kink resistant within the specified minimum bend radius. The central anti-buckling member shall consist of a dielectric, glass reinforced plastic rod central member, constructed with a protective coating surrounding the glass fiber.
4. Fiber optic cable installed indoors shall be UL listed and plenum rated for flame resistance. The cable shall contain only glass fiber with no metal element as listed per NEC Article 770 as type OFNP (nonconductive fiber plenum cable). The fiber optic cables shall be factory tested in accordance with the procedures per EIA-445 Fiber Optic Test Procedures (FOTP).
5. The cable shall contain at least one ripcord under the sheath for easy sheath removal.
6. The cable shall have an overall aramid yarn strength member added to the buffered fibers to provide mechanical protection.

B. Fiber Characteristics - Multi-mode: Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be matched clad design and include a dielectric central member. The cable shall include the following specifications:

1. Fiber Category: OM3, connector housing shall match fiber category.
2. Core diameter: $50.0 \pm 3.0 \mu\text{m}$.
3. Cladding diameter: $125.0 \pm 2.0 \mu\text{m}$.

4. Core to Cladding Concentricity: $\leq 1.5 \mu\text{m}$
5. Wavelength: suitable for operation at 850 or 1300nm.
6. Minimum Number of Tube Positions: 2
7. Fibers/Tube: Provide six fibers minimum for each fiber run as shown on the Drawings:
 - a. Two fibers for communication link for Centrifuge 1 to plant SCADA.
 - b. Two fibers for communication link for Centrifuge 2 to plant SCADA.
 - c. Two fibers minimum as spare
8. Operating Temperature: -40 to 70 degrees C
9. Maximum Attenuation: 2.3 dB/km for 850nm; 0.6 dB/km for 1300 nm
10. Minimum OFL Bandwidth:
 - a. OM3: 1500 MHz-km at 850nm and 500 MHz-km at 1310nm
11. Distance Capacity per IEEE 802.3:
 - a. 1 Gbit/sec Ethernet: 800m at 850nm and 550m at 1310nm
 - b. 10 Gbit/sec Ethernet: 300m at 850nm
12. Type 50/250 OM3 Underground Conduit and Building Riser Installation:
 - a. Individual Fibers: 50/125/250 microns.
 - b. Nonmetallic, gel-free, dry water blocked, loose-tube fiber core with dielectric strength member enclosed by nonmetallic cross-ply sheath; requires buffer tubing.
 - c. Cable: Comply with ICEA S 104 696.
 - d. NEC/UL Listing: OFNR
 - e. Protective Covering: Black, Flame and UV-resistant, thermoplastic jacket with rip-cord.
 - f. Minimum Short Term Pull Strength: 600 lbf.
13. Acceptable Manufactures:
 - a. Corning
 - b. Belden Cable
 - c. Equal

C. Fiber Optic Connectors

1. The fiber optic communications system shall utilize ST type connectors for fiber optic connections. The connectors shall be designed for use with single-mode cables as specified in these Specifications.
2. Single-mode connectors shall have an insertion loss of 0.35dB with ceramic ferrule and composite housing. Acceptable manufactures shall be Corning, General Cable, Belden, or Equal.

D. Industrial Ethernet Passive Components:

1. Provide connectors, sockets, and couplings suitable for use in industrial Ethernet applications for 10 Gigabit Ethernet data transmission.
2. Components shall be rated for IP20 and IP67 class of protection in accordance with IEC 529.
3. Equipment shall be designed to withstand harsh industrial environments including high temperatures and damp locations. Housings shall be resistant to dirt and liquids.
4. Applicable Standards: NEC/UL CMR, TIA 568-C.2, ISO/IEC 11801 Class EA, UL 1666 Vertical Riser Flame Test.
5. Acceptable Manufacturers:
 - a. Phoenix Contact PLUSCON data
 - b. Weidmuller Steady Tec
 - c. Approved equal

E. Flexible Cords, Cables, and Fittings:

1. Where flexible cords and cables are required, provide Type SO, 600-volt, having the number and size of copper conductors shown on the Drawings.
2. Provide liquid-tight strain relief fittings for exposed flexible cord and power cable where cables enter electrical panels and enclosures. Provide strain relief as manufactured by Hubbell (Kellums), OZ Gedney, or approved equal

F. Electrical Tape for Color Coding:

1. Electrical tape shall be premium grade, not less than 7 mils thick, rated for 90 degree C minimum, flame-retardant, weather resistant, and available in suitable colors for color coding. The tape shall be resistant to abrasion, ultraviolet rays, moisture, alkalis, solvents, acids, and suitable for indoor and weather-protected outdoor use. The tape shall be suitable for use with PVC and polyethylene jacketed cables, and meet or exceed the requirements of UL 510.
2. Acceptable Manufactures:
 - a. 3M 35 Scotch Vinyl Electrical Tape for Color Coding
 - b. Plymouth Rubber Company Premium 37 Color Coding Tape
 - c. Approved equal

G. Low Voltage Splices, 600 volts and below:

1. Power Conductors

- a. General: Provide low voltage splices consisting of 600 volt compression type connectors and connector insulators, suitable for indoor and outdoor field installations.
- b. Provide two way, uninsulated, compression connectors, long barrel type, suitable for use with stranded copper conductors. Provide UL listed connectors rated 600 volts minimum. Acceptable manufacturers: Burndy, Thomas and Betts, Panduit, or approved equal.
- c. Connector insulators shall be cold shrink type factory expanded and assembled tubular EPDM rubber sleeves, suitable for field installation. Insulators shall shrink over in line connections, forming a water proof seal. Provide insulators rated for 1000 volts, minimum.
- d. Acceptable manufacturers:
 - 1) 3M
 - 2) Approved equal

2. Control Conductors

- a. Insulated compression type connectors shall be of the expanded vinyl insulated parallel or pigtail type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or approved equal.
- b. Solderless pressure connectors shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air. Connectors shall be sized according to manufacturer's recommendations. The connectors shall be UL listed and CSA approved, as manufactured by King Technology, St Louis, MO; Ideal Industries, Inc., Sycamore, IL or approved equal.

H. Low Voltage Terminations, 600 volts and below:

1. Power Conductors

- a. Provide solderless, die type or set screw compression type lugs and connectors. Provide plated copper alloy terminations as manufactured by Thomas and Betts; Burndy; or approved equal. Provide lugs and connectors recommended by the manufacturer for the cable type used.
- b. Motor connections shall be screw type insulated pressure connections terminations installed on the branch circuit wires and the motor leads and secured with bolt, nut and springwasher. Provide insulation by heat shrink boot especially made for motor termination use. Wire nuts, split bolts, etc., are not acceptable. Connections shall be insulated with a Raychem Type MCK, roll-on stub insulator or approved equal and shall be as recommended by the manufacturer for the cable type used.

2. Control, Status, and Alarm Conductors

- a. Termination connectors shall be of the locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or approved equal.

3. Instrumentation Cables

- a. Termination connectors shall be of the locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or approved equal.

I. Wire and Cable Markers

1. Wire and cable markers shall be pre-printed, clip sleeve type as manufactured by the W.H. Brady Co.; Thomas & Betts Co.; 3M Co. or approved equal.
2. Wire and cables with diameters exceeding the capacity of the clip sleeve type shall be marked with pre-printed, self-adhesive vinyl tapes as manufactured by the W.H. Brady Co.; Panduit Corp. or approved equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Use lubrications to facilitate wire pulling. Lubricants shall be UL approved for use with the insulation specified.
- B. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii. Pulling of cable shall be performed in such a manner that the cable outer jacket does not scrape against the edge of the conduit, at both the inlet and outlet ends of the conduit. Cable shall be free of sandy or gritty material during pulling. If cable is laid on ground during pulling, cable shall be wiped free of sandy or gritty material prior to entry of cable into conduit and prior to application of any pulling compound.
- C. Tighten all screws and terminal bolts using torque type wrenches and/or drivers to tighten to the inch pound requirements of the NEC and UL.
- D. Where single conductors and cables enter manholes, handholes, vaults, and other indicated locations bundle the conductors from each conduit throughout their exposed length with nylon, self locking, releasable, cable ties placed at intervals not exceeding 18 inches on centers.
- E. Wrap exposed lengths of 480V feeders in manholes or handholes, #4/0 and higher, with fire resistant tape.
- F. Terminate no more than two control conductors per terminal point. Terminate all spare conductors on terminal blocks.
- G. When pulling low voltage power and control conductors in the same conduit, only combine conductors with no more than two wire sizes difference to prevent possible installation damage to the smaller conductors; otherwise use separate conduits.
- H. Uniquely identify all wires, cables and each conductor of multi-conductor cables (except lighting and receptacle wiring) at each end with approved wire and cable marker systems as specified herein.

3.02 CONDUCTOR 600 VOLTS AND BELOW

- A. Provide conductor sizes indicated on drawings with no splices except as approved in writing by the Engineer.
- B. Wire nuts may be used only on 120 volt lighting and 120 volt receptacle circuits. Place no more than one conductor in any single-barrel pressure connection. Use crimp connectors with tools by same manufacturer and/or UL listed for connectors of all stranded conductors. Soldered mechanical joints insulated with tape will not be acceptable.
- C. Color coding on wire sizes larger than No. 6 AWG shall be by taping the individual conductors with the appropriate colored self adhesive vinyl electrical tape.
- D. Provide terminals and connectors recommended by the manufacturer for the type of material used.
- E. Arrange wiring inside control panels, motor starters, switchgear. etc., neatly cut to proper length, remove surplus wire, and bridle and secure in an acceptable manner. Identify all circuits entering switchgear, motor starters, control panels, etc., in accordance with the cable schedules on the drawings. Terminate cable conductors on the same side of the terminal blocks as shown on the drawings.
- F. Terminations for power conductors shall be die type or set screw type pressure connectors as specified. Splices for power conductors if specifically requested by the Contractor and approved in writing by the Engineer, shall be die type compression connector and waterproof with shrink fit rubber boot (as specified) or epoxy filling for copper conductors # 4 AWG and larger. Splices shall be solderless pressure connectors with insulating covers for copper conductors # 6 AWG and smaller. Approved splicing shall be performed only in enclosures approved for splicing in the NEC.
- G. Terminate control and instrumentation wiring with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions. Where terminals provided will accept such lugs, terminate all control and instrumentation wiring (except solid thermocouple leads) with insulated, locking fork compression lugs. Control panel incoming field wireway sizes indicated on the Drawings are considered minimum. Contractor shall adjust wireway sizes to meet NEC percentage fill requirements.
- H. For terminals designed to accept only bare wire compression terminations use only stranded wire and terminate only one wire per terminal. Tighten all terminal screws with torque screwdriver to recommended torque values.
- I. For control and instrumentation cables use ferrule on ends of wire. For cables terminating on terminal blocks, also use ferrule type.
- J. Attach compression lugs with a tool specifically designed for that purpose which provides a complete, controlled crimp where the tool will not release until the crimp is complete. Use of plier type crimpers is not acceptable.
- K. Where conductors pass through holes or over edges in sheet metal, remove all burrs, chamfer all edges, and install bushings and protective strips of insulating material to protect the conductors.
- L. For conductors that will have final terminations by Others, provide at least six feet spare conductor in freestanding panels and at least two feet spare in other assemblies. Provide sufficient spare conductor length in any particular assembly as required to reach the termination point plus an additional two feet of slack conductor.

- M. Cables passing through manholes and handholes shall be trained along the walls on cable racks. Allow two feet of slack in each run in a "drip loop" at least once along a wall. Loops and cables shall be organized, trained, bundled, and neatly installed.
- N. Do not strip cables more than eight inches from the nearest termination point of that cable.
- O. Cap spare conductors and conductors not terminated with UL listed end caps.
- P. All spare pairs shall be bundled and labeled with the cable designation. All individual pairs shall be tagged to enable identification of spare pairs when making future terminations.
- Q. Splices will not be permitted except as accepted in writing by the Engineer.
- R. Ends of cable shall not be exposed to the ambient environment more than 24 hours after pulling or splicing. After 24 hours the cable shall be purged with nitrogen or sealed with tape.

3.03 INSTRUMENTATION CABLES 600 VOLTS AND LESS

- A. All circuits shall be installed as twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required.
- B. Terminal blocks shall be provided at all instrument cable junction and all circuits shall be identified at such junctions. Direct splicing of signal and instrumentation circuits is not acceptable. Shielded instrumentation wire, coaxial, data highway, I/O and fiber optic cables shall be run without splices between instruments, terminal boxes, or panels.
- C. Shields shall be grounded as recommended by the instrument manufacturer and isolated at all other locations. Terminal blocks shall be provided for inter-connecting shield drain wires at all junction boxes. Where individual circuit shielding is required, each shield circuit shall be provided with its own block.

3.04 FIBER OPTIC CABLE INSTALLATION

- A. General
 - 1. Install and terminate cables as indicated on the Fiber Allocation Table.
 - 2. Install in conformance with NECA 301 – Standard for Installing and Testing Fiber Optic Cables.
 - 3. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii. Where pulling compound is used, use only UL listed compound compatible with the cable outer jacket, voltage rating, and with the raceway involved.
- B. Installation
 - 1. Swab out conduits prior to installing new cables. Inspect raceways and boxes for allowable bending radius prior to installing cable and notify the Engineer of any condition which would prevent the proper installation of the cable.
 - 2. Lubricate cables with lubricants specially formulated for fiber cabling jackets during installation.

3. Pulleys used to install fiber optic cable must be sized according to the cable's published minimum bending radius.
4. Terminate all cabling per the cable and termination device manufacturer's instructions.
5. Provide Kellems or similar crimp-on grips for pulling the fiber optic cable. Use correct sized grip for the cable being pulled.
6. When laying loops of fiber on a surface during a pull, use "figure-8" loops to prevent twisting of cable.
7. Install all fibers on this Project without splicing. Should specific installation requirements dictate a potential splice condition, immediately notify the Engineer regarding the specific requirements and need for a splice. Splicing shall not be allowed unless specifically approved by the Engineer.

3.05 LACING OF WIRES AND CABLES

- A. All wires and cables shall be laced in pull or junction boxes, manholes, handholes, wireways, and at each termination. Wires and cables shall be laced so that the wires of the individual circuits are laced together by circuit and the laced together circuit or cable shall be tagged with the cable number. All wiring entering and exiting the control panels or pull structure shall be bundled into groups. Power, lighting, control, alarm, and instrumentation wiring shall be bundled and laced as specified herein.

3.06 FIELD QUALITY CONTROL

- A. Provide acceptance testing of all of the low voltage cables per Section 16080.
- B. Coordinate system loop checking including point to point cable continuity checking and verification in conformance with the requirements of Section 13300.
- C. All data highway and special systems cabling shall be tested as required by the system manufacturer requirements. Testing shall be performed as specified in the individual Division 13 or Division 16 sections to verify satisfactory signal transmission and reception in conformance with manufacturer's published requirements.

1.2 FIBER OPTIC CABLE SYSTEM FIELD TESTS

A. General

1. Field tests will be performed on each fiber. All fibers will be tested for breaks, abnormalities, and overall attenuation characteristics to ensure that the dB loss at each splice point and test location is in conformance with the requirements specified in these Specifications. Cables shall be tested per Standard NECA 301 where applicable and per the requirements of this Section.
2. Test jumpers (end-to-end attenuation) or test fiber box (OTDR) are of the same fiber core size and connector type as the cable system.
3. For multi-mode, optical sources shall be stabilized and have center wavelengths within $\pm 20\text{nm}$ of the 1300nm multimode nominal wavelengths. In accordance with TIA/EIA-526-14-

A, multimode LED sources shall have spectral widths from 30-60nm at 850nm and 100-140nm at 1300nm.

4. All system connectors, jumpers, and adapters used during the test procedures shall be properly cleaned prior to and during test measurements.
5. Test technicians shall use the same brand and model of test equipment using the same testing profile. Use of different test equipment and profiles may result in test reports being rejected by the Engineer.
6. Test multi-mode fiber at 850nm and 1300nm wavelengths using LED light sources.
7. Submit each set of test results for review. Each set of test results shall be submitted and favorably reviewed prior to proceeding on to the next test in the sequence.

B. Installation Test

1. Perform installation test after cable has been installed and prior to the final acceptance test.
2. Cable shall be tested after the cable is pulled through conduits prior to splicing to verify that there has been no damage to cable after installation. The cable shall be tested with an OTDR and signature traces documented indicating the cable type, length and cable number per the Fiber Allocation Table included under Appendix 16122-A, as shown on the Drawings, or as directed by the Engineer.
3. An OTDR measurement shall be completed on each splice (if approved by the Engineer) and field installed connector. The measurement test shall be done after each splice and field connection to ensure that a clean, low-loss connection was made. Measurement shall be done in both directions.
4. Acceptable losses are as follows:
 - a. Splices: Not applicable
 - b. Field installed connectors: $\leq .75$ dB.
5. If the measured loss does not meet the specified levels, the components shall be replaced and retested until the measured loss values are below the acceptable limits as specified.

C. Final Acceptance Test

1. Perform final acceptance test after satisfactory results on the installation test.
2. After installation of fiber cables are complete, perform an end-to-end attenuation test from both directions for each fiber cable link or from patch panel to patch panel as shown on the Drawings. Test using the wavelengths as specified in these Specifications.
3. Use an OLTS power meter and source to test for attenuation losses.
4. Measured attenuation losses (dB) shall be documented for each fiber cable.
5. If measured attenuation losses are greater than the manufacturer's maximum link-loss value, troubleshoot the fiber cable links using an OTDR. The OTDR shall be utilized to locate fault

points in the cable system. Once the fault points are located and repaired the link shall be tested again with an OLTS to verify attenuation losses. This process will be repeated until the attenuation losses are below the maximum link-loss budget for that particular fiber link.

6. Once the dual end-to-end attenuation test is completed the results shall be submitted in a test report for review and approval by the Engineer.
 - a. Provide a brief explanation at the beginning of the report describing testing methods used.
 - b. In the report include the budget link-loss for each link and indicate criteria used for dB loss values. Label each link using the conduit number as provided in the Conduit Schedules as shown on the Drawings.
 - c. Measured test values shall be provided in one section with the budgeted link-loss values.

3.07 SPARES

- A. Identify spare conductors with source location and other identifiers as shown on the Drawings. Provide a minimum of 5-feet of extra conductors for each spare circuit. Wrap excess conductor lengths, provide with plastic tie-wrap, and coil up in last pullbox location of the run.

END OF SECTION

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SECTION 16130

RACEWAY AND BOXES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included:

1. This section covers the work necessary to furnish and install, complete raceways and boxes for electrical systems.
2. Raceway Schedules indicating conductor number and minimum required conductor sizes are included on the Drawings. The Schedules are prepared as a guide to the Contractor and additional circuits from home runs, specialty manufacturers cables, and supplier specific wiring may require additional conductors not specifically included in the schedule. Such items not included in the Schedules shall not relieve the Contractor of the responsibility of furnishing and installing the necessary cables and raceways as required by the remainder of the Contract Documents for a fully functioning and operational system.
3. Home runs indicated are to assist the Contractor in identifying raceways to be installed concealed or exposed. Raceways identified to be installed exposed on the Drawings shall be run near the ceilings or along the walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes and hoists, lighting fixtures, doors and hatches. Raceways indicated to be run concealed shall be run in the center of concrete floor slabs, in partitions, or above hung ceilings, as required.
4. Raceway supports and restraints indicated on the Drawings are shown only to convey the general intent of the design and not intended to represent a complete system for all locations. The absence of location and specific details of the supports, additional restraints, and other mounting details on the Drawings shall not relieve the Contractor of the responsibility for providing them as specified.

1.02 RELATED SECTIONS:

- A. Conduit Schedules are shown on the Drawings
- B. Section 16000 – Common Work results For Electrical

1.03 SUBMITTALS

- A. Submit data in accordance with Section 01300 and Section 16000.
- B. Submit manufacturers' names, product designation, and catalog numbers with marked cut sheets clearly and uniquely identifying all materials to be provided under this Section.
- C. Submit data for conduits, raceways, fittings, boxes, hardware, identification systems, and other materials specified in this Section.

1.04 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. ANSI C80.1: Electrical Rigid Steel Conduit (ERSC).
 - 2. ANSI C80.4: Fittings for Rigid Metal Conduit and Electrical Metal Tubing.
- B. California Code of Regulations
 - 1. Title 24, Part 3 – California Electrical Code (NEC)
- C. National Electrical Manufacturer's Associate (NEMA)
 - 1. NEMA FB 1: Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
- D. Federal Specifications (FS)
 - 1. FS W-C-586D (A-A-50563): Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical: Cast Metal
- E. Underwriters Laboratory (UL)
 - 1. UL 6: Electrical Rigid Metal Conduit - Steel
 - 2. UL 514B: Fittings for Conduit and Outlet Bodies
 - 3. UL 1660: Liquid-Tight Flexible Non-Metallic Conduit

1.05 CONDUIT SCHEDULES

- A. General: Conduit schedules are included in shown on the Drawings.
- B. Identification: Conduits are identified on the Drawings using a tagging scheme as follows:

XX#####A

where

XX: one or two letter designating function per the table below

#####: conduit number [including area number and equipment number] [including equipment number] [MCC source/equipment number] as required.

A: for parallel power feeder conduits, merged control conduits, parallel fiber optic conduits, or otherwise as required to ensure uniqueness

C. Functional Designation Table

Conduit Designator Table	
Letter Designator	Function
C	Control and Monitoring 120V
CM	Control and Monitoring 120V, Multiconductor Cable
EL	UPS 120V Circuit - UPS Sourced
FO	Fiber Optic
J	Control, Low Voltage DC Discrete
L	240/208/120V Panelboard Circuit
N	Other Network or Data Link
P	Power, <=480V
S	Low Voltage Signal (4-20mA)
X	Spare (e.g., PX#### = spare power conduit)

PART 2 PRODUCTS

2.01 STEEL CONDUIT AND FITTINGS

A. Galvanized Rigid Steel Conduit (GRS)

1. Hot-dipped galvanized rigid steel conduit, including threaded type couplings, elbows, nipples, and other fittings, shall meet the requirements of ANSI C80.1, ANSI C80.4, UL and the NEC. Do not use setscrew or threadless type couplings, bushings, elbows, nipples, and other fittings, except when approved in writing by the Engineer.

B. Acceptable Manufacturers:

1. Allied Tube and Conduit
2. Western Tube & Conduit Corporation
3. Cal Pipe Industries, Inc
4. Approved equal

2.02 PVC COATED RGS CONDUIT AND FITTINGS

- A. PVC-coated rigid steel conduit shall be hot-dipped galvanized rigid steel conduit meeting the requirements of NEMA RN 1, UL/6, and ANSI C80.1. Provide a factory installed PVC coating, 40 mils nominal thickness, and applied over and permanently bonded to the galvanized surface. Coating shall include an interior 2 mil urethane coating.
- B. All male threads on conduit, elbows, nipples and other fittings shall be protected by an application of a urethane coating; they shall be threaded and galvanized with integral plastic sleeves overlapping the plastic-coated conduit.
- C. Provide PVC coated conduit suitable for conductors with 75°C insulation.

D. Product shall bear the ETL PVC-001 certification mark.

E. Acceptable Manufacturers:

1. Robroy, Plasti-Bond Red
2. Perma-Cote Industries, Supreme Conduit System
3. Approved equal

2.03 FLEXIBLE METAL CONDUIT, LIQUID-TIGHT

A. Flexible metal conduit shall be UL listed per UL 360, liquid-tight, consisting of galvanized steel flexible conduit core covered with an extruded PVC jacket and terminated with nylon bushings or bushings with steel or malleable iron body and insulated throat and sealing O-ring.

B. Provide conduit with sunlight resistant outer jacket, suitable for both concealed and exposed location.

C. Acceptable Manufacturers:

1. Allied Tube & Conduit (Tyco), Liquid-Tuff
2. Anamet, Anaconda Sealtite Type UA
3. Electri-Flex Liguatite Type LA
4. Approved equal

2.04 MISCELLANEOUS RACEWAY FITTINGS

A. Rigid Steel Fittings

1. Watertight hubs for rigid steel conduit shall be male thread type zinc-plated malleable iron with recessed "O" ring seal.

a. Acceptable Manufacturers:

- 1) OZ Gedney Type CHM
- 2) Appleton HUB Series
- 3) Myers Scru-Tite Hubs
- 4) Approved equal

2. Provide insulated throat grounding bushings at each end of every metal conduit. Provide threaded zinc-plated malleable iron grounding bushings with solderless bonding screw and insulated throat rated for 150°C.

a. Acceptable Manufacturers:

- 1) Thomas & Betts Grounding and Bonding Bushings

- 2) OZ Gedney Type BLG
 - 3) Appleton Threaded Grounding Bushings
 - 4) Approved equal
 3. Provide all malleable iron conduit bodies and covers with captive stainless steel screws and neoprene gaskets.
 - a. Acceptable Manufacturers:
 - 1) Appleton Form 35 threaded Unilets
 - 2) Kilark
 - 3) Approved equal
 4. Conduit End Caps: Provide PVC end caps to plug spare conduits and protect against entry of rodents, water, or dirt into the spare conduit. Provide end caps designed to fit into the end of standard conduit trade sizes and include integral cap eyelet for tying off spare conduit pull ropes or string.
- B. PVC-Coated Rigid Steel Conduit Fittings:
1. General: All boxes and fittings used with PVC coated conduit shall be furnished with a PVC coating bonded to the metal, the same thickness as used on the coated steel conduit. The ends of couplings and fittings shall have a minimum of one pipe diameter PVC overlap to cover threads and provide a seal.
 2. Products shall bear the ETL PVC-001 certification mark where applicable.
 3. Provide insulated throat grounding bushings with threaded zinc-plated malleable iron grounding bushings with bonding screw and insulated throat rated for 150 degrees C.
 - a. Acceptable Products:
 - 1) Thomas & Betts Grounding and Bonding Bushings
 - 2) OZ Gedney Type BLG
 - 3) Appleton Threaded Grounding Bushings
 - 4) Approved equal
 4. Provide watertight and corrosion resistant hubs with a minimum 40 mil PVC exterior coating, a urethane interior coating, and pressure sealing sleeves.
 - a. Acceptable Manufacturers:
 - 1) Robroy Plasti-Bond Red Type ST Hub
 - 2) Perma-Cote Industries Supreme Type ST Hub

- 3) Approved equal
- 5. Provide corrosion resistant conduit bodies sized as required by the NEC. Provide cast iron conduit bodies and covers with captive stainless steel screws, a 40 mil minimum PVC exterior coating, 2 mil (nominal) internal urethane coating, and pressure sealing sleeves on all conduit openings. Fittings shall be Form 8 with a V-Seal tongue-in-groove gasket and supplied with plastic encapsulated stainless steel cover screws. Form 8 fittings shall be UL Type 4X listed and IEC IP69 certified. Fittings shall be from the same manufacturer as the conduit in order to maintain system continuity and warranty. PVC Coated fittings for hazardous locations shall be UL 1203 listed after the coating is applied and have a red metal tag attached to the fitting to signify compliance.
 - a. Acceptable Manufacturers:
 - 1) Robroy Plasti-Bond Red Conduit Bodies
 - 2) Perma-Cote Industries Supreme Conduit Bodies
 - 3) Approved equal
- C. Liquid-Tight Flexible Metal Conduit Fittings:
 - 1. Throat Connectors:
 - a. In NEMA 4X areas, provide zinc-plated malleable iron or galvanized steel insulated throat connectors suitable for use in wet locations, with a minimum 40 mil PVC exterior coating and pressure sealing sleeves.
 - b. Acceptable Manufacturers:
 - 1) Robroy Plasti-Bond Red Liquid Tight Connectors
 - 2) Perma-Cote Industries Supreme Liquidtight Connectors
 - 3) Approved equal
 - 2. Hubs:
 - a. In NEMA 4X areas, provide watertight and corrosion resistant hubs with a minimum 40 mil PVC exterior coating, a urethane interior coating, and pressure sealing sleeves.
 - b. Acceptable Manufacturers:
 - 1) Robroy Plasti-Bond Red Type ST Hub
 - 2) Perma-Cote Industries Supreme Type ST Hub
 - 3) Occidental Coating Company OCAL-Blue Double-Coat Type ST Hub
 - 4) Approved equal

3. Conduit Bodies:

- a. General: Provide conduit bodies sized as required by the NEC. Provide integral rollers and bushings to facilitate pulling and protect wire insulation for conduit bodies greater than 1-inch; provide mogul type conduit bodies for sizes greater than 2-inch.
 - b. For areas not designated NEMA 4X, provide cast iron conduit bodies and covers with captive stainless steel screws and neoprene gaskets. Acceptable manufacturers:
 - 1) Appleton Form 35 threaded Unilets
 - 2) Crouse-Hinds Form 7 threaded condulets
 - 3) OZ Gedney Form 7 threaded conduit bodies
 - 4) Approved equal
 - c. For NEMA 4X areas, provide corrosion resistant conduit bodies sized as required by the NEC. Provide cast iron conduit bodies and covers with captive stainless steel screws, a 40 mil minimum PVC exterior coating and nominal 2 mil internal coating, and pressure sealing sleeves on all conduit openings. Fittings shall be Form 8 with a V-Seal tongue-in-groove gasket and supplied with plastic encapsulated stainless steel cover screws. Form 8 fittings shall be UL Type 4X listed and IEC IP69 certified. Fittings shall be from the same manufacturer as the conduit in order to maintain system continuity and warranty. PVC Coated fittings for hazardous locations must be UL 1203 listed after the coating is applied and have a red metal tag attached to the fitting to signify compliance. Acceptable manufacturers:
 - 1) Robroy Plasti-Bond Red Conduit Bodies
 - 2) Perma-Cote Industries Supreme Conduit Bodies
 - 3) Approved equal
4. Flexible couplings shall be type ECGJH as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Killark Electric Manufacturing Co. or equal.
 5. Explosion proof fittings shall be as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; O.Z./Gedney Co. or equal.

2.05 BOXES

A. NEMA 1 and NEMA 12 Utility Boxes:

1. Provide pressed steel switch and outlet device boxes hot-dipped galvanized after fabrication. Provide extra-depth boxes with knockouts, size and style suitable for the application.
2. Small boxes used for junction boxes or pull boxes 100 cubic inches and smaller shall be constructed of minimum 14 USS gage sheet steel, galvanized after fabrication. Provide boxes with minimum depth of 2-1/8-inches with overall size, style, and knockouts to match the application. Provide blank covers affixed with round head brass or stainless steel machine screws.

3. Boxes used for junction or pull boxes larger than 100 cubic inches shall be constructed of minimum 14 USS gage sheet steel, galvanized after fabrication. Provide boxes without knockouts with overall size and style to match the application. Provide blank covers affixed with round head brass or stainless steel machine screws. All joints shall be welded and edges ground smooth.
4. Acceptable Manufacturers:
 - a. Raco Manufacturing Co.
 - b. O.Z. Manufacturing Co.
 - c. Approved equal

B. NEMA 1 and NEMA 12 Terminal Boxes

1. Provide terminal boxes fabricated of sheet steel unless otherwise shown on the Drawings. Boxes shall have continuous welded seams and mounting feet. Welds shall be ground smooth. Boxes shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 14 gauge metal. Covers shall be continuously hinged, gasketed with rolled lip, and fastened with stainless steel latches or clamps. Boxes shall be furnished with terminal mounting straps and brackets.
2. Acceptable Manufacturers:
 - a. Hoffman Engineering Co.
 - b. Lee Products Co.
 - c. Keystone/Rees, Inc.
 - d. Approved equal

C. NEMA 4 Utility Boxes

1. Provide Type FD switch and outlet device boxes of cast or malleable iron or cast copper-free aluminum as required by the application. All device boxes shall be extra depth and gasketed. Covers shall be with cadmium-zinc finish with cast iron or aluminum covers and stainless steel screws.
2. Boxes shall be UL514 listed 514 conforming to NEMA FB-1 and Federal Specification W-C-586D standards.
3. Acceptable Manufacturers:
 - a. Hubbell-Killark
 - b. Appleton
 - c. Crouse-Hinds Co.
 - d. Approved equal

- D. Provide NEMA 4 or NEMA 4X terminal boxes, junction boxes, pull boxes etc., manufactured of Type 316 stainless steel unless otherwise noted. Boxes shall have continuous welded seams and mounting feet. Welds shall be ground smooth. Boxes shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be continuously hinged, gasketed, and fastened with stainless steel clamps. Terminal boxes shall be furnished with terminal mounting straps and brackets.

1. Acceptable Manufacturers:

- a. Hoffman Engineering Co.
- b. Lee Products Co.
- c. Keystone/Rees, Inc.
- d. Approved equal

2.06 WIREWAYS

- A. For areas designated NEMA 1, or NEMA 12 on the Drawings, provide UL listed, hinged cover, NEMA 12 wireway bodies and covers fabricated from 16 gauge steel minimum, with an enamel or epoxy finish.

1. Acceptable Manufacturers:

- a. Square D Square-Duct Wireway
- b. Hoffman
- c. Approved equal

- B. For all other areas or where NEMA 3R, NEMA 4, or NEMA 4X is shown on the Drawings, provide UL listed, raintight, hinged cover NEMA 4X wireway bodies and covers fabricated from stainless steel.

1. Acceptable Manufacturers:

- a. Square D
- b. Hoffman
- c. Approved equal

2.07 RACEWAY SUPPORTS AND FITTINGS

- A. General: Raceways shall be supported using trapeze hangers, flush mounted hardware, conduit racks, and conduit hangers as shown on the Drawings and as required.
- B. For areas not designated as NEMA 4X on the Drawings, supports and fittings for support systems for electrical equipment and raceways shall be channel supports sized to meet specified seismic requirements. Finish shall be hot-dipped galvanized after fabrication for strut, pipe straps, clamp back spacers, hanger rod, strut nuts, u-bolts, beam clamps, and all other supports and fittings.

1. Acceptable Manufacturers:
 - a. Unistrut
 - b. B-Line
 - c. Power Strut
 - d. Approved equal
- C. For areas designated as NEMA 4X on the Drawings; supports and fittings for support systems for electrical equipment and raceways shall be channel supports sized to meet seismic requirements. Materials of construction shall be 40 mil PVC coated hot-dipped galvanized steel, 316 stainless steel, or self-extinguishing fiberglass which meets UL94V-0 flammability tests, for strut, pipe straps, clamp back spacers, hanger rod, strut nuts, U-bolts, beam clamps, and other supports and fittings. However, selection of support material used shall be resistant to the material(s) stored or resident in the location where installed.
 1. Acceptable Manufacturers:
 - a. Robroy Plasti-Bond-Red PVC Coated Steel Strut and accessories
 - b. Perma-Cote Supreme PVC Coated Steel Channel and accessories
 - c. Approved equal

2.08 EXPANSION AND DEFLECTION COUPLINGS

- A. General: Provide expansion and/or deflection couplings for use where shown and wherever conduit crosses an expansion joint. The couplings shall alleviate longitudinal, angular, and shear conduit stress caused by thermal expansion and/or differential settlement.
- B. Couplings shall be suitable for either rigid metallic or non-metallic conduits and for embedded or exposed applications.
- C. Requirements:
 1. Suitable for concrete-embedded or exposed wet locations. Weatherproof, watertight, corrosion-resistant construction.
 2. Axial expansion or contracting up to 3/4 inch
 3. Angular misalignment of the axes of the coupled conduit runs in any direction up to 30 degrees
 4. Parallel misalignment of the axes of coupled conduit runs in any direction up to 3/4 inch
 5. Integral flexible copper braid grounding straps to assure grounding continuity
 6. Stainless steel jacket clamps
 7. Integral Erickson union
 8. Couplings shall comply with UL standard 514B.

9. Acceptable Manufacturers:
 - a. Crouse-Hinds Type XD
 - b. Appleton, Type DF
 - c. O.Z. Gedney Co. Type AXDX
 - d. Thomas and Betts, Type XD
 - e. Approved equal

2.09 CONDUIT TAGS

- A. Provide permanent, stamped brass round tags conduit numbers as designated on the conduit schedule, pressure stamped onto the tag. Stamped conduit identification numbers shall have a minimum height of 1/4-inches. Tags shall be fabricated from minimum 19 gauge brass with minimum diameter of 1-1/2-inches and predrilled mounting top hole.
- B. Tags relying on adhesives or taped-on markers are not acceptable. Attach tags to conduits with 316 stainless steel clamps at each end and at least once in every 50 feet near the midpoint of exposed conduit in ceiling spaces, surface mounted, and inside manholes and handholes.
- C. Conduits installed higher than 15 feet above finished grade or finished floor elevations shall be provided with large plastic identification nameplates at these locations. Minimum character size shall be 1/2" black engraved lettering on white plastic nameplate.
- D. Acceptable products
 1. Seton Identification Products
 2. National Band and Tag Company
 3. Emedco
 4. Approved equal.

2.10 DUCT SEAL

- A. General Penetration Sealant
 1. Provide non-hardening compound designed as a waterstop and moisture barrier for sealing the conduit annular space between conduit and electrical conductors. Material shall also be suitable for use around conduit entrance points including service conduits wood, metal, or other materials where shown on the Drawings. Seal material shall be asbestos free, non-toxic, and non-corrosive to metals and plastic, including wire insulation. Material shall be reusable, paintable. And suitable for locations with thermal expansion and contraction.
 2. Acceptable Products:
 - a. O-Z Gedney DUX
 - b. Rainbow Technology, Duct Seal Putty

- c. Approved equal
- B. Fire Rated Penetration Sealant
 - 1. Provide conduit penetration and cable sealant similar to general penetration sealant except provide material with fire rating that meets or exceeds the wall or floor construction as shown on the Drawing. Material shall be solvent free and UL or FM approved for the application.
 - 2. Acceptable Products:
 - a. Thomas & Betts Corp.; Pro Set Systems
 - b. Neer Mfg. Co.
 - c. Spec Seal, LCI Sealant
 - d. McMaster-Carr, 9340
 - e. Approved equal with fire rating as required for the application.

PART 3 EXECUTION

3.01 GENERAL

- A. Check the approximate locations of raceway system components shown on drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, consult the Engineer. Make modifications and changes required.
- B. Protection during construction: Prior to installation, store all products in a dry location. Following installation, protect products from the effects of moisture, corrosion, and physical damage during construction. Keep openings in conduit and tubing capped with manufactured seals during construction. Cover PVC conduit, elbows, and PVC coated rigid steel conduit, nipples, elbows, and fittings from exposure to sunlight.
- C. Material and equipment installation: Follow manufacturer's installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturer's installation instructions, codes and regulations, and these contract documents, follow Engineer's decision. Keep copy of manufacturer's installation instructions on the jobsite available for review at all times.
- D. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.

3.02 INSTALLATION

- A. Minimum size conduit shall be 3/4-inch.
- B. Raceway type for location and installation method unless otherwise noted:
 - 1. Exterior, exposed, higher than 6-inches above grade:
 - a. Galvanized rigid steel conduit

2. Interior, exposed unless noted otherwise:
 - a. Galvanized rigid steel conduit
 3. Interior, concealed, not embedded in concrete:
 - a. Galvanized Rigid steel conduit
 4. Risers through concrete pads:
 - a. PVC Coated rigid steel conduit.
 5. NEMA 4X areas:
 - a. PVC Coated rigid steel conduit.
 6. PVC coated rigid galvanized steel elbows shall be used for pad-mounted transformer stub-ups.
 7. Conduits shall be installed using threaded fittings. The use of running threads is prohibited. Where such threads are necessary, a 3-piece union shall be used. Rigid galvanized steel conduits which have been field cut and threaded shall be painted with cold galvanizing compounds.
 8. Rigid galvanized steel conduits buried in earth shall be completely painted with bitumastic.
 9. PVC coated rigid galvanized steel conduit shall be used for elbows at risers at the utility pole for electrical and telephone service conduits. Rigid galvanized steel conduit shall be used at utility pole for electrical and telephone service and fire alarm conduits to a height of 10-ft above finished grade. Furnish and install weather heads at service pole riser if required by utility company.
 10. Provide PVC coated rigid steel conduit under equipment mounting pads unless encased in concrete as specified herein.
 11. Where conduit changes from underground direct burial to exposed; extend PVC coated rigid steel conduit up to 6 inches above finished grade or as shown on the Drawings.
 12. Where exterior conduit transition through concrete walls, slabs, and floors to exposed runs, provide PVC coated rigid steel conduit with factory manufactured elbows. Extend PVC coated rigid steel conduit a minimum of 6-inches beyond the concrete walls, slabs, or floors or as shown on the Drawings.
- C. PVC Coated Rigid Steel Conduit:
1. Suitable UL listed PVC coated conduits, boxes, and fittings only shall be used. Galvanized conduits with a subsequent or field application of PVC material is not acceptable.
 2. Install in strict accordance with the manufacturer's instructions. Touch up any damage to the coating with conduit manufacturer acceptable patching compound. PVC boot shall cover all threads. Where belled conduits are used, bevel the unbelled end of the joint before joining. Leave no metallic threads uncovered. Clean field threads with solvent and coat with urethane touch-up. Keep two cans of urethane touch-up at each threading station.

D. Location, Routing, and Grouping:

1. Conceal or expose raceways as indicated on the Drawings. Group raceways in same area together. Locate raceways at least 12 inches away from parallel runs of heated piping for other utility systems.
2. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes to provide a neat appearance. Follow surface contours as much as possible. No diagonal runs will be allowed. All conduits shall be run plumb, straight, and true.
3. 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.
4. Do not notch or penetrate structural members for passage of raceways except with prior approval of the Engineer.
5. Do not run raceways horizontally in equipment foundation pads.
6. Do not route raceways exposed across walkways unless approved conduit threshold coverings are provided.
7. Route conduits within the furring lines of building walls and ceilings unless specifically noted to be exposed.
8. Provide all necessary sleeves and chases required where conduits are routed through floors or walls; seal all openings and finish to match adjacent surfaces.
9. Where conduit routing changes from concrete embedded within floors, slabs, or equipment pads to exposed, maintain a minimum separation of 6-inches between the closest wall, pad, or structure face and the outer edge of the exposed conduit.
10. Where conduits are routed through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke in accordance with UL requirements and the details shown on the Drawings. The sealing method shall have a UL fire rating, which equals or exceeds the fire rating of the wall or floor construction.
11. Conduits shall not be routed to cause obstruction of passageways to pedestrian or vehicular traffic. Conduits shall not be routed across pipe shafts, access hatches or vent duct openings. They shall be routed to avoid such present or future openings in floor or ceiling construction.
12. Conduits routed from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc, shall be sealed with "Duxseal" as manufactured by Manville or seal fitting to prevent the accumulation of condensation.
13. Conduits shall be routed a minimum of 3-in from steam or hot water piping. Where crossings are unavoidable, the conduit shall be kept at least 1-in from the covering of the pipe crossed.
14. A mandrel shall be pulled through all existing conduits to be reused under this Contract and through all new conduits 2-in in diameter and larger. Conduits shall be proved with the mandrel prior to installation of any conductors.

15. Emergency (generator) source and normal (power company) source feeders shall not be run through the same pull box.

E. Box Applications

1. Unless otherwise specified herein or shown on the Drawings, all boxes shall be metal.
2. Pull boxes, junction boxes, or terminal boxes shall be used in any conduit run where a splice is required. Pull boxes shall be provided every 200 feet of straight run, every 150 feet with 90 degrees of bends, every 100 feet with 180 degrees of bends, and every 50 feet with 270 degrees of bends.
3. Where no type or size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of the NEC. Enclosure type and material shall be as specified herein.
4. Exposed switch, receptacle and lighting outlet boxes and conduit fittings shall be cast or malleable iron.
5. Concealed switch, receptacle and lighting outlet boxes shall be pressed steel.
6. Terminal boxes, junction boxes and pull boxes shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16000.
7. Boxes flush in block, brick or tile walls shall be located at a course line and provided with square tile covers. Flush boxes shall not project beyond the finished surfaces nor shall surfaces project more than 1/8-in beyond the box enclosure. Wiring devices located in close proximity to each other shall be installed in one solid gang box with single cover.
8. All conduit bodies and pulling outlets shall comply with NEC wire bending space requirements. Mogul type fittings shall be used for sizes 2-1/2-in and larger. Where left or right side opening conduit bodies may be required for larger size conductors, provide pull boxes or other means where mogul style is not available. In no case shall the listed fill size cross sectional area for the conduit body be exceeded by the installed wire.
9. Conduit terminating in pressed steel boxes shall have double locknuts and insulated bushings

F. Final connection to equipment subject to movement or vibration:

1. Provide liquid-tight, PVC-jacketed flexible conduit for final connection to motors, wall or ceiling mounted fans and unit heaters, dry type transformers (primary and secondary terminations), generator terminations, valves, local instrumentation, and other equipment where flexible connection is required for vibration and to facilitate removal or adjustment of equipment.
2. Provide 18-inch minimum, 60-inch maximum lengths unless otherwise approved by the Engineer. Provide flexible conduit size for installations of 4 inches or less. For larger sizes, use rigid steel conduit as specified.
3. The flexible conduit length shall be sufficient to allow the connected equipment to be withdrawn and fully moved off its base.

4. Flexible couplings shall be used in hazardous locations for all motor terminations and other equipment where vibration is present.
- G. Wireways: Mount wireways securely in accordance with the NEC and manufacturer's instructions. Orient cover on accessible vertical face of wireway to allow removal of all fasteners and complete removal or rotation of cover for installation of conductors.
- H. Raceway Supports
1. General:
 - a. Support raceways at intervals not exceeding NEC requirements unless otherwise indicated. Supports shall be provided to ensure a rigid and durable installation.
 - b. Support spacing and anchoring method shall be as required by the seismic mounting calculations. All support spacing requirements specified are maximum values only and shall be increased as necessary based on the final seismic calculations as specified. Anchoring method specified shall be modified as required by the final seismic calculations as specified
 - c. Support all raceways from structural members only. Do not support from pipe hangers or rods, cable tray, or other conduit.
 - d. Support flexible metal conduit with conduit clamps, except where the flexible metal conduit is fished and where sections less than 4 feet in length are used in concealed areas to supply lighting fixtures in accordance with the NEC. Adjustable steel and plastic band hangers, adjustable band hangers, adjustable swivel ring hangers and J-hangers are not acceptable.
 - e. Attachment to concrete shall be cast-in-place inserts, cast-in place welded plates with welded studs or stainless steel adhesive anchors.
 - f. 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.
 - g. All reinforcing bars shall be located by the Contractor with the use of a rebar locator prior to installing adhesive capsule type anchors. Mark the location of all reinforcing bars in an area bounded by a line drawn at least 18-in from the edge of the support bearing/weld plates on all four sides of the bearing/weld plates prior to fabricating and installing bearing/weld plates.
 - h. Where interference occurs, adjust anchor locations to clear reinforcing bars and alter support configuration at no additional cost to the Authority.
 - i. Miscellaneous steel for the support of fixtures, boxes, transformers, starters, contactors, panels and conduit shall be furnished and installed. Channel supports shall be ground smooth and fitted with plastic end caps.
 - j. Steel channels, flat iron and channel iron shall be furnished and installed for the support of all electrical equipment and devices, where required, including all anchors, inserts, bolts, nuts, washers, etc, for a rigid installation. Channel supports shall be ground smooth and fitted with plastic end caps.

2. Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface.
3. Multiple runs of conduits shall be supported on fabricated channel trapeze type racks with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-in diameter. Surface mounted panel boxes, junction boxes, conduit, etc, shall be supported by spacers to provide a minimum of 1/2-in clearance between wall and equipment.
 - a. Conduit support trapezes shall be vertically supported every 10-ft or less, as required to obtain rigid conduit construction.
 - b. Lateral restraints (sway bracing) shall be spaced 30-ft or less.
 - c. Horizontal restraints shall be spaced at 40-ft or less. There shall be at least one horizontal restraint per horizontal run.
 - d. Trapeze attachment to structural steel shall be by beam clamps or welded beam attachment. C-clamps will not be allowed for vertical hangers. Side beam clamps with beam hooks shall be used when required for seismic restraints only.
4. Conduit Racks
 - a. Support shall be spaced 10-ft or less, as required to obtain rigid conduit construction.
 - b. Horizontal seismic restraints shall be spaced at 30-ft or less.
5. Conduit Hangers
 - a. Conduit hangers shall be vertical supported 10-ft or less.
 - b. Lateral seismic restraints (Sway Bracing) shall be spaced 20-ft or less.
 - c. Horizontal seismic restraints shall be spaced at 30-ft or less. There shall be at least one horizontal restraint per horizontal run.
 - d. Attachment to structural steel shall be by beam clamps or welded beam attachment. C-clamps will not be allowed for vertical hangers. Side beam clamps with beam hooks shall be used for seismic restraint only.

I. Bends

1. Make changes in direction of runs with symmetrical bends or cast metal fittings. Make bends and offsets of the longest practical radius. Avoid field-made bends and offsets where possible, but where necessary, make with an acceptable hickey or conduit bending machine. Do not heat metal raceways to facilitate bending.
2. Make bends in parallel or banked runs of raceways from the same center or centerline so that bends are parallel, concentric, and of neat appearance. Factory elbows may be used in parallel or banked raceways if there is a change in the plane of the run and the raceways are of the same size. Otherwise, make field bends in parallel runs.
3. Make no bends in flexible conduit that exceed allowable bending radius of the cable to be installed or that significantly restricts the conduits flexibility.

J. Threaded Joints

1. Paint all field-cut threads with zinc rich paint or liquid galvanizing compound for rigid steel conduit and for PVC-coated rigid steel conduit after removal of chips and cleaning with solvent. Touch up after assembly to cover nicks or scars.
2. Use approved, highly conductive jointing compound on all joints, Appleton Type TLC, or approved equal.

K. Bushings, Hubs, and Insulating Sleeves:

1. Where rigid steel conduit, PVC coated rigid steel conduit, or liquid-tight flexible metal conduit enters metal cabinets/enclosures, install an insulated throat grounding bushing on the end of each conduit. Install a bonding jumper from the bushing to suitable equipment ground bus or ground pad. Ground pads designated for instrumentation signal grounds as specified in Division 13 shall not be used for this purpose.
2. Interconnection or daisy-chaining of bonding jumpers from each conduit grounding bushing to the equipment ground bus or ground pad is acceptable.
3. If neither a ground bus or ground pad exists, connect the bonding jumper to the metallic enclosure with a listed bolted-lug connection.
4. All connections between conduits and NEMA 1, 1A, and 12 enclosures shall be made with hubs outside and bushings on the inside.
5. Conduit connections to NEMA 3R, NEMA 4, or NEMA 4X enclosures, junction boxes, terminal junction boxes, or device outlet boxes, shall be made with watertight, corrosion resistant hubs. The conduit connections shall maintain the integrity of the enclosure NEMA rating.

L. Raceway Penetrations:

1. Seal the interior of all raceways entering structures or buildings at the first box or outlet with duct seal to prevent the entrance into or exit from the structure of gases, liquids, or rodents.
2. All underground conduit penetrations at walls or other structures shall be sealed watertight using wall seals in core drilled openings or with specified conduit wall sleeves. Conduit wall seals and sleeves shall be used in accordance with the manufacturer's installation instructions and the details shown on the Drawings.
3. Above Grade Penetrations
 - a. Seal all above grade penetrations of concrete, CMU, metal, or wooden walls or roofs with duct seal. Install duct seal around conduit penetrations and inside conduits for sealing the annular space between conduit and conductors.
 - b. Where raceways penetrate fire-rated walls, floors, or ceilings, provide fire stop material as specified herein or per Division 7 [Section 07 84 00] in openings around electrical penetrations to maintain the fire-resistance rating.
4. Liquid Chemical Containment Area Sealing: Internally and externally seal each conduit entering or leaving any liquid chemical containment areas to prevent chemical migration or

drainage via the conduit system. Sealing shall be in accordance with the typical details shown on the Drawings. Seal conduits with a polyurethane elastomeric caulking material installed in accordance with the manufacturer's instructions. The material shall be SikaFlex-2C used with the primer No. 449 or No. 260 as appropriate for the conduit or approved equal.

M. Expansion Joints:

1. Provide expansion/deflection fittings for raceways crossing expansion joints in structures, between structures and walkways or concrete slabs to compensate for expansion, contraction, and deflection. Provide for the high rate of thermal expansion and contraction of PVC conduit by providing PVC expansion joints as recommended by the manufacturer and as required. See Structural Drawings for locations of expansion joints.
2. Provide expansion only fittings on exposed, rigid steel conduit runs a minimum of every 200 feet or as required for the specific thermal characteristics of the application.
3. Provide bonding jumpers around expansion joint fittings.

3.03 PREPARATION FOR PULLING IN CONDUCTORS

- A. Do not install crushed or deformed raceways. Do install conductors in crushed or deformed raceways.
- B. Install raceways to avoid introduction of traps.
- C. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals until the time for pulling in conductors. Take care to prevent the lodging of plaster, concrete, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Make raceways entirely free of obstructions or replace them.
- D. Ream all raceways, remove burrs, and clean raceway interior before introducing conductors or pull wires.
- E. For concrete-encased raceways (after the concrete envelope has set), and for direct buried conduits, pull a mandrel through each raceway to remove debris. Pull a mandrel of a diameter approximately 1/4 inch less than the raceway inside diameter, through each raceway. Use cleanout or flexible mandrels for conduit sizes greater than 2-inches; use rubber/foam mandrel for conduit sizes 2-inches and below.
- F. For all raceways which contain less than 50 percent of the NEC allowed fill of control cables or individual conductors, install a nylon pull rope with the conductors.

3.04 EMPTY RACEWAYS

- A. Certain raceways will have no conductors pulled in as part of this Contract. Identify with conduit tags at each end and at any intermediate pull point of each such empty, spare raceways.
- B. Raceways noted as spare shall be capped or plugged at both ends with easily removable conduit cap fittings
- C. Provide a fabricated, listed removable cap over each end of empty raceways. Provide cap with eyelet for tying off pull rope.

- D. 3/16-in nylon pull ropes shall be installed in all new or existing unused conduits noted as spares or designated for future equipment. Provide pull rope with a minimum of 3-feet of slack length at each end of each empty raceway. Tie off the pull rope at the conduit end cap eyelet.

3.05 IDENTIFICATION

- A. Attach conduit identification tags to conduits with 304 stainless steel hose clamps and/or stainless steel jack chains.
- B. Provide conduit identification tags for all conduits at each end of conduit and at least once in every 50 feet of exposed conduit runs.
- C. Provide conduit identification tags for each conduit inside all manholes and handholes.
- D. Conduits installed higher than 15 feet above finished grade or finished floor elevations shall be provided with large plastic identification nameplates at these locations. Attach plastic nameplates with plastic ties.

3.06 PAINTING

- A. Paint exposed metal raceway systems in accordance with the requirements of Section 09900.

END OF SECTION

SECTION 16190

MISCELLANEOUS ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Section includes:

1. All miscellaneous electrical equipment as shown on the Drawings and as specified herein.

B. The following equipment is included under this Section:

1. Control stations.
2. Corrosion inhibitors.
3. Equipment identification nameplates.
4. Equipment mounting stands.
5. Termination cabinets

1.02 RELATED SECTIONS

- A. Section 16000 – Common Work Results for Electrical

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Sections 01300 and 16000. Submittals shall contain detailed catalog information or drawings describing electrical and physical characteristics of all equipment specified.

1.04 REFERENCE STANDARDS

- A. Equipment enclosures shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16000.
- B. Underwriters Laboratories (UL):
- C. National Fire Protection Association (NFPA):
1. NFPA 70 – National Electrical Code

PART 2 PRODUCTS

2.01 CONTROL STATIONS

- A. Control stations shall be heavy-duty type, with full size operators (30mm) and LED type indicating lights.

- B. Control station operators noted as local emergency stop (LES) on the Drawings shall be maintained contact, push to stop/pull to release type.
- C. Provide control stations sized for the number and type of pilot devices as shown on the Drawings. Control station dimensions shall be adequate to accommodate device contact blocks and a minimum of one additional auxiliary contact block for remote monitoring of pilot operator positions.
- D. Provide permanent engraved escutcheon plates for all devices labled with the specific functions as shown on the Drawings or as specified (e.g., RUN, HAND-OFF-AUTO)
- E. Control Station enclosures shall be 316 stainless steel.
- F. Control stations shall be by Eaton Corporation; General Electric Co.; Square D; or equal.

2.02 CORROSION INHIBITORS

- A. All equipment enclosures, terminal boxes, etc, located in a corrosive rated area (where shown on the Drawings) that contains electrical or electronic equipment or terminal strips shall be furnished with an internally mounted, chemically treated corrosion inhibitor pad.
- B. The corrosion inhibitor pads shall be as manufactured by Hoffman Engineering Co.; 3M or approved equal.

2.03 EQUIPMENT IDENTIFICATION NAMEPLATES

- A. All field mounted electrical equipment such as disconnects, push button stations, etc, shall be provided with a weather resistant engraved laminoid equipment identification nameplate screwed or bolted adjacent to the device. Nameplate shall identify the mechanical equipment controlled exactly as shown on the electrical single-line drawings (i.e., P-95 Cooling Water Pump No. 1).

2.04 EQUIPMENT MOUNTING STANDS

- A. Equipment mounting stands shall be custom fabricated from steel plate and steel supports, as shown on the Drawings.
- B. Steel plates and supports shall be hot dip galvanized.

2.05 TERMINATION CABINETS

- A. All interiors shall be completely factory or shop assembled with terminal blocks and insulating barriers. All 120 volt AC and DC terminal blocks shall be isolated from each other by insulating barriers or separate enclosures. Interiors shall be designed so that terminal blocks or control relays can be replaced or added without disturbing adjacent units.
- B. All wiring carrying signals and voltages of a similar type shall be grouped together within the cabinets in harnesses and secured to the structure.
- C. All shielded cables shall terminate in separate cabinets. A third terminal shall be provided for each twisted shield pair and the shield for each connected thereto, unless otherwise noted on manufacturer's shop drawings.

- D. Terminal blocks shall be molded plastic, tubular screw type with pressure plates and shall be rated 600 volts. Terminals shall be double sided and supplied with removable covers. Each cabinet shall be furnished with a minimum of 50 spare terminals. Terminal blocks shall be Allen Bradley; ABB; Kukla, or equal.
- E. Boxes shall be made from 14 gauge galvanized steel and shall be of sufficient size to provide a minimum of 6-in of wiring space on all sides and between adjacent terminal blocks. Boxes in wet, damp, corrosive and all outdoor locations shall be NEMA 4X, Type 316 stainless steel. A minimum of four mounting studs shall be provided on each cabinet. Cabinets shall be furnished without knockouts. Holes for raceways shall be drilled on the job coordinated with incoming conduits.
- F. A single hinged door shall cover the front of each terminal cabinet. Doors shall have a neoprene gasket, vault type handle, three point hatch and lock. Two keys shall be supplied for each lock. All locks shall be keyed alike. A terminal block schedule shall be provided with each terminal point numbered and identified (typewritten) as to function.
- G. All exterior and interior steel surfaces of the cabinets shall be properly cleaned and finished with white over a rust-inhibiting phosphatized coating conforming to ANSI A55.1. The finish paint shall be of a type to which field applied paint will adhere.
- H. Cabinet enclosures shall be as manufactured by Hoffman Engineering Company; Hennessy Products; Lee, or equal, with latch kit hardware.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mounting Stands

- 1. Field mounted disconnects, pushbutton control stations, etc., shall be mounted on steel stands as shown on the Drawings. Where clearance requirements for stands may not be maintained, the Construction Manager may direct equipment to be wall-mounted adjacent to the equipment, but in no case shall the distance from the equipment to the control station exceed 3-ft.

END OF SECTION

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SECTION 16220

LOW VOLTAGE MOTORS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide three-phase and single-phase AC induction motors 600V or less, rated 500HP or less and operating at greater than 75% load for equipment as shown on the Contract Documents.
- B. Provide all motor accessories, features, and enclosures as specified herein.
- C. Motors furnished under other Sections, shall be in conformance with the requirements listed in this Section unless otherwise noted in the detailed technical specifications included in Division 11.

1.02 RELATED SECTIONS

- A. Section 16000 – Electrical and Instrumentation General Provisions
- B. Section 16060 – Grounding and Bonding for Electrical Systems
- C. Section 16260 – Variable Speed Drives

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Sections 01340 and 16000.
- B. Submittal of motor data shall include complete nameplate data and test characteristics in accordance with NEMA Standard MG1 Part 12 and, in addition, the following for motors typical of the units furnished:
 - 1. Efficiency at 1/2, 3/4 and full load
 - 2. Power factor at 1/2, 3/4 and full load
 - 3. Motor outline, dimensions and weight
 - 4. Descriptive bulletins, including full description of insulation system
 - 5. Bearing design data
 - 6. Special features (i.e., space heaters, temperature detectors, etc.)
 - 7. Power factor correction capacitor rating, type, and mounting method
 - 8. Dimensional drawings for each item of couplings and motor to be furnished for motors to be replaced under this Contract
- C. Submit method and equipment for grounding shaft rotors for motors powered by PWM variable frequency drives.

- D. For inverter duty rated motors, provide certification that the motor is in compliance with NEMA MG-1, Part 31.

1.04 REFERENCE STANDARDS

- A. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. IEEE 43: IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery
 - 2. IEEE 112: Standard Test Procedure for Polyphase Induction Motors and Generators.
 - 3. IEEE 114: Standard Test Procedures for Single-Phase Induction Motors.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA MG1: Motors and Generators
- C. American Bearing Manufacturers Association (ABMA)
 - 1. ABMA 20: Radial Bearings of Ball, Cylindrical Roller, and Spherical Roller Types – Metric Design

1.05 QUALITY ASSURANCE

- A. Where motors are specified under the technical specifications as “Severe Duty” they shall be designed and manufactured in accordance with the latest version of IEEE Standard 841.
- B. Unless noted otherwise herein, routine tests shall be performed on representative motors in accordance with IEEE Standard 112, and shall include the information described in NEMA MG1-Part 12 and manufacture’s standard testing. Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors. Certification shall be provided that motors have passed the factory tests.

PART 2 PRODUCTS

2.01 RATING

- A. Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage 10 percent below nameplate rating. Where shown on the Drawings to be operated on a reduced voltage starter, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method.
- B. All motors shall be rated for continuous duty suitable for operation in a 40 degrees C ambient and not less than minus 15 degrees C with altitudes less than 1,000 meters unless otherwise noted.
- C. Motors shall be rated for frequency variation within plus/minus 5%.
- D. Specific motor data such as HP, rpm, enclosure type, etc, are specified under the detailed specification for the equipment with which the motor is supplied.
- E. Provide motors 1 horsepower and above with service factor of 1.15 at 40°C under sinusoidal operation unless specifically noted otherwise.

- F. Motors specified for operation under variable frequency drives shall be inverter duty rated in compliance with NEMA MG-1, Part 31 and shall have a nameplate service factor of 1.15 (sinusoidal operation) and 1.0 when driven from a non-sinusoidal source.

2.02 ENCLOSURES

- A. Motors specified herein will conform to one of the following NEMA standard enclosure designs:
 - 1. Weather Protected Type II (WP2): A weather-protected Type II machine shall have, in addition to the enclosure defined for a weather protected Type I machine, its ventilating passages at both intake and discharge so arranged that high velocity air and air-borne particles blown into the machine by storms or high winds can be discharged without entering the internal ventilating passages leading directly to the electric parts of the machine itself. The normal path of the ventilating air which enters the electric parts of the machine shall be so arranged by baffling or separate housings as to provide at least three abrupt changes in direction, none of which shall be less than 90 degrees. In addition, an area of low velocity not exceeding 600 feet per minute shall be provided in the intake.
 - 2. Totally enclosed fan cooled (TEFC) Motors shall have a steel or cast iron frame, cast iron end brackets, cast iron conduit box, drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger) and upgraded insulation by additional dips and bakes to increase moisture resistance. Fan for cooling the motor shall be integral.
- B. Motors shall have a steel or cast iron frame and a cast iron or stamped steel conduit box.
 - 1. Conduit box shall be split from top to bottom and shall be capable of being rotated to four positions.
 - 2. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and between the conduit box and its cover.
 - 3. Where available for the enclosure type specified, motor leads shall be sealed with a non-wicking, non-hygroscopic insulating material.
 - 4. A frame mounted pad with drilled and tapped hole, not less than 1/4-in diameter, shall be provided inside the conduit box for motor frame grounding.

2.03 SEVERE DUTY

- A. Where motors are specified to be "Severe Duty" per the technical specifications they shall be of the corrosion resistant type conforming to motors designated by the manufacturer as "Corro-Duty", "Mill and Chemical", "Custom Severe Duty", or similar quality designation. Severe duty motors shall have a cast iron frame, cast iron end brackets, cast iron conduit box, tapped drain holes (corrosion resistant plug for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger).
- B. Motors shall be single speed, totally-enclosed fan-cooled (TEFC), squirrel-cage polyphase induction motors.
- C. Where fractional horsepower motors are specified in the process equipment specifications or shown on the Drawings for applications requiring severe duty motors, provide nominal 1 horsepower severe duty motor conforming to manufacturer's standard severe duty equipment.

2.04 NAMEPLATES

- A. Provide motor manufacturer's nameplates engraved or embossed on stainless steel and fastened to the motor frame with stainless steel screws or drive pins. Nameplates shall indicate clearly all of the items of information enumerated in NEMA Standard MG1-10.38 or MG1-20.60, as applicable.

2.05 CONDENSATION HEATERS

- A. Provide condensation winding space heaters for every 3-phase motor provided under this Contract unless specified otherwise under the detailed equipment specifications. Heaters shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 Volt, single phase with wattage as required or as recommended by the motor manufacturer for the specific application. The heater wattage and voltage shall be embossed on the motor nameplate. Power leads for heaters shall be brought out at the motor lead junction box or auxiliary termination box if available.

2.06 SINGLE PHASE MOTORS

- A. Unless otherwise specified, motors smaller than 1/2 Hp shall be single phase, capacitor start. Small fan motors may be split-phase or shaded pole type if such are standard for the equipment. Wound rotor or commutator type single-phase motors are not acceptable unless their specific characteristics are necessary for the application.
- B. Single-phase motors shall be rated for operation at 115 Volts, 208 Volts, or 240 Volts, single phase, 60 Hz, as shown on the Drawings.
- C. Locked rotor current shall not be greater than specified in NEMA Standard MG1, Part 12, Design "N".
- D. Motors shall be totally enclosed in conformance with NEMA Standard MG1, Part 1. Small fan motors may be open type if suitably protected from moisture, dripping water and lint accumulation.
- E. Motors shall be provided with sealed ball bearings lubricated for 10 years normal use.
- F. Motors shall be by Nidec-U.S. Motors; Baldor; GE Motors (ABB); or equal.

2.07 THREE PHASE MOTORS-FRAMES 143T THROUGH 449T

- A. General
 - 1. Unless otherwise specified, motors 1/2 Hp and larger shall be 3 Phase, squirrel cage induction type, premium efficiency.
 - 2. All motors 3/4 Hp and larger shall be a NEMA frame 143T or larger. 1/2 Hp motors and 3/4 Hp motors rated 1800 and 3600 rpm, shall be a 56 frame. Motors shall be designed and connected for operation on a 480 Volt, 3 Phase, 60 Hz alternating current system. Dual voltage (230/460) rated motors are acceptable.
 - 3. Unless otherwise required by the load, all motors shall be NEMA Design B, normal starting torque. Locked rotor kVA/Hp shall not exceed Code Letter G as described in NEMA Standard MG1-10.37 for motors 20 Hp and larger.

B. Bearings

1. Anti-friction motor bearings shall be designed to be regreasable and initially shall be filled with grease suitable to ambient temperature of 40 degrees C. Bearings shall be AFBMA Types BC or RN, heavy duty, or shall otherwise be shown to be suitable for the intended application in terms of B-10 rating life, Class M3 or better.
2. All grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with an easily accessible grease supply, flush, drain and relief fittings including an externally visible sight glass to view the oil level. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic type by the Alemite Division of the Stewart-Warner Corporation.
3. Grease lubricated bearings shall be designed for electric motor use. The grease shall be capable of higher temperatures associated with electric motors and shall be compatible with Polyurea-based greases.
4. Bearings shall be rated for a minimum of 26,280 hours L-10 life at full-load direct-coupled, except vertical high thrust motors.
5. Vertical motors shall be capable of withstanding a momentary up-thrust of at least 30% of normal down-thrust.

C. Insulation

1. Insulation systems shall be Class B (130 degrees C) and shall be manufacturer's premium grade, resistant to attack by moisture, acids, alkalies and mechanical or thermal shock. Maximum temperature rise by resistance at rated HP shall not exceed Class B limits (80 degree C)
2. For motors at 1.15 Service Factor, the maximum temperature rise by resistance shall not exceed Class F limits of 115 degree C.
3. Motors for severe duty service shall have vacuum/pressure impregnated epoxy insulation for moisture resistance.
4. Insulation for inverter duty motor windings shall meet or exceed the Pulse Endurance Index for magnetic wire and shall not be injured when exposed to repeated pulse type waveforms, repetitive high voltage transients, switching frequency and rate of rise of the pulse. Class H varnish shall be used.

D. Vibration

1. Vibration shall not exceed 0.15 inch per second, unfiltered peak.

E. Grounding Motor Shafts

1. All motors operated by variable frequency drives shall be provided with shaft grounding attachment devices.
2. The shaft grounding device shall be a metallic impregnated brush installed onto the shaft rotor such that the brush contacts the rotor surface to ground out any voltage present on the shaft rotor.

3. Brush shall be bristle type and be easily removable for replacement and maintenance without having to disassemble the motor and remove the rotor.
4. Shaft grounding device shall be manufactured by Sohre, Aegis or Equal.

F. Motor Efficiencies (Three Phase Motors)

1. Motor efficiencies shall meet the requirements of the Energy Independence and Security Act (EISA) and be manufactured to meet the following efficiency standards:
 - a. General purpose motors (subtype I) with a power rating of 1 Hp through 200 Hp shall have a nominal full-load efficiency that is not less than as defined in NEMA MG- 1 (2006) Table 12–12 (“NEMA Premium®”) efficiency levels. Subtype I motors include:
 - 1) Foot-mounted 3-digit frame sizes with C-face and foot mount
 - 2) Includes ODP, TEFC, TENV, explosion-proof, etc.
 - b. NEMA Design B, general purpose electric motor, with a power rating of 200 Hp through 500 Hp shall have a nominal full-load efficiency that is not less than as defined in NEMA MG–1 (2006) Table 12–11.
2. Efficiency values shall be based on tests performed in accordance with IEEE 112, Method B. Motors with horsepower or rpm's not listed shall conform to comparable standards of construction and materials as those for listed motors.
3. Where California laws dictate higher efficiencies than those listed, the higher efficiency motors shall be furnished.

Table 12-11
NEMA Full-Load Efficiencies of Energy Efficient Motors¹
OPEN MOTORS

	2 POLE		4 POLE		6 POLE		8 POLE	
Hp	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	--	--	82.5	80.0	80.0	77.0	74.0	70.0
1.5	82.5	80.0	84.0	81.5	84.0	81.5	75.5	72.0
2.0	84.0	81.5	84.0	81.5	85.5	82.5	85.5	82.5
3.0	84.0	81.5	86.5	84.0	86.5	84.0	86.5	84.0
5.0	85.5	82.5	87.5	85.5	87.5	85.5	87.5	85.5
7.5	87.5	85.5	88.5	86.5	88.5	86.5	88.5	86.5
10	88.5	86.5	89.5	87.5	90.2	88.5	89.5	87.5
15	89.5	87.5	91.0	89.5	90.2	88.5	89.5	87.5
20	90.2	88.5	91.0	89.5	91.0	89.5	90.2	88.5
25	91.0	89.5	91.7	90.2	91.7	90.2	90.2	88.5
30	91.0	89.5	92.4	91.0	92.4	91.0	91.0	89.5
40	91.7	90.2	93.0	91.7	93.0	91.7	91.0	89.5
50	92.4	91.0	93.0	91.7	93.0	91.7	91.7	90.2
60	93.0	91.7	93.6	92.4	93.6	92.4	92.4	91.0
75	93.0	91.7	94.1	93.0	93.6	92.4	93.6	92.4
100	93.0	91.7	94.1	93.0	94.1	93.0	93.6	92.4
125	93.6	92.4	94.5	93.6	94.1	93.0	93.6	92.4
150	93.6	92.4	95.0	94.1	94.5	93.6	93.6	92.4
200	94.5	93.6	95.0	94.1	94.5	93.6	93.6	92.4
250	94.5	93.6	95.4	94.5	95.4	94.5	94.5	93.6
300	95.0	94.1	95.4	94.5	95.4	94.5	--	--
350	95.0	94.1	95.4	94.5	95.4	94.5	--	--
400	95.4	94.5	95.4	94.5	--	--	--	--
450	95.8	95.0	95.8	95.0	--	--	--	--
500	95.8	95.0	95.8	95.0	--	--	--	--

Notes:

1. Values included in the table above were taken from the NEMA Standards MG 1-2006

Table 12-11
NEMA Full-Load Efficiencies of Energy Efficient Motors¹
ENCLOSED MOTORS

	2 POLE		4 POLE		6 POLE		8 POLE	
Hp	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	75.5	72.0	82.5	80.0	80.0	77.0	74.0	70.0
1.5	82.5	80.0	84.0	81.5	85.5	82.5	77.0	74.0
2.0	84.0	81.5	84.0	81.5	86.5	84.0	82.5	80.0
3.0	85.5	82.5	87.5	85.5	87.5	85.5	84.0	81.5
5.0	87.5	85.5	87.5	85.5	87.5	85.5	85.5	82.5
7.5	88.5	86.5	89.5	87.5	89.5	87.5	85.5	82.5
10	89.5	87.5	89.5	87.5	89.5	87.5	88.5	86.5
15	90.2	88.5	91.0	89.5	90.2	88.5	88.5	86.5
20	90.2	88.5	91.0	89.5	90.2	88.5	89.5	87.5
25	91.0	89.5	92.4	91.0	91.7	90.2	89.5	87.5
30	91.0	89.5	92.4	91.0	91.7	90.2	91.0	89.5
40	91.7	90.2	93.0	91.7	93.0	91.7	91.0	89.5
50	92.4	91.0	93.0	91.7	93.0	91.7	91.7	90.2
60	93.0	91.7	93.6	92.4	93.6	92.4	91.7	90.2
75	93.0	91.7	94.1	93.0	93.6	92.4	93.0	91.7
100	93.6	92.4	94.5	93.6	94.1	93.0	93.0	91.7
125	94.5	93.6	94.5	93.6	94.1	93.0	93.6	92.4
150	94.5	93.6	95.0	94.1	95.0	94.1	93.6	92.4
200	95.0	94.1	95.0	94.1	95.0	94.1	94.1	93.0
250	95.4	94.5	95.0	94.1	95.0	94.1	94.5	93.6
300	95.4	94.5	94.5	94.5	95.0	94.1	--	--
350	95.4	94.5	95.4	94.5	95.0	94.1	--	--
400	95.4	94.5	95.4	94.5	--	--	--	--
450	95.4	94.5	95.4	94.5	--	--	--	--
500	95.4	94.5	95.8	95.0	--	--	--	--

Notes:

1. Values included in the table above were taken from the NEMA Standards MG 1-2006

Table 12-12
NEMA Premium Full Load Efficiencies¹
OPEN MOTORS

Hp	3600 RPM		1800 RPM		1200 RPM	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	86.5	84.0
2.0	85.5	82.5	86.5	84.0	87.5	85.5
3.0	85.5	82.5	89.5	87.5	88.5	86.5
5.0	86.5	84.0	89.5	87.5	89.5	85.7
7.5	88.5	86.5	91.0	89.5	90.2	88.5
10	89.5	87.5	91.7	90.2	91.7	90.2
15	90.2	88.5	93.0	91.7	91.7	90.2
20	91.0	89.5	93.0	91.7	92.4	91.0
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	94.1	93.0	93.6	92.4
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.0	94.1	94.5	93.6
100	93.6	92.4	95.4	94.5	95.0	94.1
125	94.1	93.0	95.4	94.5	95.0	94.1
150	94.1	93.0	95.8	95.0	95.4	94.5
200	95.0	94.1	95.8	95.0	95.4	94.5
250	95.0	94.1	95.8	95.0	95.4	94.5
300	95.4	94.5	95.8	95.0	95.4	94.5
350	95.4	94.5	95.8	95.0	95.4	94.5
400	95.8	95.0	96.2	95.4	96.2	95.4
450	95.8	95.0	96.2	95.4	96.2	95.4
500	95.8	95.0	96.2	95.4	96.2	95.4

Notes

1. Values included in the table above were taken from the NEMA Standards MG 1-2006.

Table 12-12
NEMA Premium Full Load Efficiencies¹
ENCLOSED MOTORS

	3600 RPM		1800 RPM		1200 RPM	
Hp	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	87.5	85.5
2.0	85.5	82.5	86.5	84.0	88.5	86.5
3.0	86.5	84.0	89.5	87.5	89.5	87.5
5.0	88.5	86.5	89.5	87.5	89.5	87.5
7.5	89.5	87.5	91.7	90.2	91.0	89.5
10	90.2	88.5	91.7	90.2	91.0	89.5
15	91.0	89.5	92.4	91.0	91.7	90.2
20	91.0	89.5	93.0	91.7	91.7	90.2
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	93.6	92.4	93.0	91.7
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.4	94.5	94.5	93.6
100	94.1	93.0	95.4	94.5	95.0	94.1
125	95.0	94.1	95.4	94.5	95.0	94.1
150	95.0	94.1	95.8	95.0	95.8	95.0
200	95.4	94.5	96.2	95.4	95.8	95.0
250	95.8	95.0	96.2	95.4	95.8	95.0
300	95.8	95.0	96.2	95.4	95.8	95.0
350	95.8	95.0	96.2	95.4	95.8	95.0
400	95.8	95.0	96.2	95.4	95.8	95.0
450	95.8	95.0	96.2	95.4	95.8	95.0
500	95.8	95.0	96.2	95.4	95.8	95.0

Notes

1. Values included in the table above were taken from the NEMA Standards MG 1-2006.

PART 3 EXECUTION

3.01 GENERAL

- A. Install all motors in accordance with the manufacturer's printed recommendations and as required under the specific specification sections for the driven equipment.

3.02 INSTALLATION

- A. Motors shall be stored indoors in a clean, dry location with space heaters energized to preclude moisture buildup.
- B. Bolt the motor to the equipment or rigid foundation using bolts of the largest size permitted by the holes in the motor bracket. Do not install motors in such a way as to restrict motor ventilation.
- C. Motor enclosure type shall be used in the following locations unless otherwise specified in the technical specifications:
 - 1. WPFI: Indoor/Outdoor, severe rain and snow, dirty environment.
 - 2. TEFC: Indoor/Outdoor, wet, dirty or dusty environment.

3.03 FIELD QUALITY CONTROL

- A. Submit field test procedures for the Construction Manager's approval before testing begins. Test and submit test results for each motor.
- B. Field tests and inspections: Field testing shall be as specified in Section 16000.

END OF SECTION

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SECTION 16260

LOW VOLTAGE VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included:

1. Provide labor, equipment, supervision and materials for the installation, testing and start-up of the variable frequency drive(s) (VFD) as shown on the Drawings and as specified herein.
2. Provide a manufactures technician to start-up each VFD. The technician shall be present during the field acceptance testing.
3. Where VFD's are provided as part of a packaged system, the system supplier shall indicate that the motor is suitable for operation with a VFD.
4. The variable frequency drives will operate motors as specified in Division 11. The drives furnished shall be certified compatible and certified for operation with the motors to be supplied.

B. Related Sections:

1. Section 16000 – Common Work Results for Electrical
2. Section 16080 – Commissioning of Electrical Systems
3. Section 16221 – Low Voltage Motors

1.02 QUALITY ASSURANCE

- A. Variable frequency drives shall utilize a field proven design. The VFD manufacturer shall demonstrate at least three years of continuous field operating experience with equipment of similar size and design.
- B. A factory authorized service and parts organization shall be located within 150 miles of the project location. Provide the name and address of the factory authorized service and parts organization nearest to the project location at the time of the bid.
- C. Equipment shall be UL or ETL labeled.
- D. Manufacturer shall be ISO 9001 certified.

1.03 SUBMITTALS

A. Submit shop drawings and product data, in accordance with Section 01300, as follows:

1. Equipment outline drawings showing elevation, plan and interior views, front panel arrangement, dimensions, and weight.
2. Indicate all options, special features, ratings and deviations from the specifications.

3. Power and control schematics including external connections. Show wire and terminal numbers and color coding.
4. Network module data sheets. Include parameter list with recommended values to be monitored for diagnostic purposes.
5. Drive performance specifications.
6. Instruction and replacement parts books.
7. Certified shop test reports.
8. Field test and inspection reports.
9. Submit details of any input filters or other devices determined to be necessary to achieve the specified harmonic limits. Details shall include catalog cuts, dimensional information, and mounting requirements, conduit and wire sizing, and interconnection details.
10. Submit certification that the VFD's are compatible with the motors they will be operating.

B. Operations and Maintenance Manuals

1. Submit operations and maintenance manuals, in accordance with 01700, as follows:
 - a. Instruction, installation, and maintenance manuals for all components provided.
 - b. Software configuration manuals.
 - c. As-built drawings for the complete VFD assemblies.
 - d. Itemized list of spare parts furnished specifically for this project including quantities, part numbers, and descriptions.
 - e. Complete listing of drive configuration parameters and settings for each drive furnished.

1.04 MOTOR COMPATIBILITY

- A. The VFDs shall be coordinated with the motors supplied under this contract. Motors operated by VFD's shall be inverter duty rated as specified in Section 16220.

1.05 UNIT RESPONSIBILITY

- A. Unit responsibility for the VFDs in this section shall be as specified in Section XXXXX. The Contractor shall submit letters of certification with the shop drawings from the VFD manufacturer, the motor manufacturer, and the driven equipment manufacturer stating that they have reviewed each application and that the combination will satisfy the application duties required, for the actual motor sizes required, regardless of deviations from the scheduled "nominal horsepower."
- B. Where the pump system supplier is responsible for supplying the pump, motor and VFD as required in Division 11, the pump system supplier shall coordinate the VFD and motor and provide certification that the VFD and motor are compatible per the requirements as specified herein. Certification from the supplier shall state that they have reviewed each application and that the

combination will satisfy the application duties required, for the actual motor sizes required, regardless of deviations from the scheduled "nominal horsepower."

1.06 PERFORMANCE

- A. The VFDs shall be capable 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.
- B. The harmonics introduced by the VFD at the point of common coupling (PCC) shall meet the requirements of IEEE Std 519-2022 for General Systems. The Contractor shall provide the available short circuit value at the PCC.
- C. During power outage, the VFD shall cease output to the motor and, upon restoration of power supply, shall have the capability to restart, catch, and reaccelerate the spinning motor to its original speed without damaging the motor.
- D. The VFD shall start, accelerate, and operate the motor through the specified speed and load range with an input voltage variation of $\pm 10\%$ from nominal and an input frequency variation of $\pm 5\%$ from nominal.
- E. Unless otherwise specified, the power electronic system shall comply with the applicable emissions and immunity limits of IEC 61800-3-2004.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Package the equipment for maximum protection during delivery and storage.
- B. Store the equipment indoors in a clean, dry, heated storage facility until ready for installation. Do not install the equipment in its final location until the facilities are permanently weather tight. Furnish, install and wire temporary electric space heaters in the equipment until the permanent heating equipment is operational. Protect the equipment at all times from exposure to moisture and chemicals.

1.08 REFERENCE STANDARDS

- A. IEEE Standard 519 (2022) - "IEEE Standard for Harmonic Control in Electric Power Systems."
- B. National Electrical Code (NFPA 70) latest edition.
- C. Underwriters Laboratories (UL)
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.09 PROJECT/SITE REQUIREMENTS

- A. The VFD shall not produce motor noise in excess of the manufacturers published noise standards for 60-Hz operation.
- B. The VFD shall be capable of continuous operation in an ambient temperature range between 0°C and 40°C .

1.10 SPARE PARTS

- A. Provide the following spare parts for each size drive in the quantities specified:
 - 1. One of each type printed circuit board.
 - 2. Two power diodes.
 - 3. One pair power semiconductor modules (e.g., transistors, SCRs)
 - 4. 50 percent replacement fuses, all types and sizes.
 - 5. One operator interface module.
 - 6. Two replacement LEDs for pilot lights of each color and type.
- B. Spare parts shall be boxed or packaged for long term storage. Identify each item with manufacturers name, description and part number on the exterior of the package.

1.11 MANUFACTURER'S FIELD SERVICES

- A. The Manufacturer shall furnish a service representative for the equipment and materials furnished under these specifications. The service representative shall be technically competent, factory trained, experienced in the installation and operation of the equipment, and authorized by the manufacturer to perform the work stipulated.
- B. Each service representative shall be a direct employee of the manufacturer of the respective item of equipment.
- C. The service representative shall provide such services and assistance as is required for the proper installation, testing, and operation of each item of equipment to include but not be limited to:
 - 1. Service considered by the manufacturer as a condition to providing the warranties and guarantees specified herein.
 - 2. Service required to correct design and manufacturing errors.
 - 3. Service required to aid the Contractor during installation of the equipment.
 - 4. Equipment inspection and testing after installation and changes or adjustments required to assure proper operation.
- D. Signed service reports verifying the tests and work performed, errors corrected, and the state of the equipment readiness at the time of inspection shall be submitted to the District upon completion of any service representative's visit to an erection site. The reports may be in letter form or on special forms furnished by the equipment manufacturer.
- E. The bid shall include all costs of service representatives, including overtime work, to provide the services specified herein.
- F. The bid shall include the following number of person-days for the services under (C) and (D) above, travel time and expenses excluded:

Person-Days	Manufacturer's Service
1	Installation assistance, field corrections.
1	Inspection, adjustments, testing and startup.
1	Certification and test reports.

1.12 WARRANTY SERVICE

- A. Warranty to commence 12 months from the date of start-up, not to exceed 18 months from the date of shipment.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURES

- A. Manufactures: Subject to compliance with these specifications, the typical equipment, systems and accessories installed shall be manufactured by:

1. Allen Bradley, PowerFlex 755
2. ABB, ACS880
3. Approved equal

2.02 RATING

- A. Service Conditions

1. Input power: 460 VAC, ± 10 percent, 3 phase, 60 Hz.
2. The VFD shall have a continuous output current rating equal to or greater than the motor full load nameplate current.
3. Input frequency: $\pm 5\%$
4. Ambient temperature: 0 degrees C to [40][50] degrees C.
5. Elevation: Up to 3300 feet above mean sea level.
6. Relative humidity: Up to 90% non-condensing.

- B. Minimum drive efficiency: 95% or better at full load.

- C. Displacement power factor: .95 or higher throughout the entire speed range, measured at drive input terminals.

- D. Drive output: 100 percent rated current continuous, suitable for operation of the driven equipment over the required speed range without overloading. Drives shall be capable of a continuous overload up to 110 percent rated current for 60 seconds for variable torque loads and 150 percent rated current for constant torque loads. Starting torque shall be matched to the load.

- E. Output frequency drift: No more than plus or minus 0.5 percent from setpoint.

- F. Drives shall withstand five cycle transient voltage dips of up to 15 percent of rated voltage without an undervoltage trip or fault shutdown, while operating a variable torque load.

2.03 CONSTRUCTION

A. General

1. The VFDs shall be 6 pulse technology with additional elements if required to reduce the harmonic current to meet IEEE Standard 519 criteria at the input terminal of the drive. The VFD's shall utilize a digital pulse width modulated (PWM) design to convert the fixed AC input to a variable voltage, variable frequency AC output.
2. 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 voltage distortion and commutation notches up to 36,500 volt microseconds, or when other VFD's are operating from the same bus. The drive shall include transient voltage suppression to allow reliable operation on a typical commercial power distribution system.
3. The VFD shall consist of a full-wave diode bridge converter to convert incoming fixed voltage/frequency to a fixed DC voltage. Provide a DC link choke smoothing reactor to limit fault throughput.
4. 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 65 kAIC.
5. The VFD shall have an output voltage regulator to maintain correct output Volt/Hertz despite incoming voltage variations. The VFD shall be 6 pulse with additional elements if required to reduce the harmonic current to meet IEEE Standard 519 criteria at the input terminal of the drive.
6. The enclosure shall be metal, free standing, front maintenance type with top or bottom conduit entry for power, control, and motor cables. The enclosure shall be NEMA 12 gasketed and filtered and include a thermostatically controlled space heater.
7. The VFD shall include a molded case circuit 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.
8. The VFD enclosure shall include fans and a thermostat to maintain the internal temperature of the drive unit based on ambient temperature limits.

B. Operator interface

1. Provide a door-mounted digital keypad/display, capable of controlling the drive and setting drive parameters. The digital display shall normally display:
 - a. Speed demand in percent
 - b. Output current in amperes

- c. Frequency in Hertz
 - d. Control mode - manual or automatic
- 2. The digital keypad shall allow operators to enter exact numerical settings in English engineering units. A user menu shall be provided as a guide to parameter settings. Coded messages on keypad will not be acceptable. Parameters are to be factory set in EEPROM and resettable in the field. Parameters shall be password protected. The EEPROM stored variables shall be transferable to new and spare boards.
- 3. The keypad/display module shall have a key switch to control operation of the keypad. The key shall be removable in either the "Enabled" or "Disabled" positions. The keypad module shall contain a "self-test" software program that can be activated to verify proper keypad operation. The keypad display shall contain a full alphanumeric character set.
- 4. At a minimum the following controls and indicators shall be provided, either separately or as part of the keypad/display:
 - a. POWER ON, RUN AND FAULT indication.
 - b. FAULT RESET control.
 - c. LOCAL-OFF-REMOTE or HAND-OFF-AUTO control mode selector as shown on the Drawings
 - d. Manual START/STOP controls.
 - e. Manual speed adjust capability.
- C. Auxiliary Contacts
 - 1. Provide two set(s) of Form C auxiliary dry contacts for remote indication of VFD running status.
 - 2. Provide two set(s) of Form C auxiliary dry contacts for remote indication of VFD fault.
- D. Auxiliary Power: Provide 120 VAC auxiliary power on drive terminal strips for use in powering auxiliary control devices.

2.04 PROTECTIVE AND OPERATIONAL FEATURES

- A. Make provisions for field adjustment of the following parameters through the keypad/display:
 - 1. Current limit and boost.
 - 2. Voltage (Volts/Hertz.)
 - 3. Frequency (Minimum and Maximum)
 - 4. Independently adjustable acceleration and deceleration rates.
 - 5. Auto restart delay.

6. Up to five critical bands where drive operation is inhibited.
- B. Provide means for remote dry contact closure to start and stop the drive(s) with the drive control system in the REMOTE or AUTO mode.
- C. Provide means to accept a 4-20 mA DC input signal for remote speed control. Input shall be isolated at the drive and active with the drive control system in the AUTO mode. Zero and span adjustability shall be provided.
- D. Provide a 4-20 mA DC isolated output signal proportional to speed for remote speed indication.
- E. Provide minimum 3% input line reactor incorporated into the drive enclosure.
- F. Provide the following short circuit and input protective features.
 1. Input circuit breaker.
 2. Solid state instantaneous overcurrent trip.
 3. Undervoltage protection with automatic restart.
 4. Ground fault protection.
- G. Provide the following internal protective features.
 1. Transient surge protection.
 2. Overcurrent protection.
 3. Current limit, inverse time type.
 4. DC bus fuse protection and discharge circuit.
 5. DC bus overvoltage trip.
- H. Provide the following output protective features.
 1. Inverse time motor overload protection.
- I. Harmonic and Radio Noise Mitigation
 1. Provide EMI/RFI filters to limit radio frequency noise in excess of the limits specified by FCC Docket 20780 (Part 15, Subpart J) or if the drives create noise in a frequency range which will interfere with other sensitive equipment at the installation (such as lighting systems, telecommunications systems, instrumentation and monitoring equipment).

2.05 DIAGNOSTIC AND FAULT CAPABILITY

- A. The following conditions shall cause an orderly drive shutdown and lockout.
 1. Incorrect phase sequence.
 2. Blown input fuse or single phasing of supply.

3. Control power supply failure.
 4. Instantaneous overcurrent.
 5. Sustained overload.
 6. Transistor overcurrent.
- B. Provide complete built-in diagnostic and test capability to enable maintenance personnel to rapidly and accurately identify the cause of equipment failure.

2.06 COMMUNICATIONS

- A. Provide network module for communicating data to the plant SCADA system via Modbus TCP, Ethernet/IP, Ethernet TCP/IP or similar..
- B. Provisions for plugging in a laptop for configuration of the VFD for communication shall be included.

2.07 SURFACE PREPARATION AND SHOP COATINGS

- A. All non-current carrying metal parts of the equipment cabinet shall be cleaned of all weld spatter and other foreign material and given a heat cured, phosphatized chemical pre-treatment to inhibit rust.
- B. Unpainted non-current carrying parts shall receive a protective zinc plating to prevent corrosion. Printed circuit boards shall be coated with a protective conformal epoxy. All device contacts shall be silver cadmium plated.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install the equipment in accordance with the manufacturer's instructions.

3.02 FACTORY QUALITY CONTROL

- A. Provide manufactures standard factory test.

3.03 FIELD QUALITY CONTROL

- A. The Contractor shall provide acceptance testing of the VFD's per NETA guidelines for VFD's and per the requirements of Section 16080.
- B. Where VFD's are part of a mechanical system package, the manufactures representative shall coordinate the acceptance test with the Contractor.

3.04 ADJUSTMENT

- A. Make all VFD internal adjustments and all adjustments necessary for manual and automatic operation of the entire system of driven equipment.

3.05 CLEANING

- A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

3.06 TRAINING

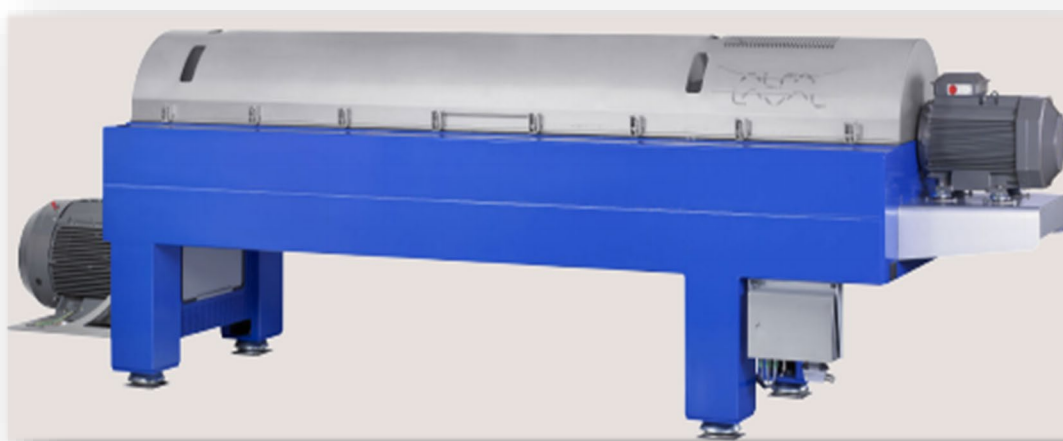
- A. Training shall be in accordance with Section 01715.
- B. The Contractor shall provide a minimum of two (2) training session each a minimum of 4 hours duration scheduled during normal workdays. Training location to be determined by the Olivenhain Municipal Water District. Training and instruction time shall be in addition to that required for start-up service and shall be included in the bid price.
- C. The manufacturer's qualified representative shall conduct the training.
- D. The training program shall consist of the following:
 - 1. Instructions on the proper operation of the equipment.
 - 2. Instructions on the proper maintenance of the equipment including drive configuration, diagnostics, and troubleshooting.

END OF SECTION

Appendix A
Alfa Laval Equipment Details and Quote
(Bid Item #4)

Project Name: Olivenhain; ALDEC-45

ALDEC 45 Decanter Centrifuge for Sludge Dewatering



Alfa Laval Reference No. 0115747 R6

September 26, 2023

Quote Validity: Through 12/31/23

Prepared by:

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San Diego, CA 92130



Date: September 26, 2023

PROJECT NAME
ALFA LAVAL REFERENCE

Olivenhain WTP
0115747 R6

Dear Ms. Ghiu,

Thank you for your enquiry. On behalf of Alfa Laval and our local representative The Coombs-Hopkins Company, we are pleased to enclose our firm quotation for One (1) ALDEC 45 Decanter Centrifuge for the Olivenhain WTP project for dewatering of the plant sludge.

As part of Alfa Laval's dedication to continuous innovation, the ALDEC Decanter Centrifuge is the industry benchmark for dewatering and thickening in wastewater treatment. In summary...

- **ALDEC decanters deliver greater operational efficiency**, allowing for increased sludge treating capacity or dryer sludge cake for reducing sludge disposal costs.
- **Lowest energy consumption**, with optimized motors & drives, delivering the lowest installed power and energy consumption.
- **Low maintenance costs**, with reduced planned maintenance and easily replaceable wear parts.

Alfa Laval offers unrivalled **24-hour service agreements**, placing your needs as close as a phone call away! Our certified field service engineers are available for installation, commissioning, maintenance, repairs, and process optimization. Additionally, Alfa Laval provides original equipment manufacturer (OEM) parts direct from our US Distribution Center in Indianapolis.

As requested, we have included the scope of supply and applicable process guarantees based on the defined influent sludge parameters. Technical details along with dimensional drawing for the proposed centrifuge including weights, bowl diameter, speed, installed power, and G-Force are enclosed in the proposal.

Alfa Laval recommends the described equipment per the outlined technical specifications, and additional clarifications for greater understanding of the offer. We trust that we have interpreted your requirements correctly and shall be pleased to provide any additional information which may be required in support of our proposal.

Note: Kindly indicate our Quotation Reference in your Purchase Order/ Letter of Acceptance/ Sales Contract and all our correspondences if the order is confirmed to us.

Best Regards,
Marc Perratore

Marc Perratore
Regional Sales Manager
Alfa Laval Food & Water Division

Cc: Jeremy Neil / Coombs-Hopkins <Jeremy@chcwater.com>

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8. SERVICE
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1. BASIS OF DESIGN.

General Data

Sludge Origin:	Water Treatment Plant
Sludge Type:	ACH Sludge
Duty:	Dewatering

Sizing Data

Operating Times

Days per Week:	TBD
Hours per Day:	TBD

Capacity per Unit

Hydraulic (gpm):	*Hydraulic loading will meet that of existing machine
Solids (lbs./hr.):	*Solids loading shall meet that of existing machine

Number of units

Operating:	1
Standby:	0

Feed Solids

Range (%):	1-2
Design (%):	1-2

Polymer Consumption:

Estimated Dosage (lbs./dT):	*Estimated dosage shall meet that of the existing machine
-----------------------------	---

Decanter Performance

Cake Solids (%):	*Cake solids shall meet the performance of the existing machine
Expected Recovery (%)	95

Other Parameters

Bowl Diameter (in)	14 (Nominal)
Maximum Bowl Speed (rpm)	4,200
Installed Power (HP)	50
G-Force (x g)	3,550

2. PROPOSAL

- **One (1) ALDEC 45 Centrifuge** will come complete and include the following scope of supply:
 - Modular frame with process-contact areas in 316 SS
 - Vibration isolators
 - Singular cover in 316 SS (covers belts, rotating assembly and gearbox). Hinged.
 - Abrasion protection (Tungsten Carbide on wear surfaces)
 - Rotating assembly complete with 2.5 kNm Planetary gearbox and pillow block bearings
 - All bearings grease lubricated
 - Vibration and temperature sensors in main bearing housings
 - Main drive Motor: 40 Hp AC VFD
 - Back drive Motor: 7.5 Hp AC VFD
 - PLC: Allen Bradley CompactLogix
 - HMI: Allen Bradley – 10 inch
 - Main Drive VFD: ABB ACS880
 - Back drive VFD: ABB ACS880
 - Control of centrifuge during power loss or outage
 - Flexible connectors
 - Solids offset chute; metal chute to approximately match existing
 - Centrate discharge chute
 - Solids diverter gate, gate supports
 - Diverter gate piping, piping supports
 - High speed flush MOV
 - Low speed flush MOV
 - Diverter gate MOV
 - Factory Paint System
 - One (1) set required lubricants
 - One (1) set of required spares
 - One (1) set of required tools for maintenance
- **One (1) Free-standing Centrifuge MCC Panel (for new ALDEC-45 unit)**, complete with the following:
 - Panel Configuration: NEMA 4X 72"Hx36"Wx18"D HMI/PLC with fan covers.
 - Allen Bradley CompactLogix 5069-L320ER PLC
 - 10 inch Allen Bradley PV7+ Performance HMI
 - AnyBus Bolt WAP (WiFi Access Point) for control on iOS and Android devices
 - 1734 Point I/O Modules
 - Dual Bearing Vibration Monitoring
 - Configured for Direct Drive Gearbox
 - Panel Input Power 120 VAC, 50/60 Hz
 - 24 VDC Control with UPS
 - UL-508A Standards with UL Label & Certificate
 - SCADA Integration to Allen Bradley/ Rockwell System using TC/IP
 - Gateway Dell E3002- Remote Support and Monitoring w/1 year Data Subscription
 - No AutoLube/Grease System
 - Feed Control for Valves (4-20mA)
 - Diverter gate/ Conveyor Control Configured
 - Configured with 120 VAC Control for HS and LS Flush Valves



- **One (1) Free-standing VFD Panel (for new ALDEC-45 unit),** complete with the following:
 - Panel Configuration: NEMA 4X 72"H x 36"W x 18"D VFD Panel with Air-Conditioner
 - Panel Input Power 380-480 VAC 3ph, 50/60 Hz
 - ABB ACS 880 VFDs: Main Drive 50 HP (6-pulse), Back Drive 10 HP (6-pulse)
- **One (1) Free-standing Centrifuge MCC Panel (for existing ALDEC-406 unit),** complete with the following:
 - Panel Configuration: NEMA 4X 72"Hx36"Wx18"D HMI/PLC with fan covers.
 - Allen Bradley CompactLogix 5069-L320ER PLC
 - 10 inch Allen Bradley PV7+ Performance HMI
 - AnyBus Bolt WAP (WiFi Access Point) for control on iOS and Android devices
 - 1734 Point I/O Modules
 - Dual Bearing Vibration Monitoring
 - Configured for Direct Drive Gearbox
 - Panel Input Power 120 VAC, 50/60 Hz
 - 24 VDC Control with UPS
 - UL-508A Standards with UL Label & Certificate
 - SCADA Integration to Allen Bradley/ Rockwell System using TC/IP
 - Gateway Dell E3002- Remote Support and Monitoring w/1 year Data Subscription
 - No AutoLube/Grease System
 - Feed Control for Valves (4-20mA)
 - Diverter gate /Conveyor Control Configured
 - Configured with 120 VAC Control for HS and LS Flush Valves
- **One (1) Free-standing VFD Panel (for existing ALDEC-406 unit),** complete with the following:
 - Panel Configuration: NEMA 4X 72"H x 36"W x 18"D VFD Panel with Air-Conditioner
 - Panel Input Power 380-480 VAC 3ph, 50/60 Hz
 - ABB ACS 880 VFDs: Main Drive 50 HP (6-pulse), Back Drive 10 HP (6-pulse)
- **One (1) ALDEC-406 Diverter Gate and Diverter Gate Piping (for existing ALDEC-406 unit),** complete with the following:
 - Solids Diverter Gate, 316SS; 115VAC Linear Actuator, 24DVC Position Sensors, 6" Pipe Coupling, 316SS; Nameplate, Caution Labels, 316SS Fasteners
 - 115VAC Electric actuator with limit switches and position feedback relays
 - Diverter Gate Interconnect Piping, 316SS; 6" Sch10 Weld Pipe & Fittings, 150# Plate Flange Outlet, 316SS Fasteners
 - Diverter Gate & Piping Supports, 304SS; Anchors are NOT Included
 - Diverter Gate Flush; 1/2" 316SS Ball Valve with 120V Quarter Turn Actuator Modulating Service and Local Controls are NOT Included. Shipped Loose, Supports are NOT Included
- **Service time as follows:**
 - One (1) Field Service Engineer,
 - up to thirteen (13) days, @ 10 hr./day, with up to three (3) round trips, for start-up, commissioning, and training.



- Any additional service time resulting from non- Alfa Laval -warranty delays, will be charged at the rate in effect at the time of service.
- **Also included with pricing:**
 - Warranty: Per the enclosed Alfa Laval's Standard Terms & Condition of Sale. Alfa Laval reserves the right to review operating and maintenance records to ensure compliance. Each unit is warranted to be free from defects in materials and workmanship for a period of **twenty-four (24) months** after successful completion of Acceptance Testing, beneficial use, or for a period not to exceed thirty months from delivery, whichever occurs first. Alfa Laval reserves the right to review operating and maintenance records to ensure compliance.
 - We are offering this DDP Jobsite
 - Electronic Submittal and O&M Manual
- **The water supply available at each unit shall be as follows:**
 - Bowl Flushing: 25 gpm up to the feed rate @ max 45 psi
 - CIP Flushing 13 gpm @ max 45 psi
 - Temperature: Ambient (40 - 90 F)
- **Cake capacity during a power loss condition for each centrifuge:**
 - 3.3 cu ft/0.12 cu yd
- **Dimensioned drawing:** See Appendix A
- **Notes of Clarification**
 - Scope of supply is per Alfa Laval standard centrifuge configuration, and in accordance with typical specifications and drawings. Any additional items not explicitly stated in this proposal or standard to Alfa Laval's typical specifications are not included in this quotation. The specified equipment is intended for installation within a non-hazardous safe area.
 - Equipment to be supplied by Alfa Laval (and /or sub-supplier), as specified in this quotation, are standard machines. Any modifications / additions other than those expressly specified in the quotation shall incur extra engineering cost, material cost and delivery time.
 - Technical submittal documentation shall be per Alfa Laval's (and /or sub-supplier) standards, delivered electronically, in English language. Additional documentation requirements shall incur extra engineering cost, material cost and delivery time.
 - The enclosed quotation is a firm quotation. All scope of supply modifications / additions requires prior agreement by both parties and written acknowledgement by Alfa Laval.
- **Escalation Charges:**

- In the event that delivery of equipment cannot be made on the scheduled delivery date agreed upon between Alfa Laval and Purchaser and as evidenced by the terms of the contract, due to Purchaser delay, Alfa Laval reserves the right to assess reasonable escalation charges to the project at the rate of 1% per month of the contract value for material price escalation for each month that the project is delayed.
- Given the current volatility in steel prices over the past twelve months, Alfa Laval has made this offer based upon shipment of the offered products contained herein within the schedule dictated above. Should the projected shipment schedule fall outside this period for any reason, pricing shall be subject to review and revision.
- **Exclusions from this quotation:**
 - All mechanical & electrical Installation
 - Equipment offloading and placement
 - Field wiring, conduit, and electrical flexible connections...etc.; contractor shall remain responsible for meeting all relevant electrical codes
 - Pipes, valves, and fittings...etc.
 - Anchor bolts are supplied by others
 - Anchor bolt seismic calculation
 - Associated equipment, i.e., sludge macerators, feed pumps, polymer preparation & dosing unit, cake conveyors, centrate tanks and pumps...etc.
 - Measuring instruments between equipment and associated equipment
 - Noise abatement enclosures
 - Odor control equipment
 - Inspection and access platforms or ladders
 - Utilities and consumables (polymer, power, water, and other consumables required during testing, startup, and commissioning)
 - Lab services for the performance test and startup
 - Solids splash guard and flexible connection for existing ALDEC 406
 - Storage and handling fees
 - Detailed or project specific related engineering
 - Duties, taxes, bonds...etc.
- **Process performance is per specified basis of design.**
 - The decanter performance (cake solids, loading, hydraulic throughput, etc.) is verified through onsite analysis of representative sampling during equipment commissioning. Variation of sludge feed may impact performance.

3. COMMERCIAL TERMS

- **Pricing**

Item	Description	Qty.	Unit Price	Extended Price
1	ALDEC 45	1	Included	Included
2	Set of Controls for ALDEC-45	1	Included	Included
3	Set of Ancillaries for ALDEC-45	1	Included	Included
6	Set of Controls for ALDEC-406	1	Included	Included
7	ALDEC-406 Diverter Gate	1	Included	Included
4	Commissioning	1	Included	Included
5	DDP Jobsite	1	Included	Included
6	One (1) year Extended Warranty	1	Included	Included
Total Sales Price				\$ 593,489.00

- **Payment Terms**

- 15% upon approval of submittals, N30 days
- 70% upon delivery or availability to deliver should owner encounter delays, N30 days
- 15% upon acceptance or beneficial use, whichever comes first, N30 days, but not later than 120 days from shipment.

- **Estimated Delivery Time**

- Submittals: 8 -12 weeks from fully executed PO
- Centrifuge: 28 - 32 weeks from receipt of approved submittals and/or release to manufacture

- **Quotation validity**

- 30 days

4. ALFA LAVAL

- **About us**

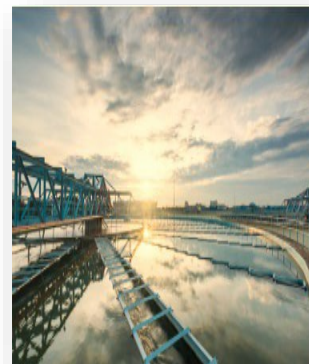
Alfa Laval is a leading global provider of separation, heat transfer, and fluid handling technology. Founded in 1883 and for more than 130 years, we have built a global presence with service centers and partners in nearly 100 countries. This offers local expertise, supported by the global breadth and depth of Alfa Laval. With these as its base, Alfa Laval aims to help enhance the productivity and competitiveness of its customers in various industries all over the world. [Alfa Laval – Our Company.](#)



- **Wastewater Separation Technologies**

Alfa Laval has been manufacturing Municipal Water and Wastewater sludge thickeners for almost 20 years. We remain committed to being the technology leader in design innovations, delivering reduced power & polymer consumption, increased cake dryness, and increased capacity within the same footprint. [Alfa Laval - Municipal wastewater treatment](#)

- Decanter Centrifuge
- Belt Filter Press
- Gravity Belt Thickener
- Rotary Drum Thickener
- Plate & Frame Press
- Tertiary Water Filtration
- SBR / MBR / Pkg. Plants



- **Lab & Pilot Testing**

Alfa Laval's DNA is to continuously bring value to our customers. Our state-of-the-art wastewater laboratory, located in the Houston, TX service center; allows Alfa Laval to analyze the optimal technology for your specific separation requirements. Additionally, Alfa Laval provides separation equipment available for on-site field testing and demonstration. These include decanter centrifuge, rotary drum filter, and belt press.



- **Always at Your Service:**

- 24/7 Support
- 75+ Authorized Service Providers
- 4 - USA Service Centers -
- Indianapolis US Parts Distribution Center
- OEM Parts – 450,000+ Spare Parts in Stock
- 50+ Field Technicians

[Alfa Laval - Service and support in the USA](#)



- **Spare Parts**

- **A smart choice**

Boost productivity and maximize uptime with quality genuine parts from Alfa Laval. With easy access to a broad range of long-lasting high-quality parts, you can lower your total cost of ownership and preserves the value of your equipment throughout its entire life cycle.



- **Available everywhere**

Through our global service network, you have easy access to our extensive genuine spare parts inventory through 11 major Alfa Laval distribution centers.

Alfa Laval maintains an extensive inventory of spare parts that supports our current product range as well as some legacy parts, which are up to 100 years old. Our parts inventory system contains specific information, such as technical details and availability, for more than 450,000 parts, and we have more than 50,000 unique items in stock.

The Americas are conveniently served through the American Distribution Center (AMDC), which is centrally located in Greenwood, IN, USA.

Alfa Laval AMDC
200 South Park Blvd
Greenwood, IN 46143

- **Unmatched quality**

Designed for durability, reliability and productivity, our parts deliver outstanding performance time and time again. Manufactured to precise specifications, Alfa Laval parts have proven performance in our material and test laboratories as well as in process lines around the world.

- **Traceability and certification**

Parts are continuously improved to meet the highest standards and comply with various certification requirements and regulations, such as REACH. [Alfa Laval - Spare parts](#)

5. ALDEC DECANter CENTRIFUGE: GENERAL DESCRIPTION

See how it work in less than 2 min [Decanter Animation Dewatering](#)

The ALDEC Decanter Centrifuge is an open, non-pressured horizontal decanter centrifuge. It features a solid horizontal bowl and scroll type conveyor, with counter current flow design. The centrifuge is designed and built to operate continuously at a maximum g-force. All parts of the centrifuge in contact with the process material are made of type Duplex stainless steel or AISI 316 stainless steel except O-rings, seals, feed tube and abrasion resistant materials. Process seals and other O-rings and seals are made of nitrile rubber, unless otherwise specified. The feed tube is fabricated from AISI 316 stainless steel. [Alfa Laval - ALDEC](#)

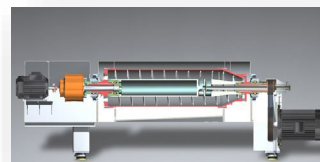
• Process Optimization

The decanter centrifuge can be adjusted to suit individual requirements by varying:

- bowl speed — to ensure the best G force required for optimized separation,
- conveying speed — for optimized balance between liquid clarity and solids discharge capacity,
- pond depth in the bowl — for optimized balance between liquid clarity, solids dryness, and inter-phase setting between heavy and light liquid phases, and
- feed flow — Alfa Laval decanter centrifuges are designed to deal with a wide range of flow rates.

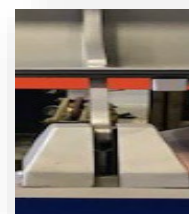
• Frame and Casing Assembly

- The frame and casing are a box beam profile type with integral casing with or without hinges.
- The material of the casing and cover is AISI 316 stainless steel.
- The inside surface of the casing consists of stainless-steel liners in the discharge areas and a painted surface in the neutral compartment.
- Casing gaskets are of nitrile rubber. The material of the frame is painted mild steel.
- The cover is bolted in place



• OPTIONAL: Hinged Cover

- Spring loaded hinges for ease of opening during maintenance or inspection (spring loading prevents cover from closing on its own).
- These can be located on the left or right side.
- The hinged cover provides the operator easy access without the requirement of overhead crane and additional manpower for routine inspections and maintenance.



- **Bowl Assembly**

- Material: centrifugally cast duplex stainless steel, AISI 304 or AISI 316.
- End-hubs: centrifugally cast duplex stainless steel.
- All surfaces are examined for cracks, shrinkage, porosity, or other defects.
- The pool depth adjustable using plate dams at the large diameter end of the bowl.

- **360-degree solids outlet**

To ensure a smooth discharge of solids from the decanter, Alfa Laval has invented a so called 360-degree solids outlet. That ensures a trouble-free discharge of solids, free of edges and corners that either can cause wear or potentially block up the outlet zone.

It is of utmost importance that the solids can leave the decanter bowl in a smooth and continuous way.

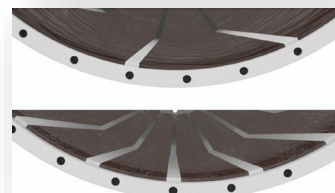
When looking for solutions to treat a large number of heavy solids, the 360-degree solids outlet design is the correct answer to this challenge. Optionally, wear liners are fitted for extra protection.



- **Transport aids — ribs on the bowl inside**

Ribs inside the bowl are present for two purposes:

- To create friction for conveying the solids by the conveyor.
- To add a wear protection to the inner bowl wall.
- The wear prevention on the bowl wall is done a bit like the protection on the conveyor – by adding an exchangeable material layer. Several ribs in stainless steel are welded on the inner side of the bowl in the full length. In some models, we even apply a larger number of ribs for better friction effect and upgraded wear protection.
- The conveyor does not touch the ribs and a layer of solids is formed over the ribs on the inner side of the bowl. That layer is not moved or scraped to the front so there is no scrolling wear on the inner side of the bowl. If any wear is seen, it will be on the upper side of the ribs, and they can be changed when worn.



- **Conveyor Assembly**

- Material: AISI 316 stainless steel.
- Feed zone of a high-capacity design.
- Flights:

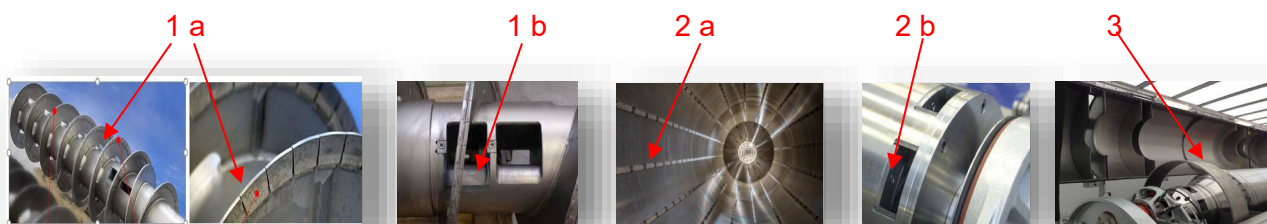
- **Windowed quasi-axial.**

- **Material**

- Tiles-length: duplex stainless steel.
- Remaining section: AISI 316.

- **Wear Protection**

- Conveyor
 - a. Flights: With a series of welded-on sintered tungsten carbide (TC) tile assemblies and from two wraps beyond the feed zone through the solids discharge end, and with flame sprayed tungsten carbide (TC) for the remaining section.
 - b. Feed zone wear liner.
- Bowl:
 - c. Stainless steel strips to secure against abrasion.
 - d. Solids discharge ports: field replaceable (TC) wear saddles, with 360° solids discharge to avoid blocking.
- Replaceable stainless steel or urethane insert is available on certain decanters to protect the solids discharge casing.

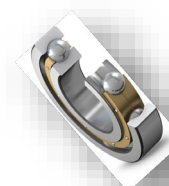


- **Gearbox**

- Alfa Laval provides a proprietary multi-stage planetary or direct drive gearbox.
- The gearbox controls the differential speed and torque between the centrifuge bowl and conveyor.
- Equipped with self-contained oil lubrication.

- **Bearings**

- Alfa Laval decanters have standardized grease lubricated bearings.
- These highly reliable bearings provide easier maintenance, greater reliability and lower power consumption.



- **Lubrication**

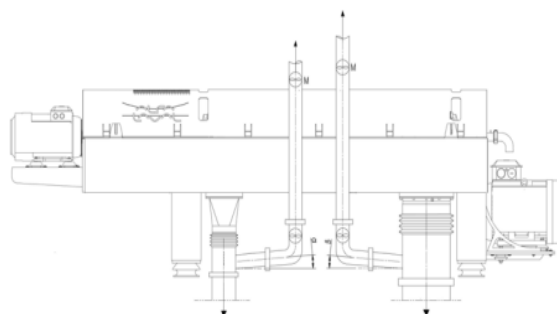
- Alfa Laval decanters have standardized grease lubricated bearings. For over a decade these highly reliable bearings provide easier maintenance, greater reliability, and lower power consumption

- **Centrifuge Electrical Equipment**

- Vibration Sensors
- Bearing Temperature Sensors
- Speed Sensors
- Main and Back drive motor thermistors/thermostats/RDT
- Cover Switch

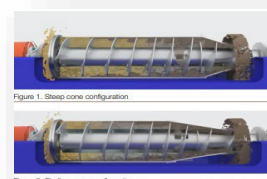
- **Other Requirements**

- **Venting:** Venting of outlets reduces the pressure impact created by air suction from the bowl rotation. Alleviating this small pressure inside the casing reduces the possibility of bearing contamination, as well as excess bowl wear.



- **Other Features**

- **Bowl configuration:** Baffle disc provides higher processing capacity and drier cake solids.
- **Cone configuration:** Steep or shallow cone configuration for optimum separation of any type of slurry.
- **Safety Features:** Cover Switch: Cover switch protection, to prevent the operation or shut down of the system if the cover switch is activated. E-Stop: Emergency Stop button to shut the system down.



6. CHUTES AND FLEXIBLE CONNECTORS

a. Feed Flexible Connector

- 150# ANSI flange with suction discharge hose and 24" long.

b. Polymer Flexible Connector

- PTFE Lined SS braided, 24" long with crimped fittings.

c. Solids Discharge Flexible Connector

- 8" Tall rubber boot, flanged top & bottom, including 2 sets of Backer bar frames, and 304SS fasteners.

d. Solids Discharge Chute

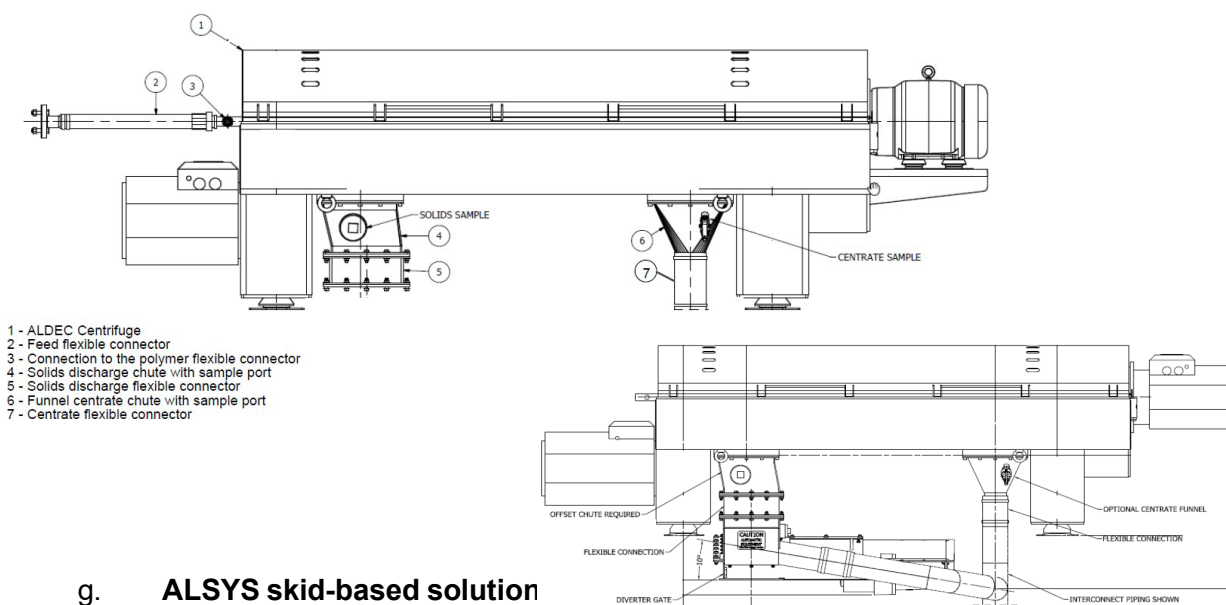
- Flange gasket, 2 1/2" sample port with plug, and 304SS fastener. Flanged chute top & bottom.

e. Centrate Discharge Funnel

- Flange gasket, top flange to match centrifuge outlet, transition to 4" OD for hose connection. 1/2" Valved sample port, 4" 125# plate flange with a 12" long discharge hose and 304SS fastener.

f. Diverter Gate (Optional)

- The diverter/slide gate is of the knife/gate type with an electric actuator, limit switches and position feedback relays specifically designed for diverting liquid flow, as specified and/or wastewater sludge. 110V Linear actuator, 2" inspection port, 24VDC position sensors, 4" pipe coupling, 1/2" flush nozzle, 316SS nameplate and caution labels. Diverter piping: 4" Sch40 welded piping, 4" 125# plate flange.



g. ALSYS skid-based solution

The ALSYS module is a compact, reliable and efficient solution for reducing the liquid content of sludge. It is specially configured for dewatering many of the sludge types normally encountered in industry and in smaller-scale municipal and potable water treatment plants.

It is a self-contained system that includes all the equipment required for on-site dewatering. This includes a progressing cavity feed pump, flow meters, polymer dosing pump and all the necessary piping and valves, along with a screw conveyor for the dewatered sludge.

- Plug-and-play” design that ensures rapid, easy installation on site
- Compact layout reduces floor space requirements and ensures easy maintenance
- Automatic operation does away with the need for continuous attendance
- Factory-tested modular construction paves the way for rapid commissioning by Alfa Laval field service personnel.

The ALSYS module is based on the ALDEC / ALDEC G3 decanter centrifuge and is available with Alfa Laval Decanter Connect System (DCS) technology, designed to make both installation and operation more efficient, simple and cheap. The very efficient DCS ensures trouble-free operation, with excellent levels of safety built in.



7. ELECTRICAL ASSEMBLY AND CONTROLS

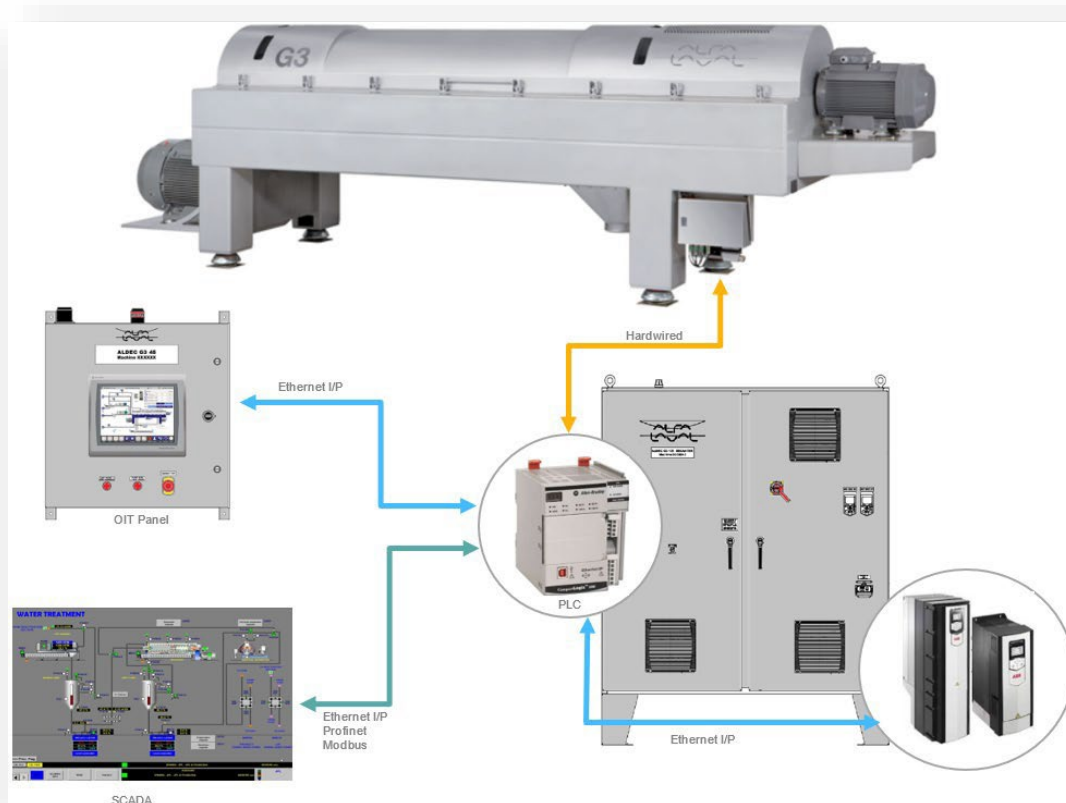
a. Electrical Assembly

- Main-drive motor: see section 2.1
- Back-drive motor: see section 2.1
- The selected main-drive motor and the back-drive motor are both VFD control, 460 Volt, 60 Hz, 3 phase power supply.

b. Controls

- Alfa Laval's standard design: Alfa Laval's Decanter Connect Control Package
- Regulation of the conveying torque or differential speed between the conveyor and the bowl via the VFD-controlled back-drive motor
- Control of associated equipment (e.g. sludge macerator, sludge feed pump, diverter-gate, cake-conveyor, flushing valve, etc., starter-panels of these to be provided by others).
- Centrifuge vibration sensor control and PT 100 for main bearings temperature control are incorporated for added safety of the machine.

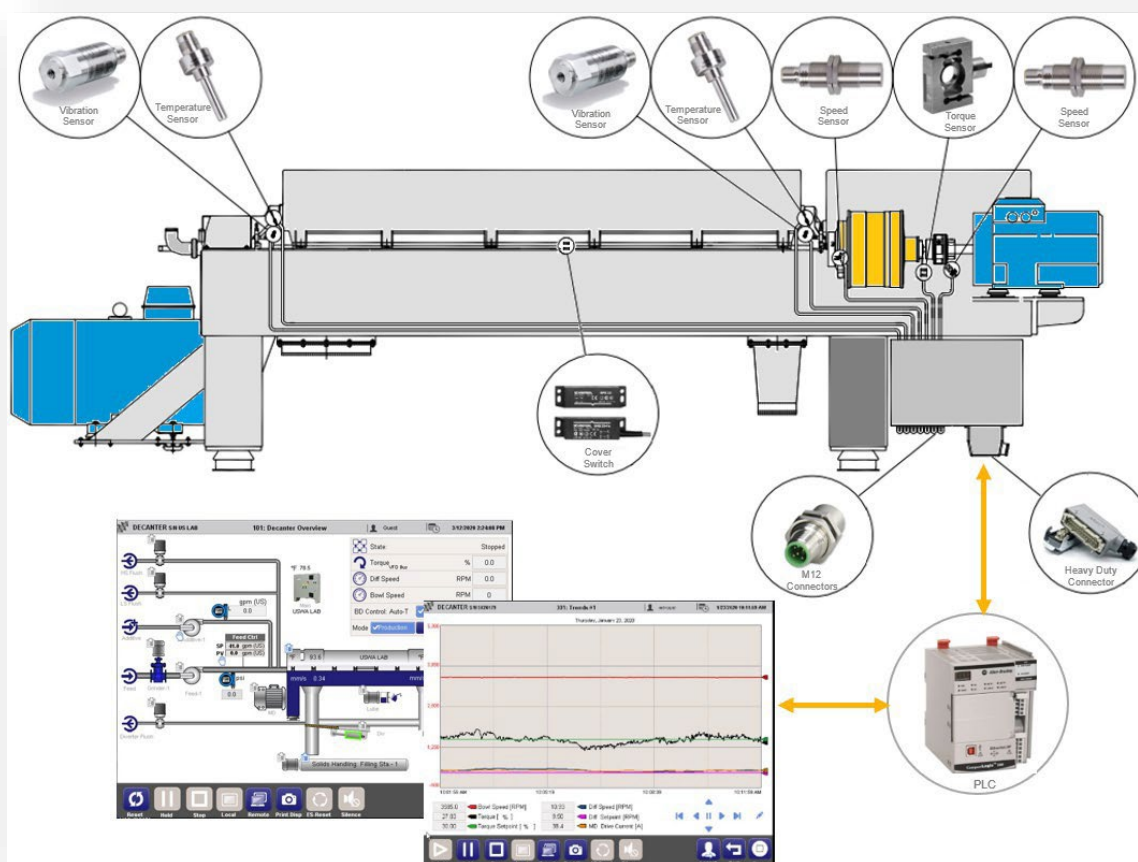
Alfa Laval Decanter-Connect Controls



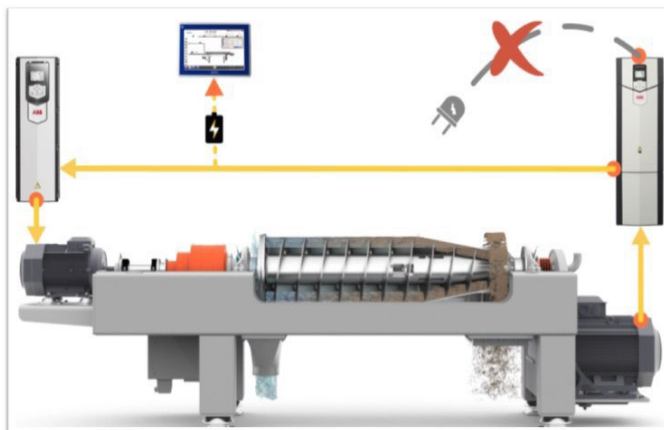
c. Alfa Laval Connect Control System

i. Key Features

- a) Allen Bradley CompactLogix (or optional ControlLogix PLC)
- b) Ability to use ABB ACS 880 series (or optional AB PF755 series VFDs)
- c) PanelView 7 Performance HMI – 10" (or optional 15")
- d) SCADA Communication to Allen Bradley, Delta V, ProfiNet, or Modbus TCP protocols
- e) Fully assembled & wired to centrifuge instrumentation
- f) Pre-wired and tested with all core centrifuge instrumentation: Speed sensors, backdrive torque sensor, main bearing vibration sensors, and main bearing PT-100 temperature sensors
- g) Touch-screen 10" HMI-Display (or optional 15")
 - o Easy Navigation
 - o Machine animated overview screen
 - o Analog, Digital and Multi centrifuges data display
 - o Alarms
 - o Trend curves



- h) **POWER LOSS-** The control of centrifuge during power loss or outage will allow the centrifuge to run through a short duration power blip, generally defined as 3-5 seconds. If the power outage extends past the 3-5 seconds the system will shut down the feed and polymer pumps and put the centrifuge into the production standby mode for a programmed set time. If power is restored during this time the feed pump and polymer pump will automatically restart and production will resume. Should the power not be restored, the control system will allow the centrifuge to be brought to a stop in a normal shutdown mode (as if it had power) maintaining the differential speed during the coast down period. This system will allow the centrifuge to scroll the solids out and be available for an immediate restart once power is restored. [Click on the image to see how it works](#)



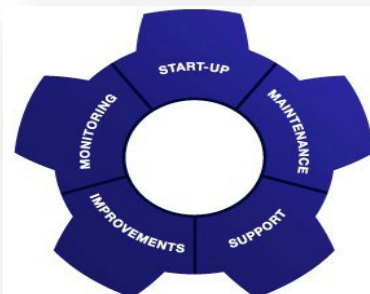
- i) Control Panel Optional Configurations
- Different configurations for Local and Starter panels
 - NEMA 12 or NEMA 4X
 - VFD ABB Type ACS800 for Main Motor
 - VFD ABB Type ACS800 for Back-drive Motor
 - Power supply Source: 460 V / 60 Hz / 3 Ph
 - For locating within “safe” non-hazardous area,



8. SERVICE

a. 360° Service Portfolio

Alfa Laval partners with you for the entire life cycle of your equipment – from start-up, through operation, monitoring and maintenance, all the way to reconditioning and eventual redesign. Our goal is to ensure that our equipment continuously gives you optimized process performance.



b. Alfa Laval Service Centers:

You can trust Alfa Laval service technicians to maintain your equipment in peak performance and minimize the risk of unscheduled production stops. Our local service centers are equipped with the tools and expertise to improve the performance of your rotating drum thickeners. Join us on a virtual tour of our state-of-the-art facilities.



[Alfa Laval - Chesapeake service center](#)

[Alfa Laval - Greenwood service center](#)

[Alfa Laval - Houston service center](#)

[Alfa Laval - Fresno service center](#)

Learn more about Alfa Laval Decanter Service

[Alfa Laval - Decanter centrifuge service](#)



c. Commissioning

Services consist of:

- installation review,
- performance checks,
- process optimization,
- operator training.

The commissioning process ends with a handover or acceptance certificate and is often the first day of warranty.

The commissioning:

- Enables trouble-free start-up and process fine-tuning.
- Advice on optimizing process conditions.
- Checks on surrounding components, systems and controls and optimization recommendations.
- Help to reduce maintenance costs with a customized proposal to optimize maintenance.

d. Preventive Maintenance

Highly experienced Alfa Laval specialists can formulate and implement an optimal maintenance plan for your equipment.

Service intervals are determined by various factors, including type of application as well as the usage and condition of the equipment.

The service can be performed on site or in one of the local Alfa Laval Service Centers located near you.

The preventive maintenance:

- Delivers peace of mind and operational reliability
- Secures maximum throughput
- Increases overall equipment lifetime and provides good cost control
- Maintains safe equipment operation

e. Repair

Alfa Laval specialists repair the equipment according to your needs, replacing unsafe or worn parts as required, and then reassemble the equipment.

- Minimizes downtime
- Maximizes production performance
- Extends the lifetime of equipment
- Prevents equipment from consequential damage and accidents

f. Equipment Upgrades

There is a wide range of upgrade solutions available to ensure your Alfa Laval equipment features the latest technical developments.

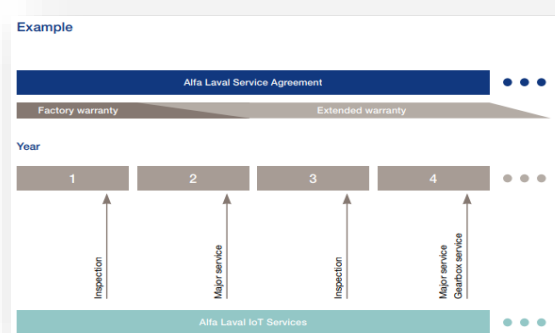
As operating conditions change over time, new challenges can call for a review of the current installations.

Equipment Upgrades can also include control upgrades that improve equipment automation.

9. SUPPORT

a. Service Performance Agreements

With an Alfa Laval Service Agreement, you ensure outstanding performance from your Alfa Laval decanter and minimal total cost of ownership. Tailored to your priorities and requirements, a service agreement is the ideal maintenance solution from the original manufacturer of your equipment. Alfa Laval offers Service Performance Agreements which include premium customer discount levels on parts, preferential scheduling for field service and free unlimited access to Alfa Laval's Technical Helpdesk.



A quotation for a Service Agreement tailored to your requirements can be provided upon request. For more information on Service Performance Agreements, and our local service organization which includes 11 service centers, over 50 factory-trained field technicians, a centrally located parts distribution center, and our 24/7 365 Days Technical Helpdesk, visit our website link below

[Alfa Laval - Performance Agreements](#)

b. Connected Services

Imagine the possibilities if you could have an eagle eye's view of your equipment. At Alfa Laval, our top priority is ensuring that customers get outstanding and reliable performance from their equipment throughout its long lifetime. That's why we're investing heavily in R&D for IoT (internet of things) services to interconnect your production and control systems. You'll have vital information at your fingertips to truly get the most from your equipment – each and every day!

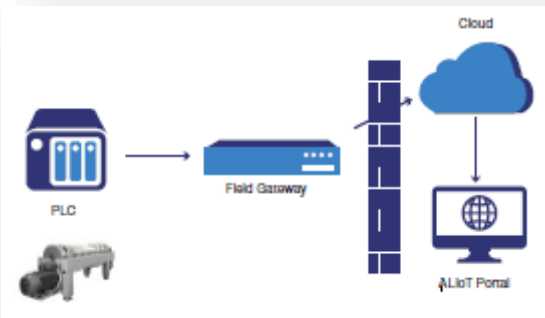


Alfa Laval IoT Services add new possibilities to your Alfa Laval wastewater decanter such as remote support and monitoring, condition monitoring, predictive maintenance, and process optimization. The results are lower service costs, maximum operating reliability, higher process efficiency and more uptime. Learn more about Alfa Laval's IoT Services for decanters in wastewater plants in the sections below or contact us for a discussion on the best combination for your plant.

[Alfa Laval - IoT Connected Services](#)

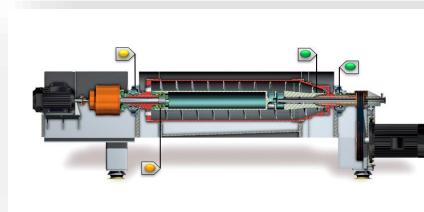
c. Remote Monitoring & Support

Remote Monitoring helps assure you that your decanter is running as expected. Access data like bowl speed and torque in the Alfa Laval IoT portal via your laptop, tablet or phone. Alarm notifications can be sent by e-mail or SMS/text message to let you know about anomalies. Remote Support allows our experts insight to live and historic data to identify the problem more quickly and accurately when you call for support.



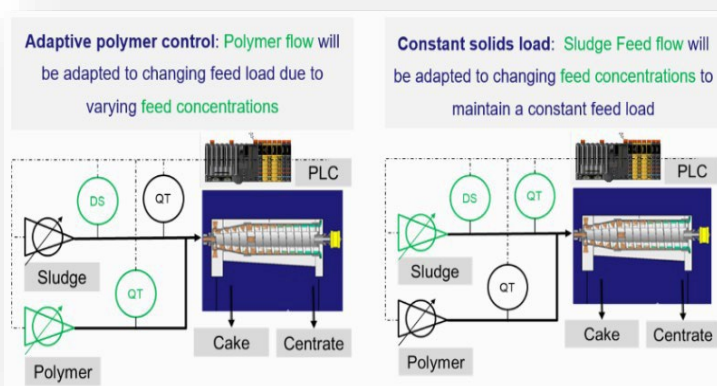
d. Predictive Maintenance

The Predictive Maintenance area of Connected Services develops services that help our customers improve reliability and avoid risk. The long-term objective is to develop a predictive maintenance solution that predicts failures before they ever happen. The first service in this area, is ConditionAlert™; based on vibration measurements and frequency analyses which can identify the source of abnormal vibration levels and suggest remedies. The customer is notified by Alfa Laval with a plan for service.



e. Process Optimization

The Process Optimization area of Connected Services develops services that help our customers optimize their decanter process, thereby reducing cost and increasing savings. Focused on the Wastewater Treatment industry, we offer Constant Solids Load & Adaptive Polymer Control, with the long-term objective of developing a self-optimizing decanter.





10. TERMS AND CONDITIONS OF SALES

These Terms and Conditions of Sale ("Terms and Conditions") apply to all quotations, orders, and contracts for Alfa Laval Inc. products (hereafter "Equipment") and associated services ("Services") as used in these Terms and Conditions, the word "Equipment" includes all hardware, parts, components, software, and options.

1. **ACCEPTANCE:** Our sale to you is limited to and expressly made conditional on your assent to these Terms and Conditions and, if applicable, on the attendant quotation, both of which form a part of the contract between us and which supersede and reject all prior agreements, representations, discussions, or negotiations, whether written or oral, with respect to this sale and any conflicting terms and conditions of yours, whether signed by you. Any terms and conditions contained in your purchase order or request for quotation or other form which are different from, in addition to, or vary from these Terms and Conditions are expressly rejected, shall not be binding upon us, and are void and of no force or effect. These Terms and Conditions may not be changed except by the written agreement of both parties.

2. **PRICES:** Unless otherwise specified in writing, all quoted prices are in U.S. Dollars and are firm for thirty (30) days from the date of offer. Prices quoted are exclusive of taxes, freight and insurance, and you agree to pay any and all sales, revenue, excise or other taxes (exclusive of taxes based on our net income) applicable to the purchase of Equipment. If you claim an exemption from any such taxes, you shall provide us with a tax exemption certificate acceptable to the taxing authorities.

3. **DELIVERY; FORCE MAJEURE:** Dates for the furnishing of Services and/or delivery or shipment of Equipment are approximate only and are subject to change. Quoted lead times are figured from the date of receipt of complete technical data and approved drawings as such may be necessary. We shall not be liable, directly, or indirectly, for any delay in delivery or failure to deliver caused by carriers or by labor difficulties, shortages, strikes or stoppages of any sort, or difficulties in obtaining materials from ordinary sources and suppliers. In addition, we shall not be liable for any such delays or for any failure to perform our obligations under an order or contract due to any one or more of the following events, whether foreseeable or not: war, hostilities, military operations, terrorism, riots, disorder, accidents, floods, storms, natural disasters, fires, acts of God, epidemics and/or pandemics (and specifically in relation hereto and notwithstanding anything else stated herein, whether or not outbreak of such epidemic or pandemic has occurred prior to acceptance of this order or execution of a contract for the Services), governmental, judicial or administrative decisions, decrees or orders, embargoes or blockades, or any causes beyond our reasonable control. Unless otherwise specifically agreed in writing by us, in no event shall we be liable for any damages or penalties whatsoever, or however designated, resulting from our failure to perform or delay in performing due to any of the causes specified in this paragraph 3.

4. **SHIPMENT, RISK OF LOSS, TITLE:** All sales are made F.O.B. Alfa Laval shipping point, unless otherwise noted. Duty, brokerage fees, insurance, packing and handling as applicable are not included unless otherwise noted. Our liability for delivery ceases upon making delivery of Equipment to the carrier at the shipping point in good condition. The carrier shall be your agent. Risk of loss shall pass to you upon such delivery. Regardless of the delivery term specified, we shall retain title to the Equipment until final payment thereof has been made.

5. **CREDIT AND PAYMENT:** Payment terms are (30) days net, unless agreed otherwise by us in writing. *Pro rata* payments shall become due with partial shipments. Any discount period which may be granted by us begins on the invoice date and all payments are due 30 days after the invoice date. All payments shall be made without deduction, deferment, set-off, lien or counterclaim of any nature.



All amounts due not paid within 30 days after the date such amounts are due and payable shall bear interest at the lesser of 1.5 percent per month or the maximum rate of interest allowed by law. We reserve the right at any time to suspend credit or to change credit terms provided herein, when, in our sole opinion, your financial condition so warrants. Failure to pay invoices when such invoices are due and payable, at our election, shall make all subsequent invoices immediately due and payable irrespective of terms, and we may withhold all subsequent deliveries until the full account is settled. We shall not, in such event, be liable for delay of performance or nonperformance of contract in whole or in part subsequent to such event.

6. **SECURITY AGREEMENT:** You hereby grant us a security interest in the Equipment, including a purchase money security interest, and in such materials, proceeds and accessories thereof, to secure payment of the purchase price of the Equipment. You authorize us to file or record a purchase order or copy thereof or any UCC financing statement showing our interest in the Equipment in all jurisdictions where we may determine filing to be appropriate, and you agree to sign all such documents reasonably related thereto promptly following our request. You will not encumber the Equipment with any mortgage, lien, pledge or other attachment prior to payment in full of the price therefor.

7. **CANCELLATIONS AND CHANGES:** Orders which have been accepted by us are not subject to cancellation or changes in specification except upon prior written agreement by us and upon terms that will indemnify us against all losses resulting from or arising out of such cancellation or change in specifications. In the absence of such indemnification, we shall be entitled to recover all damages and costs of whatever nature permitted by the Uniform Commercial Code.

8. **DEFERRED SHIPMENT:** If shipment is deferred at your request, payment of the contract price shall become due when you are notified that the Equipment is ready for shipment. If you fail to make payment or furnish shipping instructions, we may either extend the time for so doing or cancel the contract. In case of deferred shipment at your request, storage and other reasonable expenses attributable to such delay shall be payable by you.

9. **EQUIPMENT WARRANTY AND REMEDY:**

(a) For new Equipment only, we warrant to you that the Equipment that is the subject of this sale is free from defects in design (provided that we have design responsibility), material and workmanship. The duration of this warranty is twenty-four (24) months from successful completion of Acceptance Testing or beneficial use, or for a period not to exceed thirty months from delivery whichever occurs first (the "Warranty Period"). If you discover within the Warranty Period a defect in design, material, or workmanship, you must promptly notify us in writing. Within a reasonable time after such notification, we shall repair, replace, or, at our option, refund you the price of the defective Equipment or part thereof.

(b) For repairs, parts and Services provided by us, we warrant to you that the repairs, parts and Services we provide to you will be free from defects in material and workmanship. The duration of this warranty is ninety (90) days from as applicable (i) the date the Equipment which required the repairs, parts or Services is returned to you by us, (ii) the date of your receipt of the part, or (iii) the date of completion of the repair or other Services, if performed at your facility. If during this ninety-day period you discover a defect in the repairs, parts or Services you must promptly notify us in writing, and we shall correct such defect with either new or used replacement parts or reperform the Services as applicable. If we are unable to correct the defect after a reasonable number of attempts, we will provide a refund of the price paid for the defective repair, parts or Services.

(c) All warranty service is subject to our prior examination and approval and will be performed by us at your facility or at service centers designated by us. All transportation to and from the designated



service center will be at our expense. The remedies set forth above are your exclusive remedies for breach of warranty. Unless otherwise agreed in writing by us, our warranty extends only to you and

is not assignable to or assumable by any subsequent purchaser, in whole or in part, and any such attempted transfer shall render all warranties provided hereunder null and void and of no further force or effect.

(d) The warranties set forth above are inapplicable to and exclude any product, components or parts not manufactured by us or covered by the warranty of another manufacturer. We shall have no responsibility for defects, loss or damage to the extent caused by (i) normal wear and tear, (ii) your failure to follow all installation and operation instructions or manuals or to provide normal maintenance, (iii) repairs or modifications by you or by others not under our direct supervision, or (iv) a product or component part which we did not design, manufacture, supply, or repair.

(e) **DISCLAIMER OF IMPLIED WARRANTIES.** THE WARRANTIES SET FORTH ABOVE AND IN SECTION 12 BELOW ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

10. **LIMITATION OF LIABILITY:** In no event shall we be liable, and you hereby waive any claims against us and release us from liability to you, for any indirect, special, punitive, incidental, or consequential damages whatsoever based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory. In no circumstance, shall we be liable for, however such damages are characterized, loss of profits, loss of savings or revenue, loss of use of the Equipment or any associated equipment, cost of capital, cost of any substitute Equipment, facilities or services, downtime, or loss of prospective economic advantage. **OUR AGGREGATE LIABILITY FOR FAILURE TO PERFORM, BREACH OF WARRANTY OR BREACH OF OTHER CONTRACTUAL OBLIGATIONS SHALL NOT EXCEED THE TOTAL PRICE PAID TO US FOR THE EQUIPMENT AND SERVICES THAT ARE THE SUBJECT OF ANY CLAIM BY YOU.** We shall however always remain fully liable for damages caused by our willful misconduct, gross negligence or fraudulent misrepresentation, and/or for death or personal injury caused by our negligence.

11. **OWNERSHIP:** All drawings, designs, specifications, data and other proprietary rights supplied by us (including without limitation in connection with the Equipment) have been prepared or assembled by us and are (and shall remain) exclusively our property, and upon our request you agree to execute any additional documents needed to give effect to the foregoing. Such drawings, designs and specifications have been furnished in order to provide full documentation and on the condition that they shall not be disclosed, reproduced or copied in any manner whatsoever, in whole or in part, except for your internal use as necessary, and upon the further condition that, as our sole property, they shall not be used for furnishing information and/or disclosed, in whole or in part, to others or otherwise for any purpose not specifically authorized in a writing signed by one of our corporate officers.

12. **PATENT INFRINGEMENT**

(a) We make no express or implied warranties of non-infringement with respect to the Equipment. We will, however, defend, indemnify and hold you harmless from any third party apparatus claims based upon an issued U.S. patent to the extent such claim relates to the Equipment supplied and sold to you; provided, however, that we undertake no indemnification in respect of third-party rights

(i) where the alleged patent infringement is based upon or related to any method, process or design claims in third-party U.S. patents, any combination of the Equipment with other equipment not supplied by us, or any modifications of the Equipment made by you and not approved by us, or (ii) to the extent the alleged infringement is directly attributable to the negligence or intentional misconduct of you or otherwise for which you are obligated to indemnify us for under paragraph 12(c).



(b) We shall assume defense of a claim at our expense in accordance with these Terms and Conditions, provided you shall notify us within 30 days of your receipt of notice of an alleged third-party claim that you believe would entitle you to patent infringement indemnification pursuant to paragraph 12(a). You acknowledge and agree that we shall have the sole right to settle or otherwise

compromise such a third-party claim, including but not limited to the right to either (i) modify the Equipment to avoid infringement if you are agreeable to the modification, (ii) repurchase the Equipment from you at a price equal to the then-current fair market value of the Equipment, or (iii) secure rights by assignment or license to permit continued use of the Equipment.

(c) If a third-party charges us with patent infringement relating to Equipment sold by us to you, we shall have the right to either (i) modify the Equipment to avoid infringement if you are agreeable to the modification, (ii) repurchase the Equipment from you at a price equal to the then-current fair market value of the Equipment, or (iii) secure rights by assignment or license to permit continued use of the Equipment. If a third party charges us with patent infringement on the bases set forth in paragraph 12(a)(i) or (ii), you shall indemnify and hold us harmless for all expenses as well as any awards of damage assessed against us, and, without limiting any of our other rights and remedies available at law or in equity, we shall also have the right to modify or repurchase the Equipment or to secure rights for continued use by way of assignment or license as set forth in this paragraph.

13. **INSPECTION:** Upon prior written notice, you may make reasonable inspections of Equipment at our facility. We reserve the right to determine the reasonableness of the request and to select an appropriate time and location for such inspection. You agree to execute appropriate confidentiality provisions upon our request prior to visiting our facility. All costs of inspection shall be solely determined by us and shall be payable by you. No inspection or expediting by you at the facilities of our suppliers is authorized.

14. **SOFTWARE PROVISIONS:** If software is provided hereunder (whether such is integrated into the Equipment or otherwise operates alongside the same), you are hereby granted a non-exclusive, non-sublicensable, non-transferable, royalty free license to access and use such software as provided and as intended with our Equipment. Without limiting the foregoing, under the foregoing license you may specifically: (i) use our software in machine readable object code only and only with the Equipment provided; (ii) copy our software into any machine-readable object code form solely for back up purposes in support of your use of our software on the Equipment provided in accordance with these Terms and Conditions; and (iii) create one additional copy of the software for archival purposes only. This license may only be assigned, sublicensed, or otherwise transferred by you with our prior written consent. You hereby recognize and acknowledge that the software provided to you hereunder comprises valuable trade secret and/or copyright property of Alfa Laval (or its licensors) and you covenant that you will take adequate precautions against access to the software by, or disclosure of the software to, anyone not authorized hereunder to use or have access to the software as contemplated herein. The software is subject to the confidentiality obligations set forth below in paragraph 15.

15. **CONFIDENTIALITY:** Subject to any non-disclosure or confidentiality agreement already in effect between us, any drawings, data, software or other information exchanged between us is proprietary or confidential to us and shall not be used or disclosed by you without our prior written consent. Confidential information shall not be any information that (i) is known previously to you under no obligation of secrecy; (ii) becomes known to the public through no breach of an obligation of secrecy by you; or (iii) is independently developed by you without use or reference to any of the confidential information or materials provided to you by us.



16. **INAPPLICABILITY OF CISG:** The parties specifically agree that the United Nations Convention on Contracts for the International Sale of Goods shall not apply to any sale or order or the contract between us.

17. **GOVERNING LAW & VENUE:** These Terms and Conditions and any dispute or claim arising out of or related to an order or the contract between us shall be finally decided in accordance with the laws of the Commonwealth of Virginia, without giving effect to the provisions thereof relating to conflict of laws. You agree that the venue for any such dispute shall lie in the United States District Court for the Eastern District of Virginia, Richmond Division. In the event that federal jurisdiction cannot be established pursuant to 28 U.S.C. §§ 1331 or 1332, the venue for any such dispute shall lie in the Circuit Court of Henrico County, Virginia. You expressly submit and waive any objection to the sole and exclusive jurisdiction of such courts.

18. **GENERAL:** All previous agreements or understandings between us, either oral or written, with regard to the subject order, with the exception of a pre-existing non-disclosure agreement between us, are void and these Terms and Conditions constitute the entire agreement between us with respect to the matters addressed herein. Neither of us shall assign an order or contract to which these Terms and Conditions apply without the prior written consent of the other party, which consent shall not be unreasonably withheld. If any provision of these Terms and Conditions is held to be invalid or unenforceable, such holding shall not affect the validity or enforceability of any other provision herein. No waiver by either of us of any default or breach by the other party will operate as or be deemed a waiver of any subsequent default or breach.