



COVINGTON WATER DISTRICT

KING COUNTY  
WASHINGTON

CONTRACT PROVISIONS  
PROPOSAL, CONTRACT FORMS, SPECIFICATIONS AND PLANS

for

**222<sup>nd</sup> Place Corrosion Control Facility Rehabilitation**

**Bid Opening Date: July 1, 2026 at 10:00 AM, PST**

Covington Water District

18631 SE 300<sup>th</sup> Place,  
Covington, WA, 98042  
(253) 631-0565

Covington Water District,

District Engineer:

Steve Lee, PE

253-867-0940

Project Manager:

Joseph Xi, PE

253-867-0882

Design Engineer

Kennedy/Jenks Consultants:

Milt Larsen, PE

253-835-6400



## 222<sup>ND</sup> PLACE CORROSION CONTROL FACILITY REHABILITATION PROJECT

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222<sup>nd</sup> Place Corrosion Control Facility Rehabilitation  
Covington Water District**

**CALL FOR BIDS**

**ENGINEER'S ESTIMATE: \$850,000 - \$1,200,000**

Notice is hereby given that sealed bids will be received by Covington Water District until 10:00 AM, July 1, 2026 at which time bids will be opened and publicly read aloud.

Bid proposals may be sent by mail to 18631 SE 300th Place, Covington, WA 98042, or hand delivered to the District Reception Desk prior to the opening. The sealed envelope shall be plainly marked with "Covington Water District – 222<sup>nd</sup> Place Corrosion Control Facility Rehabilitation - CIP Project No. 2304" and shall clearly indicate the name and address of the bidder. The bid opening will take place at the District Administrative Office. Proposals received after the time fixed for opening will not be considered.

The work to be performed within **210 Calendar Days** from date of commencement under this contract shall include, but not be limited to: replacing the onsite hypochlorite generation system including the brine and hypochlorite storage tanks, replacing the hot water tank, installing secondary containment coatings and chemical resistance epoxy flooring, replacing the sodium hydroxide vent and fill piping, replacing butterfly valves, demolishing the unused air piping system and backup hypochlorite feed system.

Contract documents including plan drawings, specifications and addenda will be available for viewing and downloading on-line through Builders Exchange of Washington, Inc. (BXWA) at <http://www.bxwa.com>. To view the documents on BXWA's website, select the following links: "Posted Projects"; "Public Works"; "Covington Water District"; "Projects Bidding". Bidders are encouraged to "Register as a Bidder" in order to receive automatic e-mail notification of future addenda and be placed on the "Bidders List". Contact the Builders Exchange of Washington at (425) 258-1303 should you require further assistance.

A non-mandatory pre-bid site visit is scheduled for June 17<sup>th</sup> at 11:00 AM. Details are provided in the Information for Bidders.

Questions about the project shall be addressed to: Tom Malphrus at 253-867-0906 or [tom.malphrus@covingtonwaterwa.gov](mailto:tom.malphrus@covingtonwaterwa.gov).

Each bid shall be accompanied by a certified check, cashier's check or bid bond (with authorized surety company as surety) made payable to Covington Water District in an amount not less than five percent (5%) of the amount bid.

Covington Water District reserves the right to reject any or all bids and to waive irregularities in the bid or in the bidding.

No bidder may withdraw their bid after the hour set for the opening thereof or before award of contract, unless said award is delayed for a period exceeding sixty (60) days.

Thomas Keown, P.E., General Manager  
Covington Water District

First Publication: Daily Journal of Commerce  
June 2, 2026

Second Publication: Daily Journal of Commerce  
June 15, 2026

## INFORMATION FOR BIDDERS

BIDS will be received by Covington Water District (herein called the District) at the time and location set forth in the Call for Bids herein before and then at said office publicly opened and read aloud.

Each BID must be submitted in a sealed envelope addressed to Covington Water District. Each sealed envelope containing a BID must be plainly marked on the outside as BID for “**222<sup>nd</sup> Place Corrosion Control Facility Rehabilitation**”. The envelope should bear on the outside the name of the BIDDER, address, phone number, and the name of the project for which the BID is submitted. If forwarded by mail, the sealed envelope containing the BID must be enclosed in another envelope addressed to the District at the address listed in the Call for Bids and be plainly marked on the outside as Bid for “**222<sup>nd</sup> Place Corrosion Control Facility Rehabilitation**”.

All BIDS must be made on the required PROPOSAL FORM. All blank spaces for BID prices must be filled in, in ink or typewritten, and the PROPOSAL FORM must be fully completed and executed when submitted. Only one copy of the PROPOSAL FORM is required.

The District may waive any informalities or minor defects or reject any and all BIDS. Any BID may be withdrawn prior to the above scheduled time for the opening of BIDS or authorized postponement thereof. Any BID received after the time and date specified shall not be considered. No BIDDER may withdraw a BID within sixty (60) days after the actual date of the opening thereof. Should there be reasons why the contract cannot be awarded within the specified period, the time may be extended by mutual agreement between the District and the BIDDER.

Before submitting their proposal, the BIDDER shall examine the site of the work and review the drawings and specifications including ADDENDA and ascertain for themselves the work required and all of the physical conditions in relation thereto. Failure to take this precaution will not release the successful BIDDER from entering into contracts nor excuse the BIDDER from performing the work in strict accordance with the terms of the contract. No verbal statement made by any officer, agent, or employee of the District, in relation to the physical conditions pertaining to the site of the work, will be binding on the District during the gathering of information for proposal preparation by each BIDDER. After BIDS have been submitted, the BIDDER shall not assert that there was a misunderstanding concerning the quantities of WORK or the nature of the WORK to be done.

**A Non-Mandatory Pre-Bid Site Visit** is scheduled for June 17<sup>th</sup> at 11:00 AM. Prospective Bidders are encouraged to participate. The 222<sup>nd</sup> Place Corrosion Control Facility is located at: 29025 222<sup>nd</sup> PL SE, Black Diamond, WA 98010.

The CONTRACT DOCUMENTS contain the provisions required for the construction of the PROJECT. Information obtained from an officer, agent, or employee of the District or any other person shall not affect the risks or obligations assumed by the CONTRACTOR or relieve them from fulfilling any of the conditions of the contract.

Each BID must be accompanied by a BID deposit payable to the District for five percent (5%) of the total amount of the BID. As soon as the BID prices have been compared, the District will return the deposits of all except the three lowest responsible BIDDERS. When the Agreement is executed, the deposits of the two remaining unsuccessful BIDDERS will be returned. A certified check may be used in lieu of a BID bond.

A performance and payment bond in the amount of one hundred percent (100%) of the CONTRACT PRICE, with a corporate surety approved by the District, will be required for the faithful performance of the contract.

Attorneys-in-fact who sign bid bond and contract bonds must file with each bond a certified and effective dated copy of their power of attorney.

The party to whom the contract is awarded will be required to execute the Agreement and obtain the contract bond within ten (10) calendar days after the date on the NOTICE OF AWARD. The NOTICE OF AWARD shall be accompanied by the necessary Agreement and bond forms. In case of failure of the BIDDER to execute the Agreement, the District reserves the option to consider the BIDDER in default, in which case the BID deposit accompanying the bid shall become the property of the District.

CONTRACTOR shall not commence work until a NOTICE TO PROCEED has been issued by the District.

The District may make such investigations as deemed necessary to determine the ability of the BIDDER to perform the WORK, and the BIDDER shall furnish to the District all such information and data for this purpose as the District may request. The District reserves the right to reject any BID if the evidence submitted by, or investigation of, such BIDDER fails to satisfy the District, in the District's discretion, that such BIDDER is properly qualified to carry out the obligations of the Agreement and to complete the WORK contemplated therein.

If the District rejects or disqualifies a BID submitted by a BIDDER, upon receipt of the District's notice of rejection or disqualification, the BIDDER shall have five (5) business days to appeal the District's decision. The appeal must be made in writing and sent to the District at the address provided in the Call for Bids. Upon receipt of the BIDDER'S appeal a public meeting will be scheduled in which the BIDDER can present his/her appeal to the District's Board of Commissioners. The Board of Commissioners will then decide whether to uphold or overturn the District's rejection or disqualification of the BIDDER'S BID.

A conditional or qualified BID will not be accepted.

Award will be made as a whole to one BIDDER.

All applicable laws, ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the contract throughout.

Each BIDDER is responsible for inspecting the site and for reading and being thoroughly familiar with the CONTRACT DOCUMENTS. The failure or omission of any BIDDER to do any of the foregoing shall in no way relieve any BIDDER from any obligation in respect to its BID.

The low BIDDER must supply the names and addresses of major material suppliers if requested to do so by the District.

Failure to list subcontractors on the PROPOSED SUBCONTRACTORS form, with whom the bidder, if awarded the contract, will directly subcontract for performance of the work of structural steel installation, rebar installation, heating, ventilation and air conditioning, and or plumbing, as described in Chapter 18.106 RCW, and electrical, as described in Chapter 19.28 RCW or naming more than one subcontractor to perform the same work will result in your bid being non-responsive and therefore void.

The Consulting Engineer is Kennedy/Jenks Consultants, Inc. Their address is:

32001 32<sup>nd</sup> Avenue S, Suite 300, Federal Way, WA 98001

### **CONTRACT PROVISIONS SUMMARY STATEMENT**

The Contract provisions for this individual project include General Information, Bid Proposal, Agreement, Standard Specifications, Special Provisions, Prevailing Minimum Hourly Wage Rates, and Appendices. The Contract provisions address the work required for this individual project refining the method by which the work is to be completed. Where conflicting statements are found within the Contract Provisions, the more stringent requirement shall apply.

#### **Prevailing Minimum Hourly Wage Rates**

The prevailing rate of wages shall be paid to all workers, laborers, or mechanics per Chapter 39.12 RCW. Contractor is required to pay current prevailing wage as of the date of advertising for this contract. Prevailing wage rates are published and available from the Department of Labor and Industry at the following web address:

**<https://lni.wa.gov/licensing-permits/public-works-projects/prevailing-wage-rates/>** or the owner will mail a hard copy upon request. A copy of the appropriate wage rates is available for viewing at the District's Administration Office. **The prevailing wage rates applicable to this project are for King County, Washington with a publication date of February 2, 2026.**

**MUST ACCOMPANY EACH BID**

**PROPOSAL FORM**

Bidder: \_\_\_\_\_

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

Address: \_\_\_\_\_

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

TO: **Covington Water District**  
ADDRESS: **18631 SE 300th Place**  
**Covington, WA 98042**

PROJECT: **Water System Improvements – 222<sup>nd</sup> Place Corrosion Control Facility Rehabilitation**

Pursuant to and in compliance with your invitation for bids and the Instructions to Bidders and other documents relating thereto, the undersigned has carefully examined the drawings and specifications, as well as the premises and conditions affecting the work, and hereby proposes to furnish all labor and materials and to perform all work as required for construction of the improvements in strict accordance with the contract documents, specifications, and drawings for the amount shown.

TOTAL AMOUNT BID: \_\_\_\_\_  
(This price shall include sales tax. Provide price in words)

Base Price: \_\_\_\_\_  
(Provide price in numbers)

Sales Tax: \_\_\_\_\_  
(Provide price in numbers)

Total Price (base price + sales tax): \_\_\_\_\_  
(Provide price in numbers)

**Bidder's Declaration and Understanding**

If the undersigned is notified of the acceptance of this bid within sixty (60) days of the time set for the opening of bids, the undersigned agrees to execute a contract for the above work bid in the form of the contract bound in these specifications and to provide a surety bond as required by the specifications.

The undersigned further agrees that the bid guaranty accompanying this bid is left in escrow with the District; that the liquidated damages which the District will sustain by the failure of the undersigned to execute and deliver the above-named contract and surety bond, for any or all units of this bid accepted by the District, will be equal to five percent (5%) of the total bid; and that if the undersigned defaults in executing that contract and in furnishing the surety bond within ten (10) days, of the date on the Notice of Award, then the bid guaranty shall become the property of the District. If, however, this bid or any part thereof is not accepted within sixty (60) days of the time set for the opening of bids or if the undersigned executes and delivers said contract and surety bond, the bid guaranty shall be returned.

**SUBMIT WITHIN BID**

**Proposal Signature Page:**

If Sole Proprietor or Partnership:

IN WITNESS hereto, the undersigned has set his (its) hand this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
Signature of Bidder

\_\_\_\_\_  
Title

If Corporation or Limited Liability Company:

IN WITNESS WHEREOF, the undersigned corporation/limited liability company has caused this instrument to be executed by its duly authorized officers this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

Attest: \_\_\_\_\_  
Name of Corporation/Limited Liability Company

\_\_\_\_\_  
Secretary By: \_\_\_\_\_

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

Sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
Notary Public in and for the State of Washington  
Residing at: \_\_\_\_\_

- NOTE:
1. If the Bidder is a co-partnership, you must identify the name of the other partners and provide the name under which business is transacted.
  2. If the Bidder is a corporation or limited liability company, this Proposal must be executed by the duly authorized officials and notarized.

**SUBMIT WITH BID**

**SCHEDULE OF PRICES**

Covington Water District

Project: 222<sup>nd</sup> PLACE CORROSION CONTROL FACILITY REHABILITATION

Item No.	Description of Item	Quantity	Unit Price	Amount
1	Corrosion Control Facility Rehabilitation	<u>1</u> LS	\$ _____	\$ _____
Subtotal:				
Sales Tax on Subtotal (9.0%):				
<b>GRAND TOTAL (Subtotal plus Sales Tax):</b>				

Company: \_\_\_\_\_

Name of Authorized Representative: \_\_\_\_\_

Signature of Representative: \_\_\_\_\_

I \_\_\_\_\_ (name) acknowledge receipt of

Addendums Nos. \_\_\_\_\_ through \_\_\_\_\_

LS = Lump Sum

INFORMATIONAL

FUNDING

Funding for this project comes exclusively from the Covington Water District capital improvement project budget and does not include State or Federal monies.

BIDDER RESPONSIBILITY CRITERIA

A. **Mandatory Bidder Responsibility Criteria:** Pursuant to RCW 57.08.050, it is the intent of District to award a contract to the lowest responsible bidder. Pursuant to RCW 39.04.350, before award, the bidder must meet the following bidder responsibility criteria to be considered a responsible bidder. The bidder shall be required by the District to submit documentation demonstrating compliance with the criteria. The bidder must:

1. Have a current certificate of registration as a contractor in compliance with chapter 18.27 RCW, which must have been in effect at the time of bid submittal;
2. Have a current Washington Unified Business Identifier (UBI) number;
3. If applicable:
  - a. Have Industrial Insurance (workers' compensation) coverage for the bidder's employees working in Washington, as required in Title 51 RCW;
  - b. Have a Washington Employment Security Department number, as required in Title 50 RCW;
  - c. Have a Washington Department of Revenue state excise tax registration number, as required in Title 82 RCW;
4. Not be disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065(3).

**Documentation:** Bidder shall complete the "**Mandatory Bidder Responsibility Checklist**" below and submit the Checklist as part of bidder's bid.

**SUBMIT WITH BID**

**MANDATORY BIDDER RESPONSIBILITY CHECKLIST**

Provide the information requested on this form. If the information requested is not applicable or unknown mark N/A or UNK in the space provided. The Owner will verify the information is accurate before awarding the Contract.

<b>General Information</b>	
Project Name: <b>222<sup>nd</sup> Place Corrosion Control Facility Rehabilitation</b>	Project Number: <b>2304</b>
Bidder's Business Name:	Bid Submittal Deadline: <b>July 1, 2026</b>
<b>Contractor Certificate of Registration – per 18.27 RCW</b> <a href="https://secure.lni.wa.gov/verify/">https://secure.lni.wa.gov/verify/</a>	
License Number:	Status: Active: Yes <input type="checkbox"/> No <input type="checkbox"/>
Effective Date (must be effective on or before Bid Submittal Deadline):	Expiration Date:
<b>Current UBI Number –</b> <a href="https://secure.lni.wa.gov/verify/">https://secure.lni.wa.gov/verify/</a>	
UBI Number:	Account Status: Open <input type="checkbox"/> Closed <input type="checkbox"/>
<b>Industrial Insurance Coverage (Worker's Comp) - per Title 51 RCW</b> <a href="https://secure.lni.wa.gov/verify/">https://secure.lni.wa.gov/verify/</a>	
L & I Account ID:	Account Status: Yes <input type="checkbox"/> No <input type="checkbox"/>
<b>Employment Security Account Number – ES Reference Number per 50 RCW</b>	
Employment Security Account Number:	
<b>State Excise Tax Registration Number – per Title 82 RCW</b> <a href="https://secure.dor.wa.gov/gteunauth/">https://secure.dor.wa.gov/gteunauth/</a>	
Tax Registration Number (UBI Number):	Account Status: Open <input type="checkbox"/> Closed <input type="checkbox"/>

**SUBMIT WITH BID**

**MANDATORY BIDDER RESPONSIBILITY CHECKLIST (continued)**

<b>Not Disqualified from Bidding – per RCW 39.06.010 or 39.12.065</b> <a href="https://secure.lni.wa.gov/verify/">https://secure.lni.wa.gov/verify/</a>	
Is the Bidder listed on the “Contractors Not Allowed to Bid” list of the Department of Labor and Industries? Yes <input type="checkbox"/> No <input type="checkbox"/>	
<b>Wage Payment Laws - per Provisions of RCW 49.46, 49.48 or 49.52</b> <a href="https://secure.lni.wa.gov/verify/">https://secure.lni.wa.gov/verify/</a>	
Has the Contractor been found to have willfully violated the provisions of RCW 49.46, 49.48 or 49.52? Yes <input type="checkbox"/> No <input type="checkbox"/> If yes what is the date of the finding _____	
<b>Training on public works and prevailing wage – per RCW.04.350 and RCW 39.12</b> <a href="https://secure.lni.wa.gov/verify/">https://secure.lni.wa.gov/verify/</a>	
Has the bidder received training on the requirements related to public works and prevailing wage under RCW 39.04.350 and chapter <u>39.12</u> RCW? Yes <input type="checkbox"/> No <input type="checkbox"/>	
<b>Checked by (to be completed by Owner or Engineer):</b>	
Name of District or Engineering Consultant, Employee:	Date:

MUST ACCOMPANY EACH BID

**NON-COLLUSION CERTIFICATION**

CIP: 222<sup>nd</sup> Place Corrosion Control Facility Rehabilitation

STATE OF WASHINGTON )

) SS.

COUNTY OF \_\_\_\_\_ )

\_\_\_\_\_ )

COMPANY NAME

\_\_\_\_\_ of \_\_\_\_\_

NAME (print)

TITLE

\_\_\_\_\_, being first duly sworn, on oath says that

His/her COMPANY bid above submitted is a genuine and not a sham or collusive bid, or made in the interest or on behalf of any person not therein named: and s/he further says that the said bidder has not directly or indirectly induced or solicited any bidder on the above work or supplies to put in a sham bid, or any other person or corporation to refrain from bidding; and that said bidder has not in any manner sought by collusion to secure to her/himself an advantage over any other bidder or bidders.

\_\_\_\_\_  
Contractor

\_\_\_\_\_  
Date

**MUST ACCOMPANY EACH BID**

**BID DEPOSIT**

DEPOSIT STATEMENT

Submitted herewith is our bid deposit in the form of certified check, cashier's check or cash in the amount of \$ \_\_\_\_\_, which amount is not less than five percent (5%) of the total bid.

SIGN HERE: \_\_\_\_\_

RETURN OF DEPOSIT: (In the event that bidder is not awarded the project)

Received return of deposit in the sum of \$ \_\_\_\_\_

Acknowledged by: \_\_\_\_\_ Date: \_\_\_\_\_, 20\_\_

\*\*\*\*\*OR\*\*\*\*\*

**BID BOND**

KNOW ALL PEOPLE BY THESE PRESENTS:

That we, \_\_\_\_\_, as Principal, and \_\_\_\_\_, as Surety, are held firmly bound unto Covington Water District, a Washington municipal corporation, as Obligee, in the penal sum of \_\_\_\_\_ Dollars (\$\_\_\_\_\_), for the payment of which the Principal and the Surety bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally by these presents.

The condition of this obligation is such that if the Obligee shall make any award to the Principal for \_\_\_\_\_ 222<sup>nd</sup> Place Corrosion Control Facility Reahbilitation \_\_\_\_\_, according to the terms of the bid made by the Principal therefor, the Principal shall duly make and enter into a contract with the Obligee in accordance with the terms of said proposal or bid and award and shall give bond for the faithful performance thereof, with surety or sureties approved by the Obligee, or if the Principal shall, in case of failure to so do, pay and forfeit to the Obligee the penal amount of the deposit specified in the call for bids, then this obligation shall be null and void; otherwise, it shall be and remain in full force and effect, and the Surety shall forthwith pay and forfeit to the Obligee, as a penalty and liquidated damages, the amount of this bond.

SIGNED, SEALED, AND DATED THIS \_\_\_\_\_ DAY OF \_\_\_\_\_, 20\_\_.

\_\_\_\_\_ Principal

\_\_\_\_\_ Surety

**SUBMIT WITHIN BID**

**CERTIFICATION OF COMPLIANCE WITH WAGE PAYMENT STATUTES**

The bidder hereby certifies that, within the three-year period immediately preceding the bid solicitation date, the bidder is not a “willful” violator, as defined in RCW 49.48.082, of any provision of chapters 49.46, 49.48, or 49.52 RCW, as determined by a final and binding citation and notice of assessment issued by the Department of Labor and Industries or through a civil judgment entered by a court of limited or general jurisdiction.

I certify under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct.

\_\_\_\_\_  
Bidder’s Business Name

\_\_\_\_\_  
Signature of Authorized Official\*

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Date

\_\_\_\_\_  
City

\_\_\_\_\_  
State

*Check One:*

Sole Proprietorship  Partnership  Joint Venture  Corporation/Limited Liability Company

State of Incorporation, or if not a corporation or LLC, State where business entity was formed:

\_\_\_\_\_

If a co-partnership, give firm name under which business is transacted:

\_\_\_\_\_

*\* If a corporation, proposal must be executed in the corporate name by the president or vice-president (or any other corporate officer accompanied by evidence of authority to sign). If a co-partnership, proposal must be executed by a partner.*

May be Required to Submit with Bid. Bidder to verify.

## Covington Water District

### PROPOSED SUBCONTRACTORS (Per RCW 39.30.060)

Required for all projects estimated to cost \$1 million or more.

#### HVAC, Plumbing & Electrical work

Must Submit with Bid

Work to be Performed	Contractor to Self Perform Y or N	Subcontractor to Perform Name and license No. of Subcontractor
Heating, Ventilation & Air Conditioning		
Plumbing		
Electrical		

#### Structural Steel & Rebar Installation

Must Submit within 48 hours after Bid Submittal Deadline

Work to be Performed	Contractor to Self Perform Y or N	Subcontractor to Perform Name and license No. of Subcontractor
Structural Steel		
Rebar Installation		

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Bidder:

---

By:

---

Title:

PRE-AWARD CRITERIA

The “Low Bidder” must meet the following relevant criteria applicable to the Project and submit the required documentation to the District within seven (7) days of the bid opening. The District reserves the right to request such documentation from other bidders:

Respond to Items 1 - 3 below and submit to District if you are the, “**Apparent Low Bidder**”.

**1. Completion of Similar Projects**

The Bidder shall submit a list of **3 projects** of similar size and scope to this project as described in the Call for Bids completed within the last **ten (10) years** for each of the following:

The Bidder’s Company

Bidder’s proposed Project Manager

Bidder’s proposed Site Superintendent/Foreman

For the purposes of meeting this criterion, the District has determined that “similar size and scope to this project” means projects that have the following characteristics: **Installing chemical feed systems and construction of or remodeling of public works facilities.**

The information about each project shall include the following:

- Owner’s name and contact information for the owner’s representative;
- Awarded contract amount;
- Final contract amount;
- A description of the scope of the project and how the project is similar to this project.

**2. Bidder’s Standard Subcontract Form**

The Bidder’s standard subcontract form shall include the subcontractor responsibility language required by RCW 39.06.020, and the Bidder shall have an established procedure which it utilizes to validate the responsibility of each of its subcontractors. The Bidder’s subcontract form shall also include a requirement that each of its subcontractors shall have and document a similar procedure to determine whether the sub-tier subcontractors with whom it contracts are also “responsible” subcontractors as defined by RCW 39.06.020.

**Check One:**

	<u>YES</u>	<u>NO</u>
The Bidder’s standard sub contract form <b>DOES</b> comply with the requirements of RCW 39.06.020.		

**3. Federal Debarment**

The Bidder shall not currently be debarred or suspended by the Federal government.

**Check One:**

	<u>YES</u>	<u>NO</u>
The Bidder <b>IS NOT</b> listed as a current debarred or suspended bidder on the U.S. General Services Administration’s “Excluded Parties List System” website: <a href="http://www.epls.gov/">http://www.epls.gov/</a> .		

SUBMIT WITHIN SEVEN DAYS OF BID OPENING IF APPARENT LOW BIDDER

SUPPLEMENTAL INFORMATION DECLARATION

By signing below, the bidder declares under penalty of perjury that each of the following statements is true and correct:

1. The bidder has not had any public works contract terminated for cause by a government agency during the five (5) year period immediately preceding the bid submittal deadline for this project.
2. The bidder has not been assessed liquidated damages relating to the performance of a public works contract by a government agency during the five (5) year period immediately preceding the bid submittal deadline for this project.
3. The bidder has not been a plaintiff or defendant in any lawsuits in Washington State superior or district court in the Puget Sound region (defined as King, Kitsap, Pierce, Snohomish and Thurston Counties) or federal district court for Western Washington during the five (5) year period immediately preceding the bid submittal deadline for this project that involve performance or payment issues relating to a public works contract which were resolved adversely to the bidder through judgment or settlement.
4. The bidder (including any of bidder's officers, directors or owners) has not been convicted of a crime involving bidding on a public works contract within the ten (10) year period immediately preceding the bid submittal deadline for this project.

\_\_\_\_\_  
Bidder/Contractor

\_\_\_\_\_  
Date

**NOTE:** If you are not able to certify that all of the statements above are true and correct, please strikethrough any statement that is not true and accurate and sign the form as amended. If you strikethrough any statement, you must provide the District with a written explanation or description of any circumstances that you believe the District should take into consideration in making a determination as to whether the bidder is a responsible bidder. Failure to do so may result in a determination that the bidder is not a responsible contractor under the supplemental bidder responsibility criteria.

**PUBLIC WORKS COMPETITIVE**  
**SEALED BIDS CONTRACT**

THIS AGREEMENT, of which shall be deemed original, and entered into as of the date hereinafter affixed, by and between Covington Water District, hereinafter called the Owner, and \_\_\_\_\_  
\_\_\_\_\_ HEREINAFTER called the Contractor,

WITNESSETH:

That in consideration of the terms and conditions contained herein and attached and made a part of this Agreement, the parties hereto covenant and agree as follows:

I. The Contractor shall do all work and furnish all tools, materials and equipment for **-222<sup>ND</sup> Place Corrosion Control Facility Rehabilitation** in accordance with and as described in the attached plans and specifications, including Addenda No(s). \_\_\_\_\_, which are by this reference incorporated herein and made a part hereof, and shall perform any alterations in or additions to the work provided under this Agreement and every part thereof.

II. The contract award is in the principal amount of \$ \_\_\_\_\_ including sales tax as indicated on the Notice of Award.

If said work is not substantially completed by, **the Date Provided in the Notice to Proceed**, the Contractor agrees to pay to the Owner the sum set forth in **Section 1-08.9 Liquidated Damages, of the WSDOT Standard Specifications (2020 Standard Specifications)**, for each and every calendar day said work remains uncompleted after expiration of the specified time, as liquidated damages. The Contractor shall provide and bear the expense of all equipment, work, and labor of any sort whatsoever that may be required for the transfer of materials and for constructing and completing the work provided for in this Agreement and every part thereof and shall guarantee said materials and work for a period of one year after completion of the work, except such as are mentioned in the specifications to be furnished by Owner.

III. Owner hereby promises and agrees with the Contractor to employ and does employ the Contractor to provide the materials and to do and cause to be done the above-described work and to complete and finish the same according to the attached plans and specifications and the terms and conditions herein contained and hereby contracts to pay for the same according to the attached specifications and the schedule of prices bid and hereto attached, at the time and in the manner and upon the conditions provided for in this contract. Assets removed from service shall be considered surplus items approved by the Board of Commissioners for removal by the Contractor.

IV. The Contractor for themselves and for their heirs, executors, administrators, successors, and assigns does hereby agree to the full performance of all covenants herein contained upon the part of the Contractor.

V. It is further provided that no liability shall attach to Owner by reason of entering into this Agreement, except as expressly provided herein.

VI. This Agreement consists of the following documents, all of which are incorporated by reference as if set forth in full herein, and are component parts hereof:

Division 0: Bidding Requirements, Contract Forms, Contract Conditions

Divisions 1 – 17: Specifications

Addenda

Construction Plans dated: May 2026

Countersigned:

this \_\_\_\_\_ day of \_\_\_\_\_, 2026.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed the day and year first hereinabove written.

COVINGTON WATER DISTRICT, OWNER

By: \_\_\_\_\_

Title: General Manager

CONTRACTOR:

\_\_\_\_\_

By: \_\_\_\_\_

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

Address: \_\_\_\_\_

\_\_\_\_\_

Phone No.: \_\_\_\_\_

Acknowledgment of Waiver of Contractor's industrial insurance immunity.

\_\_\_\_\_  
Owner

\_\_\_\_\_  
Contractor

**PUBLIC WORKS PERFORMANCE BOND  
to Covington Water District, WA**

Bond No. \_\_\_\_\_

The **COVINGTON WATER DISTRICT**, Washington, (District) has awarded to \_\_\_\_\_  
(Principal), a Contract for, **222nd Place Corrosion Control Facility Rehabilitation**, (Contract), and said Principal is required under the terms of that Contract to furnish a bond for performance of all obligations under the Contract.

The Principal, and \_\_\_\_\_ (Surety), a corporation organized under the laws of the State of \_\_\_\_\_ and licensed to do business in the State of Washington as surety and named in the current list of "Surety Companies Acceptable in Federal Bonds" as published in the Federal Register by the Audit Staff Bureau of Accounts, U.S. Treasury Dept., are jointly and severally held and firmly bound to the District, in the sum of \_\_\_\_\_ US Dollars (\$ \_\_\_\_\_) Total Contract Amount, subject to the provisions herein.

This statutory performance bond shall become null and void, if and when the Principal, its heirs, executors, administrators, successors, or assigns shall well and faithfully perform all of the Principal's obligations under the Contract and fulfill all the terms and conditions of all duly authorized modifications, additions, and changes to said Contract that may hereafter be made, at the time and in the manner therein specified; and if such performance obligations have not been fulfilled, this bond shall remain in full force and effect.

The Surety agrees to indemnify, defend, and protect the District against any claim of direct or indirect loss resulting from the failure of the Principal, its heirs, executors, administrators, successors, or assigns (or any of the employees, subcontractors, or lower tier subcontractors of the Principal) to faithfully perform the Contract.

The Surety for value received agrees that no change, extension of time, alteration or addition to the terms of the Contract, the specifications accompanying the Contract, or to the work to be performed under the Contract shall in any way affect its obligation on this bond, and waives notice of any change, extension of time, alteration or addition to the terms of the Contract or the work performed. The Surety agrees that modifications and changes to the terms and conditions of the Contract that increase the total amount to be paid the Principal shall automatically increase the obligation of the Surety on this bond and notice to Surety is not required for such increased obligation.

This bond may be executed in two (2) original counterparts, and shall be signed by the parties' duly authorized officers. This bond will only be accepted if it is accompanied by a fully executed and original power of attorney for the officer executing on behalf of the surety.

The Surety agrees to be bound by the laws of the state of Washington and subjected to the jurisdiction of the state of Washington.

PRINCIPAL

SURETY

\_\_\_\_\_  
Principal Signature Date

\_\_\_\_\_  
Surety Signature Date

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

Local office/agent of Surety Company:

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

Telephone: \_\_\_\_\_

Address: \_\_\_\_\_

**PUBLIC WORKS PAYMENT BOND**  
**to Covington Water District, WA**

Bond No. \_\_\_\_\_

The **COVINGTON WATER DISTRICT**, Washington, (District) has awarded to \_\_\_\_\_ (Principal), a Contract for, **222nd Place Corrosion Control Facility Rehabilitation** (Contract), and said Principal is required under the terms of that Contract to furnish a payment bond in accord with Title 39.08 Revised Code of Washington (RCW) and (where applicable) 60.28 RCW.

The Principal and \_\_\_\_\_ (Surety), a corporation organized under the laws of the State of \_\_\_\_\_ and licensed to do business in the State of Washington as surety and named in the current list of "Surety Companies Acceptable in Federal Bonds" as published in the Federal Register by the Audit Staff Bureau of Accounts, U.S. Treasury Dept., are jointly and severally held and firmly bound to the District, in the sum of \_\_\_\_\_ US Dollars (\$ \_\_\_\_\_) Total Contract Amount, subject to the provisions herein.

This statutory payment bond shall become null and void, if and when the Principal, its heirs, executors, administrators, successors, or assigns shall pay all persons in accordance with RCW Titles 60.28, 39.08, and 39.12 including all workers, laborers, mechanics, subcontractors, lower tier subcontractors, and material suppliers, and all persons who shall supply such contractor or subcontractor with provisions and supplies for the carrying on of such work, and all taxes incurred on said Contract under Title 50 and 51 RCW and all taxes imposed on the Principal under Title 82 RCW; and if such payment obligations have not been fulfilled, this bond shall remain in full force and effect.

The Surety agrees to indemnify, defend, and protect the District against any claim of direct or indirect loss resulting from the failure of the Principal, its heirs, executors, administrators, successors, or assigns, (or the subcontractors or lower tier subcontractors of the Principal) to pay all laborers, mechanics, subcontractors, lower tier subcontractors material persons, and all persons who shall supply such contractor or subcontractors with provisions and supplies for the carrying on of such work.

The Surety for value received agrees that no change, extension of time, alteration or addition to the terms of the Contract, the specifications accompanying the Contract, or to the work to be performed under the Contract shall in any way affect its obligation on this bond, except as provided herein, and waives notice of any change, extension of time, alteration or addition to the terms of the Contract or the work performed. The Surety agrees that modifications and changes to the terms and conditions of the Contract that increase the total amount to be paid the Principal shall automatically increase the obligation of the Surety on this bond and notice to Surety is not required for such increased obligation.

This bond may be executed in two (2) original counterparts, and shall be signed by the parties' duly authorized officers. This bond will only be accepted if it is accompanied by a fully executed and original power of attorney for the officer executing on behalf of the surety.

The Surety agrees to be bound by the laws of the state of Washington and subjected to the jurisdiction of the state of Washington.

PRINCIPAL	SURETY
_____ Principal Signature	_____ Surety Signature
Date	Date
_____ Printed Name	_____ Printed Name
_____ Title	_____ Title

Local office/agent of Surety Company:

Name: \_\_\_\_\_ Telephone: \_\_\_\_\_

Address \_\_\_\_\_



EXHIBIT C  
Covington Water District

INSURANCE SPECIFICATIONS

Public Liability and Property Damage Insurance

General Requirements

1.1 The contractor shall obtain and keep in force during the term of the contract, Commercial General Liability and Automobile liability insurance policies with insurance companies which have an A.M. Best's rating of A-: VII or better and who are approved by the Insurance Commissioner of the State of Washington pursuant to Title 48 RCW. All insurance coverage required by these specifications shall be written and provided by "occurrence-based" policy forms rather than "claims made" forms.

1.2 Prior to the execution of the contract, the contractor shall purchase and maintain during the term of this project a Commercial General Liability insurance and Automobile insurance policies meeting the requirements set forth herein. The contractor shall file with the District **either** a certified copy of all policies **with endorsements attached**, or a certificate of insurance **with endorsements attached** as are necessary to comply with these specifications. Failure of the contractor to fully comply with the requirements regarding insurance will be considered a material breach of contract and shall be cause for immediate termination of the contract and of any and all district obligations, regarding same.

1.3 The contractor shall not begin work under the contract or under any special condition until all required insurances have been obtained and until such insurances have been approved by the District. The insurance shall provide coverage for the contractor, the contractor's agents and employees, subcontractors, and the District. The coverage so provided shall protect against claims from bodily injuries, including accidental death, as well as claims for property damage which may arise from any act or omission of the contractor, the contractor's agents and employees, subcontractors, or by anyone directly or indirectly employed by either of them.

1.4 The insurance policies shall specifically name the District, its elected and appointed officials, officers, employees, agents and volunteers as additional insureds with regards to damages and defense of claims arising from: (a) activities performed by or on behalf of the contractor; (b) products and completed operations of the contractor, and (c) premises owned, leased or used by the contractor. The insurance shall be maintained in full force and effect at the contractor's expense throughout the term of the contract. Products and completed operations coverage shall be maintained for a minimum of three years after completion of the project.

1.5 The District shall be given at least 30 days written notice of any cancellation, nonrenewal, material reduction, or modification of coverage. Such notice shall be by *certified mail* to the District.

1.6 The coverages provided by the contractor's insurance policies shall be primary to any insurance maintained by the District, except as respects losses attributable to the sole negligence of the District or otherwise limited in accord with the provisions of RCW 4.24.115. Any insurance that might cover this contract that is maintained by the District shall be in excess of the contractor's insurance and shall not contribute with the contractor's insurance.

1.7 The contractor's insurance policies shall protect each insured in the same manner as though a separate policy had been issued to each. The inclusion of more than one insured shall not affect the rights of any insured as respects any claim, suit or judgment made or brought by or for any other insured or by or for any employee of any other insured. However this provision shall not increase the limits of the insurer's liability.

1.8 The General Aggregate provision of the contractor's insurance policies shall be amended by endorsement to show that the General Aggregate Limit of the policies applies separately to this project.

1.9 The contractor's insurance policies shall not contain deductibles or self-insured retentions in excess of \$10,000 unless approved by the district.

1.10 The contractor's insurance policies shall contain a provision that the District has no obligation to report events which might give rise to a claim until a claim has been filed with the District's Board of Commissioners.

1.11 Types and Limits of Insurance Required:

#### **Commercial General Liability**

- \$1,000,000 each occurrence Bodily Injury and Property Damage liability
- \$1,000,000 annual aggregate
- Employees and volunteers as Additional Insureds
- Premises and operations
- Broad form property damage including underground, explosion and collapse hazards (XCU)
- Products completed operations (shall be maintained for at least three years after completion.)
- Blanket contractual
- Subcontractors
- Personal injury with employee exclusion deleted
- Employers liability (Stop gap)

## **Automobile Liability**

- \$1,000,000 per accident bodily injury and property damage liability, including
- Any owned automobile
- Hired automobiles
- Non-owned automobile

**Umbrella Liability** (applicable to both the Commercial General and Auto Liability coverage and employers liability, provided this requirement may be satisfied through the contractor's primary commercial general and auto liability coverage, or any combination thereof.

- \$1,000,000 per occurrence
- \$1,000,000 aggregate

1.12 Providing coverages in the stated amounts shall not be construed to relieve the contractor from liability in excess of such limits.

1.13 The contractor shall have its insurance agent/representative complete the Insurance Coverage Questionnaire contained in the proposal and attach it to the certificate of insurance for District's approval.

1.14 The contractor shall maintain Workers Compensation insurance as required by state or federal statute for all of the contractor's employees to be engaged in work on the project under this contract and, in case any such work is sublet, the contractor shall require the subcontractor similarly to provide workers compensation insurance for all of the subcontractor's employees to be engaged in such work. The contractor's Department of Labor & Industries account number shall be noted on the certificate of insurance. In the event any class of employees engaged in the work under this contract is not covered under Workers Compensation insurance or Longshore and Harbor Workers insurance (or Jones Act coverage) as required by state and federal statute, the contractor shall maintain and cause each subcontractor to maintain, Employers Liability insurance for limits of at least \$1,000,000 for each employee for disease or accident, and shall furnish the District with satisfactory evidence of such.

1.15 The contractor shall be solely and completely responsible for safety and safety conditions on the job site, including the safety of all persons and property during performance of the work. The services of District employees or the engineer's personnel in conducting construction review of the contractor's performance is not intended to include review of the adequacy of the contractor's work methods, equipment, bracing, scaffolding, or trenching, or safety measures in, on, or near the construction site. The contractor shall provide safe access for the District and its inspectors to adequately inspect the quality of work and the conformance with project specifications.

1.16 The contractor shall be solely and completely responsible to perform all work and furnish all materials in strict compliance with all applicable state, city, county and federal laws, regulations, ordinances, orders and codes. The contractor's attention is directed to the requirements of the Washington Industrial Safety and Health Act (WISHA), Chapter 49.17 RCW.

1.17 The contractual coverage of the contractor's policy shall be sufficiently broad enough to insure the provisions of the HOLD HARMLESS AND INDEMNIFICATION AGREEMENT of this contract.

1.18 Nothing contained in these insurance requirements shall be construed as limiting the extent of the contractor's responsibility for payment of damages resulting from the contractor's operations under this contract.

## **SUBCONTRACTORS**

The contractor shall ensure that each subcontractor of every tier obtains and maintains at a minimum the insurance coverages listed above. Upon request of the District, the contractor shall provide evidence of such insurance.

## **EVIDENCE OF INSURANCE**

The contractor shall provide to the District a certificate(s) of insurance and endorsements for each policy of insurance meeting the requirements set forth herein when the contractor delivers the signed contract to the District for the work. The certificate and endorsements shall conform to the following requirements:

1. An Acord certificate or a form determined by the District to be equivalent. The certificate or an endorsement form shall indicate the contractor's insurance is primary and non-contributory.
2. The contractor shall obtain endorsement forms CG 20 10 10 01 and CG 20 37 10 01, or the equivalent of each, naming the District and all other parties listed herein as Additional Insured(s) and providing the policy number. If the contractor is unsuccessful in securing these endorsements after exerting commercially reasonable efforts, the contractor shall obtain other endorsements providing equivalent coverage to the Additional Insured, subject to the review and approval of such other endorsement forms by the District. A statement of additional insured status on an Acord certificate of insurance shall not satisfy this requirement. Commercially reasonable efforts shall be evidenced by a signed statement by the contractor's insurance broker certifying the endorsement forms required by the District are not available and the endorsements submitted provide equivalent coverage to the Additional Insured.
3. Any other amendatory endorsements to show the coverage required herein.

## HOLD HARMLESS AND INDEMNIFICATION AGREEMENT

Contractor shall indemnify, defend and hold harmless the District, its elected and appointed officers, officials, employees, agents and volunteers (“Indemnified Parties”) from and against all of the following claims and demands: damages, defense, indemnity, loss, judgment, equitable recovery, equity, and any other liability or obligation including but not limited to loss of use and attorney fees and expenses of any kind, caused or occasioned in whole or in part by reason of: 1) the services performed and materials or equipment supplied under or related to this contract; or 2) the presence and activities of the Contractor or its subcontractors and suppliers, or their property, employees or agents, upon or in proximity to the property of the District, and any other property upon which the Contractor is performing any work called for or in connection with this contract, subject to the limitations provided below (collectively the “Indemnified Claims”).

In addition to any remedy authorized by law, the District may retain so much of any money due the contractor as deemed necessary by the District to ensure the defense and indemnification obligations of this Section until final disposition has been made of such Indemnified Claims.

Liability for Negligence. Pursuant to RCW 4.24.115, to the extent liability for Indemnified Claims (including defense obligations) were caused or result from the concurrent negligence of (a) the Indemnified Parties and (b) Contractor or the Contractor’s agents or employees, the indemnity and defense obligations under this contract shall be limited to the extent of the Contractor’s negligence.

Title 51 Waiver. It is further specifically and expressly understood that the indemnification provided herein constitutes contractor’s waiver of immunity under industrial insurance, Title 51 RCW, solely for the purposes of this indemnification. This waiver has been specifically and mutually negotiated by the parties.

Contractor further agrees to require its subcontractors and suppliers and their subcontractors and suppliers to similarly indemnify and hold Contractor harmless and waive immunity under Title 51 solely for the purposes of this indemnification.

**NOTE: THIS QUESTIONNAIRE MUST BE COMPLETED AND ATTACHED TO CERTIFICATE OF INSURANCE AND POLICY ENDORSEMENT.**

**Insurance Coverage Questionnaire**

For \_\_\_\_\_  
 (Name of Insured)

Project Number \_\_\_\_\_

Project Owner \_\_\_\_\_

Are the following coverages &/or conditions in effect?		
	Yes	No
The Policy form is ISO Commercial General Liability (CGL) form CG 00 01 of CG 00 02 (circle one). If No, attach a copy of the policy with required coverages clearly identified.		
(CGL) Ongoing Operations coverage (similar to CG 20 10 10 01, CG 2010 07 04, or equivalent)		
(CGL) Products and Completed operations coverage (similar to CG 20 37 07 04, CG 20 37 07 04, or equivalent)		
Personal Injury Liability Coverage. (with employee exclusion deleted)		
Broad Form Property Damage with X, C, U Hazards included		
Blanket Contractual Liability coverage applying to this contract		
Employers Liability - Stop Gap		

Deductibles  
 or SIRs:                      GL \_\_\_\_\_      AL \_\_\_\_\_      Excess \_\_\_\_\_

Insurer' Best Rating              GL \_\_\_\_\_      AL \_\_\_\_\_      Excess \_\_\_\_\_

This Questionnaire is issued as a matter of information. This questionnaire is not an insurance policy and does not amend, extend or alter the coverage afforded by the policies indicated on the attached Certificate of Insurance.

\_\_\_\_\_  
 Agency/Broker

\_\_\_\_\_  
 Completed by (type)

\_\_\_\_\_  
 Address

\_\_\_\_\_  
 Completed by (Signature)

\_\_\_\_\_  
 Name of Person to contact

\_\_\_\_\_  
 Telephone Number



# CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

**IMPORTANT:** If the certificate holder is an **ADDITIONAL INSURED**, the policy(ies) must be endorsed. If **SUBROGATION IS WAIVED**, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:	
	PHONE (A/C, No, Ext):	FAX (A/C, No):
	E-MAIL ADDRESS:	
	INSURER(S) AFFORDING COVERAGE	NAIC #
INSURED	INSURER A:	
	INSURER B:	
	INSURER C:	
	INSURER D:	
	INSURER E:	
	INSURER F:	

**COVERAGES**

CERTIFICATE NUMBER:

REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE 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. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL SUBR INSR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
	<b>GENERAL LIABILITY</b>					EACH OCCURRENCE \$
	COMMERCIAL GENERAL LIABILITY					DAMAGE TO RENTED PREMISES (Ea occurrence) \$
	CLAIMS-MADE <input type="checkbox"/> OCCUR <input type="checkbox"/>					MED EXP (Any one person) \$
						PERSONAL & ADV INJURY \$
						GENERAL AGGREGATE \$
	GEN'L AGGREGATE LIMIT APPLIES PER:					PRODUCTS - COMP/OP AGG \$
	POLICY <input type="checkbox"/> PRO-JECT <input type="checkbox"/> LOC <input type="checkbox"/>					\$
	<b>AUTOMOBILE LIABILITY</b>					COMBINED SINGLE LIMIT (Ea accident) \$
	ANY AUTO					BODILY INJURY (Per person) \$
	ALL OWNED AUTOS					BODILY INJURY (Per accident) \$
	HIRED AUTOS					PROPERTY DAMAGE (Per accident) \$
	SCHEDULED AUTOS					\$
	NON-OWNED AUTOS					\$
	<b>UMBRELLA LIAB</b>					EACH OCCURRENCE \$
	EXCESS LIAB					AGGREGATE \$
	DEED <input type="checkbox"/> RETENTION \$ <input type="checkbox"/>					\$
	<b>WORKERS COMPENSATION AND EMPLOYERS' LIABILITY</b>					WC STATU-TORY LIMITS \$ <input type="checkbox"/> OTH-ER <input type="checkbox"/>
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	Y/N <input type="checkbox"/>	N/A <input type="checkbox"/>			E.L. EACH ACCIDENT \$
						E.L. DISEASE - EA EMPLOYEE \$
						E.L. DISEASE - POLICY LIMIT \$

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

**CERTIFICATE HOLDER****CANCELLATION**

	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.
	AUTHORIZED REPRESENTATIVE

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ACORD 25 (2010/05)

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THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

**ADDITIONAL INSURED – OWNERS, LESSEES OR  
CONTRACTORS – SCHEDULED PERSON OR  
ORGANIZATION**

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART

**SCHEDULE**

<p><b>Name of Person or Organization:</b></p>    
---

(If no entry appears above, information required to complete this endorsement will be shown in the Declarations as applicable to this endorsement.)

**A. Section II – Who Is An Insured** is amended to include as an insured the person or organization shown in the Schedule, but only with respect to liability arising out of your ongoing operations performed for that insured.

**B.** With respect to the insurance afforded to these additional insureds, the following exclusion is added:

**2. Exclusions**

This insurance does not apply to "bodily injury" or "property damage" occurring after:

- (1) All work, including materials, parts or equipment furnished in connection with such work, on the project (other than service, maintenance or repairs) to be performed by or on behalf of the additional insured(s) at the site of the covered operations has been completed; or
- (2) That portion of "your work" out of which the injury or damage arises has been put to its intended use by any person or organization other than another contractor or subcontractor engaged in performing operations for a principal as a part of the same project.

POLICY NUMBER:

COMMERCIAL GENERAL LIABILITY  
CG 20 37 10 01

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

## ADDITIONAL INSURED – OWNERS, LESSEES OR CONTRACTORS – COMPLETED OPERATIONS

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART

### SCHEDULE

<b>Name of Person or Organization:</b>
<b>Location And Description of Completed Operations:</b>
<b>Additional Premium:</b>

(If no entry appears above, information required to complete this endorsement will be shown in the Declarations as applicable to this endorsement.)

**Section II – Who Is An Insured** is amended to include as an insured the person or organization shown in the Schedule, but only with respect to liability arising out of "your work" at the location designated and described in the schedule of this endorsement performed for that insured and included in the "products-completed operations hazard".

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

## PRIMARY AND NONCONTRIBUTORY – OTHER INSURANCE CONDITION

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART  
PRODUCTS/COMPLETED OPERATIONS LIABILITY COVERAGE PART

The following is added to the **Other Insurance** Condition and supersedes any provision to the contrary:

### **Primary And Noncontributory Insurance**

This insurance is primary to and will not seek contribution from any other insurance available to an additional insured under your policy provided that:

(1) The additional insured is a Named Insured under such other insurance; and

(2) You have agreed in writing in a contract or agreement that this insurance would be primary and would not seek contribution from any other insurance available to the additional insured.

**THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.**

**DESIGNATED CONSTRUCTION PROJECT(S)  
GENERAL AGGREGATE LIMIT**

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART

**SCHEDULE**

Designated Construction Project(s):

Information required to complete this Schedule, if not shown above, will be shown in the Declarations.

- A. For all sums which the insured becomes legally obligated to pay as damages caused by "occurrences" under Section I – Coverage A, and for all medical expenses caused by accidents under Section I – Coverage C, which can be attributed only to ongoing operations at a single designated construction project shown in the Schedule above:
  - 1. A separate Designated Construction Project General Aggregate Limit applies to each designated construction project, and that limit is equal to the amount of the General Aggregate Limit shown in the Declarations.
  - 2. The Designated Construction Project General Aggregate Limit is the most we will pay for the sum of all damages under Coverage A, except damages because of "bodily injury" or "property damage" included in the "products-completed operations hazard", and for medical expenses under Coverage C regardless of the number of:
    - a. Insureds;
    - b. Claims made or "suits" brought; or
    - c. Persons or organizations making claims or bringing "suits".
  - 3. Any payments made under Coverage A for damages or under Coverage C for medical expenses shall reduce the Designated Construction Project General Aggregate Limit for that designated construction project. Such payments shall not reduce the General Aggregate Limit shown in the Declarations nor shall they reduce any other Designated Construction Project General Aggregate Limit for any other designated construction project shown in the Schedule above.
  - 4. The limits shown in the Declarations for Each Occurrence, Damage To Premises Rented To You and Medical Expense continue to apply. However, instead of being subject to the General Aggregate Limit shown in the Declarations, such limits will be subject to the applicable Designated Construction Project General Aggregate Limit.

- B. For all sums which the insured becomes legally obligated to pay as damages caused by "occurrences" under Section I – Coverage A, and for all medical expenses caused by accidents under Section I – Coverage C, which cannot be attributed only to ongoing operations at a single designated construction project shown in the Schedule above:
1. Any payments made under Coverage A for damages or under Coverage C for medical expenses shall reduce the amount available under the General Aggregate Limit or the Products-completed Operations Aggregate Limit, whichever is applicable; and
  2. Such payments shall not reduce any Designated Construction Project General Aggregate Limit.
- C. When coverage for liability arising out of the "products-completed operations hazard" is provided, any payments for damages because of "bodily injury" or "property damage" included in the "products-completed operations hazard" will reduce the Products-completed Operations Aggregate Limit, and not reduce the General Aggregate Limit nor the Designated Construction Project General Aggregate Limit.
- D. If the applicable designated construction project has been abandoned, delayed, or abandoned and then restarted, or if the authorized contracting parties deviate from plans, blueprints, designs, specifications or timetables, the project will still be deemed to be the same construction project.
- E. The provisions of Section III – Limits Of Insurance not otherwise modified by this endorsement shall continue to apply as stipulated.

# DIVISIONS 1-17 SPECIFICATIONS

**222<sup>nd</sup> PLACE CORROSION CONTROL FACILITY REHABILITATION**

**CIP PROJECT NO. 2304**

**COVINGTON WATER DISTRICT**

**May 2026**

Kennedy/Jenks Consultants, Inc.  
32001 32<sup>nd</sup> Avenue S, Suite 300, Federal Way, Washington 98001  
253.835.6400

**JOB NO. 2497002\*01**

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**SECTION 00700**  
**GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT**

**ARTICLE 1 - DEFINITIONS**

1.1 The term "Contract" refers to a single identified portion of the construction which may be the whole or a part of the Project. The Project is the total construction and consists of one or more Contracts performed by the same or separate contractors or by the Owner. A single set of drawings, specifications and contract conditions may include more than one Contract; when combined with the Agreement for an individual Contract they become the Contract Documents for that Contract. The construction performed under a set of Contract Documents is the Work required by an individual Contract.

1.2 The "Contract Documents" are defined in the Contract Provisions Summary Statement.

1.3 The term "Contract Price" refers to the total monies payable to the Contractor for completion of the Work in accordance with the Contract Documents.

1.4 The term "Design Engineer" refers to the firm that prepared the Contract Documents - Kennedy/Jenks Consultants - and includes all of their officers, directors, shareholders, employees and consultants.

1.5 The term "Drawings" refers to the graphic and pictorial portion of the Contract Documents, showing the design, location, dimensions, details, scope and character of the Work. Drawings may include plans, elevations, sections, schedules, details and diagrams.

The terms Plans, Plan, Drawing and similar terms shall have the same meaning as the term "Drawings."

1.6 The term "Engineer" refers to the person or entity designated by the Owner to provide administration of the Contract.

1.7 The term "Notice to Proceed" refers to a written notice by the Owner to the Contractor authorizing it to proceed with the Work and establishing the date of commencement from which the Contract Time is measured.

1.8 The term "Owner" is the person or entity referred to in the Agreement and includes all of its officers, employees, and consultants.

1.9 The term "Work" means the entire construction required by the Contract Documents completed or in progress and includes all labor, materials, equipment and services necessary to fulfill the Contractor's obligations. The Work does not include the Contractor's tools, equipment, scaffolding, shoring, barricades, guardrails or any other temporary construction or safety devices employed by the Contractor to complete the Work.

1.10 Definitions of other terms are included at the beginning of each Article or in Division 1 Section 01010.

**ARTICLE 2 - CONTRACT DOCUMENTS**

**Contract Relationships**

2.1 The Contract Documents constitute the entire Agreement between the Owner and the Contractor for the Work and supersede prior agreements written or oral.

2.2 The Contract Documents shall not be construed to create a duty of any kind (1) on behalf of the Design Engineer or the Engineer and toward the Contractor, any subcontractor, worker, or any other party, or (2) on behalf of the Owner and toward any subcontractor, worker, or any other party.

2.3 Provisions in referenced standards, specifications, manuals, publications, installation instructions, operation and maintenance instructions or codes shall not change the duties or responsibilities between any of the parties involved in this work from those described in these General Conditions.

**Correlation, Intent**

2.4 It is the intent of the Contract Documents to include everything necessary for the proper execution of the Work as a complete functioning facility that serves the intended purpose. The Contractor shall provide all labor, material, equipment and services required by the Contract Documents or that may reasonably be inferred from the Contract Documents as being required to produce the intended result.

2.5 The Contract Documents are complementary: What is required by one shall be as binding as if

required by all. Organization of the Specifications into sections and the arrangement of the Drawings on separate sheets for Mechanical, Electrical, etc. shall not control the Contractor in dividing the Work among subcontractors or among trades.

### **Order of Precedence**

2.6 In case of conflict between different parts of the Contract Documents, the order of precedence shall be as follows:

- .1 Addenda
- .2 Proposal Forms
- .3 General Conditions take precedence over the Specifications including Division 1;
- .4 Provisions in Division 1 General Requirements apply to all sections of the Specifications.
- .5 Specifications take precedence over the Drawings;
- .6 Stated dimensions take precedence over scaled dimensions;
- .7 Larger scale drawings take precedence over smaller scale drawings;
- .8 Detailed drawings take precedence over general or typical drawings;
- .9 Specific notes on the Drawings take precedence over schedules; and
- .10 Notes, descriptions or schedules take precedence over graphic representations on drawings.
- .11 Higher quality takes precedence over lower quality.
- .12 Greater number, amount or size takes precedence over lesser number, amount or size.

2.7 The Contractor will be furnished three (3) one-half (½) size Drawings sets, 3 copies of the Project Manual, 1 PDF copy of each and the Contractor may obtain additional copies at their cost of reproduction.

### **Use of Contract Documents**

2.8 The Drawings, Specifications and other documents prepared by the Design Engineer, are instruments of service to which the Design Engineer retains legal title, including copyright rights. These instruments of service shall not be used on other projects, for subsequent changes to this project, and shall not be changed or modified without the written permission of the Design Engineer.

2.8.1 Nothing herein shall relieve the Contractor of its obligation to notify the Owner of any inconsistencies in the Contract Documents. Should it appear that the Work

to be done or any of the matters relative thereto are not sufficiently detailed or explained in the Contract Documents or in the event of a conflict, inconsistency or discrepancy in the Contract Documents, the Contractor shall immediately submit an RFI to the Owner in writing for such further written explanations as may be necessary. Any adjustment(s) to the Work made by Contractor without first obtaining written clarification from the Engineer shall be at Contractor's risk and expense and shall be subject to removal if required by Owner.

2.8.2 Contractor Deviations. No deviation by the Contractor from the Contract Documents relating to any portion of the materials, labor services or equipment required for the Work shall be construed to set a precedent with respect to subsequent interpretation of the Contract Documents or performance of the Work unless such a deviation is documented in a Change Order to the Contract.

## **ARTICLE 3 - LAND, EXISTING CONDITIONS, LAYOUTS**

### **Land**

3.1 The Owner shall furnish access to the land on which the Work is to be performed including rights-of-way and easements for access. The Contractor shall confine its operations to the land furnished or to that portion of the land indicated on the Drawings. The Contractor shall provide all other land that it may require.

### **Existing Conditions**

3.2 Execution of the Agreement by the Contractor is a representation that the Contractor has visited the site and has become familiar with existing and local conditions which may affect the Work and has included all costs associated therewith in its Bid.

### **Subsurface Soil Conditions**

3.3 If information on subsurface soil conditions was obtained for design purposes, the Contractor may rely on the boring logs as a representation of soils that existed at the location of the boring at the time the borings were made but may not rely on the interpretations or opinions contained in the report nor on the completeness or adequacy of the information for the Contractor's bidding or construction purposes.

### **Existing Utilities and Underground Facilities**

3.4 Information shown with respect to existing concealed or underground utilities and underground facilities is based on data provided by the utility or facility owners or by others. The Contractor may rely on the information shown in the Contract Documents for purposes of establishing the Scope of Work included in the Contract Price but the Owner and the Design Engineer are not responsible for the adequacy or completeness of such information for the Contractor's bidding or construction purposes.

### **Existing Structures**

3.5 Information on existing structures and facilities including concealed utilities was obtained from such records as were available from facility owners and not from exhaustive field investigations. The Contractor may rely on technical data for existing structures and facilities including concealed utilities when such data are shown in the Contract Documents but not on the completeness or adequacy of such data for the Contractor's bidding or construction purposes.

### **Contractor Responsible for Damage**

3.6 The Contractor shall be responsible for:

- .1 verifying the existence and location of all utilities and underground facilities, including the use of potholing, hand excavations and hand demolition;
- .2 coordinating work with utility and facility owners;
- .3 protection of concealed and underground utilities and underground facilities from damage;
- .4 the repair or replacement of utilities or underground facilities damaged by the Contractor's failure to exercise reasonable care; and
- .5 damage to others due to loss of utility service resulting from the Contractor's operations.

### **Differing Conditions**

3.7 If the Contractor encounters: (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inherent in work of the character covered by these Contract Documents, (3) material that the Contractor believes may be hazardous waste as defined by law, the Contractor shall immediately report them to the Engineer. Failure to notify the Engineer of a differing condition prior to performing additional work shall prejudice the Owner and shall be a waiver by Contractor

of any and all claims arising from the differing conditions. If the Engineer determines that conditions encountered are materially different from those indicated in the Contract Documents or ordinarily encountered in work of the character required and that the differing conditions cause a change in the Contractor's cost or time, it will recommend an equitable adjustment in Contract Price and/or Time. The Contractor's failure to notify the Owner of differing conditions that cause a reduction in the Contractor's cost or time shall not affect the Owner's right to make a Claim for adjustment in Contract Price and/or Time. If either the Contractor or the Owner disagrees with the Engineer's recommendation, they may make a Claim under Article 10.

### **Contractor Responsible for Safety Precautions**

3.8 The Contractor shall take all precautions required to protect workers and others from known and unknown or concealed hazards including verifying the location of concealed and underground utilities and underground facilities with utility and facility owners, potholing, hand excavation and hand demolition and shall not rely on the adequacy, accuracy or completeness of information provided in the Contract Documents or elsewhere by the Owner, the Engineer or the Design Engineer. The Contractor shall be solely responsible for and take all responsibility for safety in, on, or about the site.

### **Reference Points, Layout**

3.9 The Owner shall provide reference points to establish property corners, a baseline and an elevation. The Contractor shall protect reference points provided by the Owner and shall reset any that are damaged. The Contractor shall hire a surveyor licensed in the state where the project is being built to reset and document baseline reference points, elevation bench marks and property corners that are damaged.

3.10 The Contractor shall layout the Work from the reference points provided and shall be responsible for accurate location, alignment, elevation and level of the completed Work.

## **ARTICLE 4 - BONDS AND INSURANCE**

### **Performance and Payment Bonds (Not Used)**

### **Insurance Requirements (Not Used)**

### **Certificates of Insurance (Not Used)**

### **Property Insurance: Adjustment of Loss (Not Used)**

## **ARTICLE 5 - CONTRACTOR**

5.1 As a material inducement to enter into this Agreement, Contractor represents it and its subcontractors are skilled in the type of work required by the Contract Documents and is licensed in accordance with applicable law. The Contractor shall perform at least ten percent of the dollar value of the Work using personnel on its own payroll.

### **Supervision**

5.2 The Contractor shall supervise and direct the Work using its best skill and attention. The Contractor shall employ a competent superintendent to represent the Contractor at the site at all times work is being performed. The Superintendent shall not be replaced without reasonable cause and notice to the Engineer. Communications given to the Superintendent shall be as binding as if given to the Contractor.

### **Contractor Responsible for Means and Methods**

5.3 The Contractor shall be solely and completely responsible for and have control over construction means, methods, techniques, sequences, procedures and safety and for coordinating all portions of the Work under the Contract Documents. The Owner, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants shall not be responsible for any construction means, methods, techniques, sequences, nor for safety in, on or about the site, nor for coordinating any part of the Work.

### **Labor, Material and Equipment**

5.4 The Contractor shall provide and pay for labor, material, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, communications, and other facilities and services necessary for the proper execution and completion of the Work.

5.5 The Contractor warrants to the Owner, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants that materials and equipment furnished under the Contract will be of good quality, that the Work will be free from defects, that all material, equipment, hardware, software and firmware products provided to the Project will strictly conform with the requirements of the Contract Documents. If required by the Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. Work not conforming to these requirements, including Proposed Equivalents not Favorably Reviewed, may be considered defective. The Contractor's warranty

excludes remedy for damage caused by the Owner's abuse, modification, improper maintenance, improper operation, or normal wear.

5.6 The Contractor shall enforce strict discipline and good order among persons performing the Work. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

5.7 The Contractor shall be responsible to the Owner, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants for the acts and omissions of the Contractor's employees, subcontractors and their agents and employees, and other persons performing portions of the Work under a contract with the Contractor.

### **Subcontractors and Suppliers**

5.8 Unless listing subcontractors at the time of bidding is required by the bidding documents, the Contractor shall furnish a list of all subcontractors whose work amounts to one-half percent or more of the Contract Price prior to beginning construction. The Contractor shall not contract with any subcontractor to whom the Owner or the Engineer has made reasonable and timely objection.

5.9 Contracts between or among the Contractor, suppliers and subcontractors shall (1) require each supplier and subcontractor to be bound to the Owner, Engineer and Contractor by the terms of these Contract Documents, and to assume toward the Contractor, the Owner, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants all the obligations and responsibilities including but not limited to insurance and indemnity requirements which the Contractor, by these Contract Documents, assumes toward the Owner, the Design Engineer and the Engineer, and (2) at the Owner's option, provide for the assignment of subcontracts to the Owner at Owner's request.

### **Taxes, Permits, Fees and Notices**

5.10 The Contractor shall pay sales, consumer, use, and other similar taxes which are legally enacted when bids are received. The Contractor shall secure and pay for the building permit (less the Plan Review fee) and other permits and governmental fees, licenses and government required inspections necessary for proper execution and completion of the Work including utility connection fees. The Owner will submit the Drawings, Specifications and other required data to

the Building Official prior to bidding and will pay for the Plan Review fee. The Owner will pay capital cost assessments such as plant investment fees required by utility owners.

5.11 The Contractor shall give all notices and shall comply with all laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on furnishing and performing the Work.

### **Patents**

5.12 The Contractor shall include in its bid and shall pay royalties and license fees required for the use of all patents. The Contractor shall defend suits or claims for infringement of patent rights and shall hold the Owner, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants harmless from loss on the account thereof.

### **Documents at the Site, Record Drawings**

5.13 The Contractor shall keep a complete set of Contract Documents including all modifications and all favorably reviewed submittals at the site. The Contractor shall prepare Record Drawings by neatly adding the following information in ink at least once a week to a set of Contract Drawings: (1) references to Contract modifications including Responses to Request For Information, minor changes and Change Orders; (2) as-built work that differs from work shown on the Contract Drawings; and (3) the dimensioned, as-installed location of major underground and concealed utilities, conduits, piping, tanks, facilities and similar items. Record Drawings shall be made on a clean copy of the Contract Drawings furnished under General Conditions paragraph 2.7 and not used for any other purposes. The Contractor shall make Record Drawings available to the Engineer to verify progress. The Contractor shall submit and obtain favorable review of the Record Drawings prior to Final Acceptance.

### **Review of Contract Documents and Field Conditions**

5.14 Before starting work, the Contractor shall carefully study and compare the Contract Documents with each other and with existing site conditions and field measurements. The Contractor shall immediately report any discovered deficiencies including code violations to the Engineer, in writing. The Contractor is not responsible for finding all deficiencies but will be held responsible for construction required to correct deficiencies or code violations that the Contractor had knowledge of or should reasonably have had knowledge of and did not report to the Engineer in writing.

### **Contractor's Construction Schedule**

5.15 Within 10 days after the date in the Notice to Proceed and prior to the commencement of any onsite work, Contractor shall submit:

.1 a temporary construction schedule covering the first 60 days of the Contract Time. The submittal shall be graphic and in electronic form. The electronic information submitted shall include files using the specified scheduling software format, if specified, and an easily readable file such as Adobe Acrobat PDF;

.2 a proposed Critical Path construction schedule, which shows each constituent operation, quantity, rate and period required to accomplish the Work;

.3 the proposed method of procedure, which enumerates the methods and equipment to be employed during each phase of the Work; and

.4 a plan, which indicates the storage and working areas desired to accomplish the construction and is acceptable by the Engineer and the Owner.

5.16 Within 30 days after the date in the Notice to Proceed, the Contractor shall prepare and submit for the Owner's and the Engineer's information a construction schedule for the Work. Unless a specific type of schedule is specified in Division One, the form of schedule may be selected by the Contractor if acceptable by Engineer, and the schedule shall show the beginning and ending date for each major construction task by each trade and the interdependencies between tasks, and shall identify the critical sequence of tasks (or "Critical Path") that determines the shortest time required to complete the Work. The construction schedule shall: (i) not exceed the Contract Time and Milestone dates established in the Contract Documents; (ii) be updated at monthly intervals or as requested by the Engineer; (iii) be related to the entire Project; and (iv) provide for expeditious and practicable execution of the Work. The schedule shall reflect input from the Contractor's subcontractors and suppliers, shall include an allowance for normal unfavorable weather and enough float time to accomplish all clarifications, requests for information, all submittals and changes required in the Contract Documents, and shall not exceed time limits specified in the Contract Documents. If the Contractor's schedule shows a shorter construction period than provided in the Contract Documents, the Contractor's schedule shall be a Critical Path Method (CPM) type schedule, shall be prepared in sufficient detail to demonstrate the feasibility of early completion and shall be submitted within 30 days after

beginning construction. This CPM schedule shall show all required submittals and dates for ordering, shipping and receiving critical materials and equipment. Contractor's submittals shall be submitted with sufficient time to permit 30 days for a response and not impact Contractor's schedule. The submittals shall be graphic and in electronic format. The electronic information submitted shall include files using the specified scheduling software format, if specified, and an easily readable file such as Adobe Acrobat PDF.

5.16.1 Format. Unless otherwise provided in the Specifications, the construction schedule shall be in a detailed precedence Critical Path Method ("CPM") or Primavera-type format satisfactory to the Engineer, which shall also: (i) provide a graphic representation of all activities and events that will occur during performance of the Work; (ii) identify each phase, design, construction and maintenance; and (iii) set forth dates that are critical in ensuring the timely and orderly completion of the Work in accordance with the requirements of the Contract Documents (hereinafter referred to as Milestone dates). At a minimum the Construction Schedule shall depict the schedule or Work on a discipline by discipline and trade by trade basis and tasks within each discipline and trade. The Construction Schedule shall include (i) proposed activity sequences and durations showing the amount of Float for each activity; (ii) Milestone dates for receipt and acceptance of pertinent information, including Owner-supplied information and approvals by public authorities having jurisdiction over the Project; (iii) dates for preparation and processing of Submittals; (iv) dates for delivery of materials or equipment requiring long-lead time procurement; (v) Owner's occupancy /use requirements showing portions of the Project having occupancy priority; (vi) the dates of Substantial and Final Completion; and (vii) other information reasonably required by Owner.

5.16.2 Updates. With each Application for Payment submitted by Contractor (other than the final Application for Payment), the Contractor shall submit to the Engineer an updated construction schedule revised to indicate the portion of the Work executed, all progress slippages, corrective actions taken, or slippage carry-over, for all anticipated delays of difficulties, and all other information required to accurately present the actual status of the progress of the Work as of the date of the Application for Payment. If the Contractor does not submit an updated construction schedule with an Application for Payment, Owner shall withhold payment, in whole or in part. In the event any update to the Project Schedule indicates any delays to the Contract Time that are the fault of Contractor or others for whom Contractor is responsible, the Contractor shall propose

an affirmative plan to correct the delay, including overtime and/or additional labor, if necessary. In no event shall any construction schedule update constitute an adjustment in the Contract Time, any deadline, or the Contract Price unless any such adjustment is agreed to by the Owner and authorized pursuant to Change Order.

5.16.3 Daily Logs. Contractor shall maintain a daily log containing a record of weather, Contractor's own forces working on Site; Subcontractors working on the Site; number and labor classification of workers or each Subcontractor on Site; materials delivered; major equipment on Site, Work started, completed and accomplished that day; approximate count of all personnel at the Project Site; inspections tests and visitors; accidents, any Work stoppages, delays, shortages or losses; problems encountered and other similar relevant data as the Owner may reasonably require. The daily log shall be signed by Contractor's Superintendent, submitted by 4:30p.m. on the next Working Day to Engineer and shall be made available to others as directed by Owner.

5.16.4 Performance. The Contractor shall perform the Work in accordance with the most recent construction schedule and schedule of Submittals accepted by the Owner. The Contractor shall monitor the progress of the Work or conformance with the requirements of the Construction schedule and shall promptly advise the Engineer and Owner of any delays or potential delays.

5.16.5 Extraordinary Measures. In the event the Owner determines that the performance of the Work has not progressed or reached the level of completion required by the Contract Documents, the Owner shall have the right to order the Contractor to take corrective measures necessary to expedite the progress of construction, including without limitation: (i) working additional shifts or overtime, (ii) supplying additional manpower, equipment, and facilities and (iii) submitting a recovery schedule for re-sequencing performance of the Work or other similar measures. Such corrective measures shall continue until the progress of the Work complies with the stage of completion as required by the Contract Documents. The Contractor shall not be entitled to an adjustment in the Contract Price in connection with the corrective measures required by the Owner under or pursuant to this section. The Owner may exercise these rights pursuant to this section as frequently as the Owner deems necessary to ensure that the Contractor's performance of the Work will comply with the Contract Time or interim completion dates set forth in the Contract Documents. If Contractor or its Subcontractors fail to implement or commence

corrective measures within ten (10) calendar days of Owner's written demand, Owner may, without prejudice to other remedies take corrective action at the expense of the Contractor and shall reduce the Contract Price.

5.17 It is agreed that the Contract Price includes the Contractor's office and field overhead, profit and related charges for the full Contract Time. The Contractor may, at its option, complete the Work in a shorter period than the Contract Time but the Contractor may not make a claim for extended overhead or other charges for: (1) delays that extended completion beyond the date planned by the Contractor but not beyond the Contract Time, and (2) delays contemplated by the Contractor and the Owner. All float in the schedule shall first be for the benefit of the Owner, the Engineer, the Design Engineer and then for the benefit of the Contractor. To the fullest extent permitted by law, the Contractor on behalf of itself and its subcontractors, waive any and all claims for damages attributable to delays, interference, or acceleration caused by the Owner, the Engineer, the Design Engineer and each of their officers, employees, agents and consultants and the Contractor and its subcontractors shall be entitled to an extension of the Contract Time as their exclusive remedy.

5.18 The construction schedule shall provide for expeditious and practicable execution of the Work and shall be revised and submitted monthly unless excused by the Engineer in writing. The Contractor shall conform to the most recent schedule.

5.19 The Contractor shall prepare and keep current, for the Engineer's information, a schedule of submittals which is coordinated with the Contractor's construction schedule and allows 30 days for the Engineer's review of each submittals and 30 days for review of each resubmittal.

### **Safety of Persons and Protection of Property**

5.20 The Contractor shall be solely and exclusively responsible for construction safety means and methods and for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of this Contract.

5.21 The Contractor shall take all necessary precautions for safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or

the Contractor's subcontractors or sub-subcontractors; and

.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and underground facilities not designated for removal, relocation or replacement in the course of construction.

5.22 The Contractor shall give notices and comply with applicable laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

5.23 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, necessary fences and other safeguards for safety and protection of persons and property on and off the site and shall: (1) post danger signs and other warnings against hazards, (2) promulgate safety regulations, and (3) notify owners and users of adjacent sites and utilities when the Contractor's operations may affect them.

5.24 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry out such activities under supervision of properly qualified personnel.

5.25 The Contractor shall promptly remedy damage and loss to property that the Contractor is required to protect caused in whole or in part by the Contractor, a subcontractor, a sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable. The Contractor shall not be responsible for damage or loss resulting solely from the acts or omissions of the Owner or the Engineer or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under the Indemnification clause in this Article 5.

5.26 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's Superintendent unless otherwise designated by the Contractor in writing to the Owner and Engineer.

5.27 The Contractor shall be responsible for initiating, maintaining and supervising all safety

precautions and programs required in connection with the Work and shall send copies of all accident, injury or work-related illness reports and of all notices of unsafe conditions to the Engineer.

5.28 The Contractor shall not load or permit heavy weights to be placed on any part of the construction or site so as to endanger its safety.

### **Hazardous Materials**

5.29 If the Contractor encounters material on the site which it reasonably believes may contain asbestos, polychlorinated biphenyl (PCB) or other hazardous material, the Contractor shall stop work in the affected area and shall notify the Owner in writing. The Owner shall have the suspected material tested and if found to contain asbestos, PCB or other hazardous material, the Owner shall have the material removed or rendered harmless. Work in the affected area may be resumed when the Owner gives written notice that the material containing asbestos, PCB or other hazardous material has been removed or made harmless. If halting work in the affected area impacts the Contractor's critical path for construction, the delay will be regarded as an Excusable Delay and the Contract Time will be extended.

### **Owner's Indemnification for Hazardous Materials**

5.30 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Engineer, Design Engineer, and each of their consultants, agents, employees, officers, and shareholders from and against all claims, damages, losses and expenses, including, but not limited to, attorney's fees, arising out of or resulting from work in areas affected by asbestos, polychlorinated biphenyl (PCB) or other hazardous material, the presence and location of which has not been identified by the Owner in writing.

### **Emergencies**

5.31 In an emergency affecting safety of persons or property, the Contractor shall act as required to prevent threatened damage, injury or loss without instruction or authorization from the Owner or Engineer. Additional compensation or extension of time claimed by the Contractor on account of such an emergency shall be determined as provided under Article 10.

### **Indemnification (Not Used)**

### **Escrowed Bid Documents (Not Used)**

## **ARTICLE 6 - OWNER**

### **Owner's Right to Perform Work and Award Separate Contracts**

6.1 The Owner reserves the right to perform construction within, related to or adjacent to the Work as a separate activity using its own workers or by contracts with separate contractors under contract conditions similar to those in Article 4 with respect to insurance and subrogation. The Owner shall provide coordination of these separate activities with the Work of the Contractor.

6.2 The Contractor shall cooperate with the Owner's separate contractors and workers and shall afford them access to their work areas and space to store materials, tools and equipment. The Contractor shall adjust its construction schedule to reflect agreed upon interfaces with the Owner's separate activities.

### **Mutual Responsibility**

6.3 If part of the Contractor's work depends on or must interface with work performed by the Owner as a separate activity, the Contractor shall (1) cooperate with the Owner's coordination of the work efforts, (2) inspect work provided by the Owner's separate activities for compatibility with work provided or intended to be provided by the separate contractor, and (3) report to the Owner and the Engineer, prior to proceeding with work that may be affected, any deficiencies in work planned or executed by the Owner that would render it incompatible with work planned or completed by the separate contractor.

6.4 If the Contractor is caused delay or additional cost because of the Owner's separate activities, it may make a Claim as provided under Article 10.

### **Owner's Right to Stop the Work**

6.5 If the Contractor fails to correct defective work or continues to perform defective work, the Owner may issue a signed order directing the Contractor to stop the Work or a portion of the Work until the defective work has been corrected. This right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity.

### **Owner's Right to Carry Out The Work or Correct Defective Work During Construction**

6.6 If the Contractor fails to remove and replace or correct Defective Work, or if the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails to cure the defect, fault or neglect within 7 days after receipt of written notice from the Owner, the Owner may issue a second notice warning the Contractor that if it does not correct the defect, fault or neglect within the second 7-day period the Owner will, without prejudice to other remedies the Owner may have, correct such deficiencies. In which case, the Owner will deduct the cost of correcting such deficiencies, including compensation for any additional engineering services required, from payments due the Contractor. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. The Owner's right to correct Defective Work during the Guarantee Period is covered in Article 12.

### **ARTICLE 7 - ADMINISTRATION OF THE CONTRACT**

7.1 At the Owner's option, either the Owner or the Engineer designated by the Owner will provide administration of the Contract and will be the Owner's representative (1) during construction, (2) until final payment is due and (3) with the Owner's concurrence, from time to time during the Guarantee Period. If an engineer other than the Design Engineer is appointed to be the Engineer to administer the Contract during construction, the duties and responsibilities of the Engineer and the Design Engineer during construction will be defined in the Supplementary Conditions, in Division One of the Specifications or in a modification to the Contract.

7.2 The Engineer may visit the site at intervals appropriate to the stage of construction to become generally familiar with the progress and quality of the completed Work and to determine in general if the Work is being performed in accordance with the Contract Documents. However, the Engineer will not be required to make exhaustive or continuous on-site inspections to check quality or quantity of the Work. The Contractor shall not rely upon the Engineer's site visits nor raise as a defense to any claims of defective work, that the Engineer visited the site or observed the site.

7.3 The Engineer shall not have control over or charge of and shall not be responsible for construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, since these are solely the Contractor's

responsibility as provided in Article 5. The Engineer shall not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. Contractor stipulates that the Engineer and Design Engineer have not assumed by contract any responsibility for safety practices in, on or about the site and Contractor shall not request, imply or represent that Engineer or Design Engineer actually exercise control over any portion of the premises.

7.4 The Engineer shall not have the authority to authorize extra work or to change the Contract Time or Price. The Engineer shall not have the authority to stop the Work. The Engineer's duties, responsibilities and limitations of authority are set forth in the Agreement between the Owner and the Engineer and shall not be modified by any action or inaction of any parties and can only be changed by a fully executed Amendment to the Agreement between the Owner and the Engineer.

7.5 The Engineer will have authority to reject Defective Work. The Engineer will have authority to require additional inspection or testing of the Work whether or not such Work is fabricated, installed or completed. Neither this authority of the Engineer nor a decision not to exercise such authority shall give rise to a duty or responsibility of the Engineer to the Contractor, subcontractors, material and equipment suppliers, their agents or employees, or other persons performing portions of the Work.

7.6 The Owner may arrange for the Engineer to provide a full-time on-site Resident Engineer with additional staff as appropriate. The duties, responsibilities and limitations of authority of the Resident Engineer and his staff shall be the same as defined for the Engineer in the Agreement between the Owner and the Engineer.

### **Communications**

7.7 Communications between the Owner or the Design Engineer and the Contractor shall be through the Engineer. Communications between the Contractor and the Design Engineer shall be through the Engineer, and communications between the Contractor and the Design Engineer's consultants shall be through the Engineer and the Design Engineer. Communications between the Engineer and the subcontractors shall be through the Contractor.

### **Requests for Information and Responses**

7.8 The Engineer will endeavor to issue Responses to Requests for Information within 30 days of the date

a Request for Information is received by the Engineer unless the Engineer requests more information from the Contractor in which case the Response will be issued 20 days after receipt of the additional information. The Contractor shall use the Request for Information form, attached as Exhibit GC-1. The Engineer's Response to a Request for Information shall not authorize a change in Contract Time or Price. If the Contractor disagrees with the Engineer's interpretation of the Contract Documents, it shall notify the Engineer in writing in accordance with Article 9. The Engineer shall not be required to answer Requests for Information when the information is contained in the Contract Documents or when the Request for Information form is incomplete or not used.

## ARTICLE 8 - SUBMITTALS

### Definitions

#### 8.1 Definition of Terms:

.1 "Shop Drawings" are drawings, diagrams, schedules and other data custom prepared by the Contractor or one of its subcontractors or suppliers to illustrate some portion of the Work.

.2 "Product Data" are catalogue pages, brochures, schedules, performance charts, diagrams, instructions and other information which have been highlighted or marked and certified (if required in the Technical Specifications) by the Contractor to indicate the specific items, including options, that are being submitted for some portion of the work.

.3 "Submittal for Informational Purpose Only" is an item required for the Owner's permanent records relating, in part, to future maintenance, repair, modification, replacement of work or as otherwise required. Submittals for Informational Purpose Only will only be received and logged to document that the required submittals have been made. Neither the Owner nor Engineer will respond to a Submittal for Informational Purpose Only.

.4 A "Proposed Equivalent" is an item proposed for use by the Contractor in lieu of the first specified item and warranted by the Contractor as being at least equal in quality, utility, function and appearance to the first specified item. The Contractor shall assume all costs and be fully and solely responsible for the Proposed Equivalent.

.5 "Favorable Review" by the Engineer means that based on information submitted by the Contractor and in consideration of the Contractor's warranty required by General Conditions paragraph 8.8 the Contractor may provide the Favorably Reviewed item or work subject to the limitations in General Conditions Article 8, the General Requirements of Division 1, and the Engineer's review comments.

.6 The term "first specified item" or "first named maker" refers to the first product identified in the Specifications by a model number or trade name and/or by a maker's name for a specified item.

### Specified Items, Proposed Equivalents ("Or Equal")

8.2 When the first specified item is followed by a second maker's name and "or equal," the Contractor may submit Proposed Equivalent items for the Engineer's review. Proposed Equivalent items that are in the Engineer's judgment equal to the first specified item in quality, utility, and appearance, will be Favorably Reviewed. Where a product description and first maker's name is followed by "or equal" with no second maker's name, it means the specifier knows of no equivalent product and the Contractor may submit Proposed Equivalent products by other makers for review. Where the term "or equal" is omitted, it means that the named item is required to meet the Owner's needs; no products or makers other than those specified will be considered.

8.3 Proposed Equivalent items must be submitted as required for Product Data submittals on the form attached as Exhibit GC-3 and shall include adequate technical information to fully describe the function and quality of the item. Submittals of Proposed Equivalent items that are not made within 35 days of the Notice to Proceed will be rejected unless the Engineer has agreed in writing to a later submittal date and the Contractor agrees to comply with all conditions of the Engineer for the late submittal. If the Contractor's second attempt to obtain Favorable Review of a Proposed Equivalent item is unsuccessful, the Contractor shall submit the first specified item.

8.4 Inclusion of a second maker's name indicates the maker is acceptable but does not necessarily indicate the maker offers a standard product equal to the first specified item.

.1 Items by the second named maker are subject to the same conditions of review and compatibility as other Proposed Equivalent items.

.2 Inclusion of a maker's name and/or model number after a specification description is not a representation that the maker will furnish an item meeting the Contract requirements at bid time or at time of need. It is the Contractor's sole responsibility to furnish items meeting the Contract requirements.

8.5 Where items are specified with a description followed by a maker's name and trade name or model number, the item shall be provided with all of the

custom modifications, special features, accessories and options described even though such things may not normally be included by the maker or provider as part of the model specified. Where there is a conflict between the written description of an item and maker's trade name and/or model number, the written description shall take precedence.

8.6 The design is based on first specified items including all described custom modifications, special features, accessories and options as made by the first named maker. The Contractor shall be responsible for all cost including redesign required to accommodate a Proposed Equivalent item including items by the second named maker.

8.7 The Engineer's review of Proposed Equivalent items is based solely on information provided by the Contractor and on the Contractor's warranty that the proposed item is at least equal in quality, utility, function and appearance to the first specified item. Favorable Review of a Proposed Equivalent item has the same meaning and is subject to the same limitations that apply to the Favorable Review of Product Data and Shop Drawings described in this Article.

### **Shop Drawings, Product Data, Samples and Proposed Equivalents**

#### **Intent of Contractor's Review**

8.8 The Contractor shall make required submittals including Shop Drawings, Product Data, Samples and Proposed Equivalent items in time to allow for the Engineer's review and resubmittal, if required, without causing delay to the Work. The Contractor and appropriate subcontractor shall review, stamp, date and sign submittals before sending them to the Engineer. By making such a submittal, the Contractor makes the following warranty and shall include that warranty statement on its letter of transmittal.

"The Contractor warrants:

1. Work or items submitted are complete, accurate and meet the requirements of the Contract Documents, or else any deviations are identified and described in a separate letter accompanying the submittal form, Exhibit GC-2.
2. Work or items submitted have been coordinated with and meet the requirements of other submittals, field conditions and the Work as a whole and quantities and dimensions are correct.
3. Proposed Equivalent items are at least equal in quality, utility and appearance to the first specified item, or else any deviations are identified

in a separate letter accompanying the submittal form, Exhibit GC-3.

4. Adjustments to other work required to accommodate Proposed Equivalent items including second named items have been delineated on the submittal and will be made at the Contractor's expense.

5. This submittal includes all items needed for a particular specification section or assembly for which submittals are required.

6. And represents that all material, equipment, hardware, software and firmware product provided to the Project will perform without error, loss of data or loss of functionality arising from any failure to process, calculate, compare or sequence data accurately.

#### **Intent and Limitations on Engineer's Review**

8.9 The Engineer's review of the Contractor's submittals is done solely for the Engineer's and Owner's benefit. The Contractor agrees that the Engineer has no duty to the Contractor or any of its subcontractors or suppliers for the accuracy, completeness or adequacy of the Engineer's review of its submittals.

8.10 The Engineer's review of submittals is for compliance with the design intent and requirements of the Contract Documents and is based solely on information provided by the Contractor and on the Contractor's warranty that the work or items submitted meet the requirements of the Contract Documents, and the Work as a whole. If later information reveals that work or items submitted or furnished do not meet the requirements of the Contract Documents or the Work as a whole, the Engineer's Favorable Review shall be void and the items or work shall be considered Defective. The Engineer's Favorable Review shall not include an examination of methods or means of construction or required safety precautions. The Engineer's Favorable Review: (1) shall not include a review of quantities or dimensions, (2) shall not relieve the Contractor from responsibility for errors or omissions in submittals, (3) shall not relieve the Contractor from responsibility for complying with the requirements of the Contract Documents, (4) shall not constitute a Change Order, and (5) shall not constitute final acceptance of a product, item or portion of the Work.

8.11 The Engineer's Favorable Review of submittals shall not relieve the Contractor from responsibility for deviations from the requirements of the Contract Documents unless the deviations are specifically

called to the Engineer's attention in a separate letter accompanying the submittal form, Exhibit GC-2, and the Engineer favorably reviews the specific deviations in writing.

8.12 The Engineer's Favorable Review of a re-submittal does not include a review of changes made by the Contractor to a previous submittal that were not requested by the Engineer unless the Contractor specifically calls the Engineer's attention to the non-requested changes, in a separate letter accompanying the resubmittal of form Exhibit GC-2.

8.13 Where performance type specifications are used or where pre-engineered or Contractor designed systems, elements, equipment or components are called for, the Owner, the Design Engineer and the Engineer shall have the right to rely on the Contractor's design. Favorable Review of the Contractor's design submittal shall be limited to acknowledgment that the design was prepared with the intent of meeting the specified performance criteria, but the Engineer's review shall not constitute a review of the design itself, of the designer's calculations, or of the effectiveness of the design in actually satisfying the specified criteria.

8.14 The Contractor shall allow 30 days for the Engineer's review of each submittal and 30 days for each resubmittal unless a different period is specified by the Engineer in writing. If the Engineer requests additional information or clarification of a submittal, the 30 days shall be measured from the date the additional information or clarification is received. If the Contractor requires more than two submittals to obtain the Engineer's Favorable Review, the Contractor shall compensate the Owner for the cost of the Engineer's additional review time. The Contractor shall not perform work for which reviewed submittals are required without obtaining Favorable Review of submittals.

8.15 Submittals required for the Owner's or Engineer's information and on which the Engineer shall not be expected to take responsive action are identified in the Contract Documents.

## **ARTICLE 9 - CHANGES IN THE WORK**

### **Changes**

9.1 The Owner may order changes in the Work after executing the Agreement by issuing a written Change Order or Work Directive Change.

9.2 The Contractor expressly agrees that it shall not consider any order, instruction, Clarification, Response to a Request for Information or any other

communication either written or oral given intentionally or unintentionally by the Engineer, Owner or any other person as authorization or direction to do work that would cause a change in Contract Time or Price unless it is a Change Order or Work Directive Change signed by the Owner.

### **Requests for Quotation**

9.3 If a change involving Contract Price or Time is being considered, the Engineer will issue a Request for Quotation describing the proposed change. The Contractor shall submit a quotation promptly so not to delay or interfere with the progress of the Work, in accordance with the requirements for determining the cost of changes described in this Article.

### **Change Orders**

9.4 If the Owner and the Contractor agree on the change in Price and Time for a proposed change, a Change Order will be issued and signed by the Engineer, Contractor and the Owner. An executed Change Order shall be conclusive and final settlement of the change in Contract Time and Price for the work covered by the Change Order including the effect of the change on all other portions of the work completed or not and shall include compensation for all related claims for disruption, impact, delay or extended overhead, if any, that may result from the change. Implied in every Change Order, unless expressly reserved by the Owner or Contractor, is a waiver of all known and unknown claims arising out of the Change Order, including a waiver of Section 1542 of the California Civil Code as well as under any other state or federal statute or common law principle of similar effect which provides as follows:

"GENERAL RELEASE CLAIMS EXTINGUISHED.

A general release does not extend to claims which the creditor does not know or suspect to exist in his favor at the time of executing the release, which, if known by him, must have materially affected his settlement with the debtor."

9.5 The Owner reserves the right to have changed work performed by a separate contractor or its own workers if the Contractor and the Owner cannot agree on the change in Price and Time required.

### **Work Directive Change**

9.6 If the Owner and the Contractor have not agreed on the change in Price or Time required for a proposed change, or if time does not permit preparation of a quotation, the Owner may direct the

Contractor to proceed with the work on a cost accounting basis by issuing a Work Directive Change.

9.7 All Work Directive Changes must be signed by the Owner and will state the maximum sum the Owner is obligated to pay.

.1 If the Contractor has agreed to do the work on a cost accounting basis and to complete the work for an amount not to exceed the stated maximum sum, the Contractor shall sign the Work Directive Change.

.2 If the Contractor cannot agree to a maximum sum to complete the work, the Contractor shall not sign the Work Directive Change. In that case the maximum sum shall limit the amount the Owner is obligated to pay to the Contractor but shall not obligate the Contractor to complete the work for that sum.

9.8 When the Owner and the Contractor agree on the change in Price and Time for a Work Directive Change, the Work Directive Change shall be converted into a Change Order.

#### **Information, Interpretations and Minor Changes**

9.9 The Engineer has the authority to order minor changes in the Work including interpretations which are consistent with the intent of the Contract Documents. The Engineer does not have authority to order any changes which involve:

- .1 a change in Contract Price, or
- .2 a change in the Contract Time, or
- .3 means, methods, techniques or sequence of Work, or
- .4 safety in, on or about the site.

If the Contractor considers that any minor changes so ordered causes a change in Contract Price or Time, the Contractor shall notify the Engineer in writing within 15 days of receipt of the order and shall not proceed with the work except in the case of an emergency endangering persons or property.

9.10 If, after reviewing the Contractor's objection to a minor change, the Engineer determines the work is required by the Contract Documents and does not involve a change in Price or Time, the Owner may direct the Contractor, in writing, to proceed with the work. If so directed, the Contractor may (1) accept the Engineer's determination and proceed with the work or (2) give the Engineer written notice 5 days in advance of beginning work stating that it intends to make a claim under Article 10 and will document costs in accordance with paragraphs 9.11 through 9.14.

#### **Determining Cost of Changes**

9.11 The Contractor's quotations of cost on proposed changes and cost reported for work performed on a cost accounting basis shall be determined as the sum of the following:

.1 costs of labor including foremen engaged on the work but not of the Superintendent, field engineer, project manager, and other supervisory or support personnel except as provided in paragraph 9.11.5. Labor costs shall include the cost of social security, old age and unemployment insurance, fringe benefits required by labor agreements and workers' or workmen's compensation insurance;

.2 costs of materials, supplies and equipment, including cost of transportation, incorporated in the Work;

.3 rental costs of machinery and equipment, exclusive of portable power or hand tools, supplied by the Contractor or rented from others;

.4 costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the change;

.5 the increased or decreased cost of the Contractor's supervision and field office personnel but only if the change affects the "critical path" of construction activities and requires a change in Contract Time;

.6 the reasonable cost of any tier of subcontractors' work computed as required for the Contractor's work. The mark-up charged by a subcontractor for overhead and profit shall be the lesser of: i) subject to negotiation, ii) as included in the original bid for the Work, or iii) not to exceed 10% for work performed directly by the subcontractor and 5% for work performed by a subcontractor one tier below it, and

.7 for the reasonable work performed by the Contractor, the mark-up for overhead, profit and all other costs shall be the lesser of: i) subject to negotiation, as included in the original bid for the Work and contained in escrowed bid documents, or iii) not to exceed 10% for work performed directly by the Contractor and 5% for work performed by a subcontractor.

.8 Limitations on Markup for Changes. Where multiple tiers of Subcontractors are involved in a change in the Work, the maximum total amount of adjustment to the Contract Price and for markup for all tiers of Subcontractors and for Contractor self-performed Work shall not exceed twenty percent (20%) of the direct costs incurred by Contractor and the Subcontractors and Material Suppliers actually performing the Work.

Work shall be done making the most effective use of labor; materials shall be purchased at the lowest available price and all discounts shall be passed on to the Owner; equipment shall be rented at the most favorable rate available for the term of use required.

9.12 When both additions and deletions are related and pertain to the same work item and are included in the same Change Order, the mark-up for overhead and profit shall be computed on the net increase, if any. No deductions for overhead and profit will be made on deductive changes except for deductive changes that materially change the scope of the work or deductive changes issued pursuant to the Owner's right to correct defective work, the Owner's right to remedy the Contractor's default or neglect or the Owner's right to terminate the Contract for cause.

9.13 The Contractor shall keep the Engineer informed as to when and where work is being performed on a cost accounting basis and shall submit complete auditable records of the cost of such work including daily time sheets signed daily by the Engineer.

9.13.1 Contractor Maintenance of Daily Records for Changes. In the event that Contractor is directed to perform any changes to the Work, or should Contractor encounter conditions which the Contractor believes would obligate the Owner to adjust the Contract Price and/or the Contract Time, Contractor shall maintain detailed records of the cost of such changes on a daily basis and a summary in a daily report supplemented by back-up records. Such records shall include without limitation hourly records for labor and construction equipment, itemized records of materials, including delivery tickets, and equipment used each day in connection with the performance of any change to the Work. In the event that more than one change to the Work is performed by Contractor in a calendar day, Contractor shall maintain separate records of labor, construction equipment, materials, and equipment for each such change. In the event that any Subcontractor of any tier shall provide or perform any portion of any change to the Work, Contractor shall require that each such Subcontractor maintain records in accordance with this Article. Each daily record maintained hereunder shall be signed by the Contractor; such signature shall be deemed Contractor's representation and warranty that all information contained therein is true, accurate, complete, and relates only to the change referenced therein. All records maintained by Subcontractors of any tier, relating to the costs of a change in the Work shall be signed by such Subcontractor's authorized Project Manager or Superintendent as a representation and warranty that all information contained therein is true, accurate, complete, and relates only to the change

referenced therein. All such records shall be delivered to Engineer not later than on the day the Work is performed (same day) for independent verification. The Engineer shall attempt to review and reconcile costs of changes on a daily basis. The Engineer's signature on the report shall indicate agreement with the information reflected therein, not that the Contractor is entitled to payment of the costs in the report. If the Engineer disagrees with the response, the Engineer shall note the areas of disagreement on the report. In the event that the Contractor shall fail or refuse, for any reason, to maintain or make available for inspection, review and/or reproduction such records, adjustments to the Contract Price or Contract Time, if any, on account of any change to the Work may be deemed waived for that day. Contractor's obligation to maintain back-up records hereunder is a material inducement to and in addition to, and not in lieu of, any other Contractor obligation under the Contract Documents with respect to changes to the Work.

9.13.2 Labor. The daily report shall show the names, trade, labor, classifications, and hours worked, for the workers.

9.13.3 Material. The daily report shall describe and list quantities of materials used, attaching delivery tickets.

9.13.4 Equipment. The daily report shall show type of equipment, size, identification number, and hours of operation, including loading and transportation, if applicable.

9.13.5 Other Services and Expenditures. Other services and expenditures shall be described in such detail in the daily report as the Owner or Engineer may require.

9.13.6 Cost. The report shall provide dollar values for each category of cost.

9.14 Any work for which the Contractor may wish to make a claim shall be done in accordance with these requirements for work done on a cost accounting basis.

#### **Change in Contract Time Due to Changes in the Work**

9.15 If the work required by a Change Order affects the "Critical Path" of construction tasks and is the sole, unavoidable cause for changing the length of time required to complete the Work, the Contract Time will be adjusted accordingly.

## **ARTICLE 10 - CLAIMS AND DISPUTES**

### **Claims**

10.1 A Claim is a written demand by one of the parties to the Contract for an interpretation of Contract terms or an adjustment in Contract conditions including Price or Time and may involve questions of performance under the Contract including acceptability of work, progress of work, the extent to which work has been completed, whether work is included in the Contract, and other matters in question between the Owner and the Contractor.

10.2 Content of Claim. Claims shall be made in writing and shall include complete documentation including:

.1 The Contractor's certification, by its owner or an officer, under penalty of perjury, that (a) the claim is made in good faith, (b) supporting data are accurate and complete to the best of the Contractor's and subcontractor's knowledge and belief, and (c) the amount requested accurately reflects the Contract adjustment for which the Contractor believes the Owner is liable.

.2 Full disclosure of facts and detailed reasons supporting the Claim and citing relevant provisions in the Contract Documents.

.3 Complete documented cost of doing the work for which it is making a Claim and such cost and documentation shall be submitted in accordance with General Conditions paragraphs 9.11 through 9.14.

### **Engineer's Decisions**

10.3 The Engineer, as an arbiter of disputes, will make an initial decision on all Claims made prior to the date the final payment is due including Claims alleging an error or omission by the Engineer. The Engineer's decision will be in writing, will be consistent with the intent of the Contract Documents and will cite the basis on which it is made. The Engineer will endeavor to make decisions that are impartial and will not be liable for results of decisions made in good faith. The Engineer's decision is a condition precedent to a demand by either party that a Claim be settled by litigation, or if agreed to in advance by both parties or if required by law, be settled by mediation or arbitration.

### **Time Limits for Submitting and Deciding Claims**

10.4 The Contractor shall give written notice 5 days prior to beginning any work for which it intends to make a Claim for an increase in Contract Time or Price and expressly waives any right to make a Claim if the required notice is not given. All other Claims must be made within 14 days of the time the condition giving rise

to the Claim becomes known to the claimant. The Engineer, as an arbiter of disputes, will issue a written decision on the Claim within 30 days after receipt of the Claim unless additional information is requested from the claimant or the claimant amends the Claim and then a decision will be issued within 30 days after receipt of additional information, or an amended Claim. Should a Claim be presented that is in part timely and in part untimely, the Engineer shall reject the untimely Claim and decide the timely claim. All Claims must strictly follow the notice requirements of this agreement.

10.5 A demand to appeal the Engineer's decision and settle a Claim by litigation, mediation or arbitration can only be made after the Engineer has made a written determination, or in the absence of a determination, 7 days after the Engineer's determination became due. If no demand to settle a Claim by litigation, mediation or arbitration is made within 15 days after the Engineer's written decision was issued, the Engineer's decision shall become final and binding on the Owner and the Contractor and if a change in Contract Time or Price is involved, a Change Order shall be signed by both parties.

10.6 Provisions of law notwithstanding, the Owner and Contractor hereby agree that neither the Engineer, the Design Engineer, nor any other third party shall, without its specific written consent, be required to participate as a party in any litigation, arbitration or mediation proceedings between the Contractor and the Owner initiated to resolve disputes under the Contract Documents.

### **Mediation**

10.7 If any dispute, controversy, or Claim (hereinafter referred to as a dispute) arises out of or relates to this Contract, or breach thereof, and if the dispute cannot be settled through direct discussions, then the parties first agree to try to settle the dispute by mediation before resorting to litigation or some other dispute resolution procedure. The mediator shall be an attorney experienced in mediating construction disputes and shall be chosen by agreement of the parties, but if no agreement then appointed by the Presiding Judge of the Superior Court in the jurisdiction of the site. Each party shall bear its own costs and expenses of the mediation, including attorney's fees. The fees and costs of the mediator shall be borne equally by the parties.

### **Work Continued During Disputes**

10.8 The Contractor shall continue to work in conformance with the requirements of the Contract Documents and the progress schedule during any dispute and when waiting for decisions on Claims by the Engineer or for resolution of Claims by litigation, mediation or arbitration, unless otherwise directed in writing by the Engineer or Owner.

## **ARTICLE 11 - CONTRACT TIME AND DELAYS**

### **Definitions**

11.1 Definitions of Terms:

1 "Contract Time" is the period of time including authorized adjustments allowed for completion of the Work and is measured from the date of commencement in the Notice to Proceed to the date of Final Completion.

2 "Day" is a calendar day beginning and ending at midnight.

3 "Unusual Weather" is defined as when either the number of Wet Days or the number of Freezing Days exceeds the most recent published mean number of Wet or Freezing Days for the period of record, for the same month and for the weather observing station closest to the project site as reported in "Comparative Climatic Data" published by the National Oceanic and Atmospheric Administration, Asheville, NC 28801. "Wet Days" are defined as days that have at least 1.0 inch of rainfall. "Freezing Days" are defined as days with a minimum temperature of 32 degrees F or lower.

### **Computation of Time**

11.2 Any period of time referred to in the Contract Documents measured in days shall mean consecutive calendar days and shall exclude the first and include the last day. If the last day falls on a Saturday, Sunday or legal holiday, it shall be omitted from the calculation.

### **Contract Time**

11.3 Time limits stated in the Agreement are the essence of the Contract. The Contractor confirms that the Contract Time is a reasonable period for performing the Work and includes enough float time to allow for normal unfavorable weather and other reasonably anticipated delays.

### **Damages for Late Completion**

11.4 Liquidated damages if applicable are stipulated in the Agreement. If liquidated damages are not stipulated, the Contractor will be assessed actual

damages suffered by the Owner as a result of completion after the Contract Time.

### **Commencing Work**

11.5 The Contractor shall not commence work (1) prior to the date in the Notice to Proceed, (2) prior to giving the Engineer 5 days written notice and (3) prior to the effective date of insurance coverage required under Article 4.

### **Accelerated Work If Required to Meet Schedule**

11.6 The Contractor shall proceed expeditiously with adequate forces and shall achieve Final Completion within the Contract Time. If the Contractor's performance falls behind schedule, the Contractor shall accelerate the work as required to get back on schedule at no additional cost to the Owner. Accelerated work shall include air or express delivery of materials and equipment, increasing the number of workers, working overtime, working Saturdays, Sundays, and holidays and working additional shifts. The Contractor shall pay the Owner for any extra cost of inspection made necessary by accelerated work required under this provision.

### **Excusable Noncompensable Delay**

11.7 "Excusable Delay" means unforeseeable delay beyond the Contractor's or Owner's control and not resulting from the Contractor's fault or negligence. Excusable Delay includes labor disputes, fire, Unusual Weather, unavoidable casualties and unusual delays in transportation. The Contractor may make a Claim under Article 10 for an extension of Contract Time due to an Excusable Delay if it can show that the Excusable Delay is the sole and unavoidable cause increasing the time actually needed to complete the Work. The Contractor shall not be entitled to an increase in Contract Price due to an Excusable Delay.

### **Compensable Delays**

11.8 The Contractor may make a Claim under Article 10 for extension of Contract Time due to delays that are not due to the fault or neglect of the Contractor and which could not have been reasonably anticipated, including delays: (1) caused by the Owner or Engineer or by the Owner's separate contractors or workers, (2) resulting from the Owner's failure to provide access to lands or rights-of-way on which the Work is to be performed, or (3) due to suspension of the Work ordered by the Owner. In making such a Claim, the Contractor must demonstrate that the delay was the sole and unavoidable cause for increasing the length of time required to complete the Work on the

critical path. In the case of a delay which was caused in part by the Contractor and in part by the Owner (Concurrent Delay), Contractor shall only be entitled to an extension of the Contract Time or Milestone(s) and Contractor shall not be liable for Liquidated Damages during the period of Concurrent Delay, but Contractor shall not be entitled to any additional compensation whatsoever during the period of Concurrent Delay. For purposes of settlement of Claims under this paragraph, the Contractor's cost shall be determined in accordance with paragraph 9.11 except that no mark-up for profit will be allowed and therefore, the maximum percentage mark-ups allowed under subparagraphs 9.11.6 and 9.11.7 shall be reduced by one-third.

11.9 Changes in Contract Time associated with changes ordered by the Owner are covered under Article 9.

11.10 An executed Change Order covering changes ordered by the Owner under Article 9 or the resolution of Claims made under Article 10 shall be the final and conclusive settlement of the change in Contract Time and Price for the work or Claim covered by the Change Order including all related costs in accordance with Article 9.4.

11.11 Early Completion Delay Damages. While the Contractor may schedule completion of all the Work, or portions thereof, earlier than the Contract Time established in the Agreement, the Owner and Engineer are exempt from liability for and the Contractor shall not be entitled to an adjustment of the Contract Price or to any additional costs, damages, or compensation whatsoever, for use of Float or for Contractor's inability to complete the Work earlier than the Contract Time established in the Agreement, for any reason whatsoever, including but not limited to, delay caused by Owner, Engineer or other compensable delay.

## **ARTICLE 12 - INSPECTION, DEFECTIVE WORK, GUARANTEE**

### **Defective Work**

12.1 Defective Work is work that (1) is unsatisfactory, faulty, deficient, or leaks, breaks, fails or does not conform to the Contract Documents; or (2) does not meet the requirements of reference standards, tests or approvals specifically referred to in the Contract Documents; or (3) has been damaged prior to final acceptance; or (4) does not meet applicable industry or trade standards; or (5) a submittal is required and Favorable Review has not been obtained.

### **Access to Work and Notice**

12.2 The Contractor shall provide the Owner, the Engineer and each of their representatives safe access to every part of the Work at all times work is in progress for observation, inspecting and testing. The Contractor shall give 2 days notice of work being ready for required inspection, test or approval or of intent to cover work up.

### **Tests and Inspections**

12.3 Unless otherwise specified, the Contractor shall arrange and pay for tests, inspections and approvals required by laws, ordinances, rules, regulations, orders of public authorities having jurisdiction or by the Contract Documents. All such tests, inspections and approvals shall be performed by an independent testing laboratory or inspection agency acceptable to the Engineer or to the appropriate public authority. Samples to be tested and items of work to be inspected will be selected by the Engineer or the public authority requiring the test or inspection. Test reports, inspection reports and certificates shall be submitted directly to the Engineer by the performing laboratory or agency. The Contractor shall notify the Engineer at least 2 days prior to all tests and inspections to permit observation by the Engineer.

### **Reinspection**

12.4 If the Engineer determines that portions of the Work require additional testing or retesting, the Contractor shall provide material to be tested, safe access to test locations, power, light and other services. The cost of retesting shall be paid for by the Owner, but if the additional tests or retesting indicate that said portion of the Work is Defective, the Contractor shall pay the Owner all costs associated with additional testing or retesting including the cost of the Engineer's additional service.

### **Uncovering Work**

12.5 If work is covered or concealed without giving the Engineer 2 days notice to permit observation, it shall be uncovered or exposed at the Contractor's expense to permit observation if so requested.

12.6 If the Engineer wishes to have work uncovered for observation after having been given the required notice to observe it, the Contractor shall uncover the work on a cost accounting basis. If the work is found to be in accordance with the Contract Documents, the Owner shall pay the cost of uncovering and replacing the work. If the work is found to be Defective, the Contractor shall pay the cost of uncovering and

correcting the work and the cost of required additional engineering and testing service.

### **Correction of Defective Work**

12.7 The Contractor shall promptly correct or replace: (1) work rejected by the Engineer as being Defective, and (2) work that is Defective whether or not rejected by the Engineer. The Contractor shall correct Defective Work prior to installing subsequent related or connected Work. The Contractor's obligation to correct Defective Work applies to latent as well as patent defects and whether or not the work is fabricated, installed or completed and whether observed before or after Substantial Completion. The Contractor shall bear the cost of correcting Defective Work including consequential costs, engineering services and attorneys' fees made necessary thereby.

### **Acceptance or Use of Defective Work**

12.8 The Owner may elect to accept Defective Work in which case a deductive Change Order shall be signed by the Contractor reflecting the decreased value of the Work. If final payment has been made, the Contractor shall pay to the Owner a sum reflecting the decreased value of the Work.

12.9 The Owner may use Defective Work without negating its rejection or decreasing the Guarantee Period which shall commence when the work is finally corrected or replaced and accepted. When all or part of the Work is being used by the Owner, the Contractor shall schedule correction or replacement of Defective Work at the Owner's convenience.

### **Tests and Inspections Do Not Reduce Contractor's Responsibility for Performance**

12.10 Observations by the Engineer or tests, inspections or approvals by others shall not relieve the Contractor from its obligation to perform the Work in accordance with the Contract Documents.

### **Guarantee Period**

12.11 Within 7 days of receipt of written notice from the Owner, the Contractor shall correct or replace work found Defective within one year after the date of Final Completion of the Work and Acceptance by the Owner or such longer period as covered by any Special Guarantee required by the Contract Documents or by law. For work first performed or first made acceptable after the date of Final Completion, the one-year or longer Guarantee Period shall commence to run at the time the Work is completed or made acceptable.

### **Owner's Right to Correct Defective Work During Guarantee Period**

12.12 If the Contractor fails to correct Defective Work within 7 days of receiving notice to do so, the Owner may correct the Work and recover the cost of correction from the Contractor. If the Defective Work creates an emergency where delay would cause unsafe conditions or serious risk of loss or damage, the Owner may proceed to correct the Defective Work without giving the Contractor notice.

12.13 If the Owner corrects Defective Work under this paragraph, the Contractor shall pay the Owner all direct, indirect and consequential cost and all required engineering services and attorney's fees.

12.14 The Contractor shall be responsible for the cost of removing and replacing work provided by the Owner when such removal and/or replacement is necessary to permit correction of Defective Work for which the Contractor is responsible.

### **Contractor's Liability for Defective Work Not Limited by Guarantee**

12.15 Nothing contained in this Article 12 nor in any Special Guarantee required under Division 1 General Requirements shall be construed to limit the period of the Contractor's obligations under the Contract Documents or under law. Establishment of a time period for the Contractor's specific obligation to correct work places no limit on the time within which the Contractor's obligation to comply with the Contract Documents may be enforced nor on the period during which the Contractor may be held liable for the effect of Defective Work.

12.16 Nothing contained in this Article 12 nor in any Special Guarantee required under Division 1 General Requirements shall be construed to limit the Contractor's, subcontractor's, material or equipment supplier's liability for damages sustained as a result of latent or patent defects in equipment or materials furnished or caused by the negligence of the Contractor or his subcontractors or suppliers. The guarantees contained in this Article 12 shall not be a waiver of nor shall they reduce any guarantee or warranty offered by the suppliers of materials or equipment furnished under this Contract nor shall they reduce any responsibilities imposed on manufacturers or suppliers of such equipment under law.

## **ARTICLE 13 - PAYMENT AND COMPLETION**

### **Schedule of Values**

13.1 At least 20 days prior to the first Application for Payment Date, the Contractor shall submit a Schedule of Values, in a form acceptable to the Engineer, allocating the Contract Price to various trades, types of work, pieces of equipment, and major tasks to assist the Engineer in evaluating the percentage completion for each part of the Work. The Contractor's overhead and profit shall be uniformly pro-rated over all items in the Schedule of Values. The Schedule of Values shall represent the actual cost of each segment of the work and shall not allocate higher costs, overhead or profit to work items scheduled for early completion. If the Engineer objects to the allocation of cost or the level of detail provided, the Contractor shall revise and resubmit the Schedule of Values.

### **Application for Payment**

13.2 The period covered by each Application for Payment shall be one calendar month. Payment shall be based on work completed as of the Application for Payment Date which shall be the last day of the month unless otherwise stated in the Agreement. Within 7 days after each Application for Payment Date, the Contractor shall meet with the Engineer to review the line item amounts proposed by the Contractor for payment. When the amounts proposed are acceptable to the Engineer, the Contractor shall prepare and submit within 3 days, the Application for Payment form, attached as Exhibit GC-4, and Conditional Lien Releases from the Contractor, each subcontractor, supplier and materialman whose work is included in the Application. The Contractor shall sign and certify on the Application for Payment, subject to penalty of perjury, the following: "The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief, the Work covered by this Application for Payment has been completed in accordance with the Contract Documents and that all Work for which previous payments have been received is free and clear of liens, claims, security interests or encumbrances of any kind. The Contractor further warrants that title to all Work covered by this Application for Payment will pass to the Owner no later than the time of payment."

13.2.1 Taxes. The Contractor shall pay all applicable sales, consumer, use, and similar taxes for the Work provided by the Contractor and such taxes shall be included in the Contract Price.

13.2.2 Liability for Employee Payments. Contractor accepts full liability for the payment of any and all contributions, deductions, or taxes for social security,

unemployment insurance, old age and survivor's benefits, medical and health benefits, or for any other purpose now or hereafter imposed under any applicable law measured by the wages, salary or other remuneration paid to persons employed by or on behalf of Contractor for the Work. Contractor covenants and agrees to observe and fully comply with all applicable law, including procurement of any necessary occupational licenses, permits and inspection certificates.

### **Payment for Items Delivered But Not Installed**

13.3 If recommended by the Engineer, Applications for Payment may include the percentage of value stipulated in the Agreement for major equipment and custom fabricated items that have been delivered, stored and protected at the site providing proof is furnished that title will pass to the Owner upon payment. Payment will not be made for material stored at the site that is not custom fabricated. Payment will not be made for items stored off the site. Payment will not be made for stored or installed items that are not protected from physical, environmental or other damage. Payment for successful submittal of Shop Drawings or Product Data will be made only when specifically provided for in Division 1.

### **Engineer's Recommendation for Payment**

13.4 In accordance with RCW 39.76.011 within 8 working days after receipt of the Application for Payment, the Engineer will either issue a Recommendation for Payment for such amount as the Engineer determines is due or will notify the Contractor and Owner why the Engineer is recommending that part of all of the payment be withheld and what remedial actions must be taken by the Contractor to receive the withheld payment. Retainage to be withheld by the Owner will not exceed 5% of the money earned by the Contractor in accordance with RCW 60.28.011.

13.5 The Engineer's Recommendation for Payment will constitute a representation that to the Engineer's best knowledge, information and belief the Work has progressed to the point indicated and is generally in conformance with the Contract Documents but is subject to re-evaluation during subsequent site visits and upon final completion. The Engineer's Recommendation for Payment shall not be taken as a representation that the Engineer has (1) made exhaustive or continuous onsite inspections to check the quality of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from

subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment, (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Price, or (5) offered its legal opinion in any respect.

13.6 If, in the Engineer's opinion, the representations in paragraph 13.5 cannot be made or if the Engineer has knowledge of any of the faults listed below, then the Engineer may decline to issue a Recommendation for Payment or may recommend a reduced amount of payment or may rescind previously issued Recommendation for Payment. Faults for which payment may be withheld, reduced or rescinded include:

- .1 Defective Work not corrected;
- .2 Third party claims filed or reasonable evidence indicating probable filing of such claims;
- .3 Failure of the Contractor to make payments properly to subcontractors or suppliers for labor, materials or equipment;
- .4 Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Price;
- .5 Damage to property, the Work, the Owner, another contractor or a third party;
- .6 Reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;
- .7 Work performed for which submittals are required prior to obtaining Favorable Review of submittals;
- .8 Persistent failure to carry out the Work in accordance with the Contract Documents;
- .9 Failure to submit a construction schedule or to update the construction schedule in accordance with General Conditions paragraph 5.18;
- .10 Failure to update Record Drawings weekly;
- .11 Failure to reinstate required insurance that has been allowed to lapse; or
- .12 Non-payment of money owed to the Owner for the extra cost of inspection or engineering services provided for in the General Conditions.

### **Completion and Acceptance**

#### 13.7 Definitions

.1 "Substantial Completion" means the Work has progressed to the point that: (1) the Work is ready for beneficial use and occupancy by the Owner for the intended purpose, (2) all fire and life safety work has been completed, inspected and accepted, (3) all mechanical and process systems and equipment are

complete and have been put in automatic operation, (4) the total value of uncompleted work is less than one-half of one percent of the Contract Price and (5) completing the Work will not significantly interfere with the Owner's convenience, use or cost of operation.

.2 "Semi-Final Inspection" determines if the Work is Substantially Complete.

.3 "Final Inspection" determines if the Work has reached Final Completion.

.4 "Final Completion" indicates that the Work has been fully completed in accordance with the Contract Documents and is ready for acceptance and final payment by the Owner.

.5 "The Final Punch List" contains items that remain uncompleted after Substantial Completion but that must be completed prior to Final Completion.

### **Owner's Right to Partial Use**

13.8 When provided for in the Contract Documents or agreed to in writing by the Owner and the Contractor, the Owner may notify the Contractor and begin using a portion of the Work even though it is not Substantially Complete. The Contractor, the Owner and the Engineer shall agree on and document responsibilities for security, operation, safety, maintenance, utilities, insurance, warranties and guarantees for that portion of the Work being used by the Owner. The Owner, the Contractor and the Engineer shall inspect such portion of the Work and shall prepare a list of work to be completed or corrected before final acceptance. The Owner's use of any portion of the Work shall not constitute final acceptance of that portion of the Work prior to Final Completion and acceptance of the Work as a whole. The Owner shall allow the Contractor reasonable access to complete or correct work in areas being used by the Owner. Partial beneficial occupancy shall not relieve the Contractor of Liquidated Damages unless the Contract Documents expressly provide for and identify the portion of Work that may be considered Substantially Complete before the remaining portions of the Work.

### **Contractor's List of Deficiencies**

13.9 When the Contractor considers the Work nearly complete, the Contractor shall review the Contract Documents, inspect the Work and prepare a list of deficiencies (Punch List). The Contractor shall complete or correct the items on the Punch List until, in the Contractor's opinion, the Work is Substantially Complete and ready for occupancy and use by the Owner. The Contractor shall then deliver the Punch

List to the Engineer and notify the Engineer in writing that the Contractor believes the Work is Substantially Complete and ready for a Semi-Final Inspection.

### **Semi-Final Inspection, Substantial Completion**

13.10 When the Work is ready and the Contractor so notifies the Engineer in writing, the Engineer will make a Semi-Final Inspection and may add additional items to the Contractor's Punch List. As a result of this inspection, the Engineer may determine that (1) the Work is not sufficiently complete to warrant a Semi-Final Inspection, additions to the Contractor's Punch List, or the preparation of a Final Punch List, (2) the Work is sufficiently complete for the Engineer to prepare a Final Punch List but certain incomplete or Defective Work prohibits use of the Work for its intended purpose and therefore, the Work is not Substantially Complete, or (3) that the Work is Substantially Complete and usable for its intended purpose and the Engineer can prepare a Final Punch list. In preceding cases 1 and 2, the Contractor shall continue the Work and call for a second Semi-Final Inspection when the Work is ready. In case (3), the Engineer will prepare a Final Punch List and a notice of Substantial Completion which shall establish the date of Substantial Completion and shall state the time agreed to by the Owner and the Contractor (not to exceed 30 days) in which the Contractor shall complete all work ready for Final Inspection. The date of Substantial Completion shall be revised if necessary such that it is no more than 30 days prior to the actual date of Final Completion. The Engineer shall attach a copy of the Final Punch List to the notice of Substantial Completion. If the Contractor does not achieve Substantial Completion on the second attempt, it shall reimburse the Owner the cost of the Engineer's services for additional inspections.

### **Final Inspection, Final Completion**

13.11 When the Contractor has completed or corrected all the items on the Engineer's Final Punch List and has made all required final submittals, the Contractor shall give the Engineer written notice that the Work is ready for Final Inspection and acceptance and upon receipt of a final Application for Payment, the Engineer shall make a Final Inspection. If the Engineer finds the Work is not fully complete, it shall notify the Contractor of items still requiring completion or correction. The Contractor shall immediately correct these deficiencies and call for a reinspection. When the Engineer finds to the best of the Engineer's knowledge, information and belief, and on the basis of the Engineer's observations and inspections, the Work is acceptable and fully complete in accordance with the Contract Documents, and when all final submittals have been made, the Engineer will

recommend that the Owner issue and file a Notice of Completion, designating Final Completion, make Final Payment and Accept the Work in accordance with the terms and conditions of the Contract Documents.

13.12 Neither the Engineer's failure to include an item on the Final Punch List, nor making of the Semi-Final or the Final Inspection, nor recommendation of final acceptance shall alter the Contractor's responsibility to complete all Work in accordance with the Contract Documents.

### **Final Payment**

13.13 Within 10 days after the Contractor has delivered to the Owner a complete release of all liens arising out of this Contract or receipts in full covering all labor, materials and equipment for which a lien could be filed, or a bond satisfactory to the Owner to defend and indemnify the Owner against such liens, the Owner shall accept the Work and file a Notice of Completion. Final Payment shall not become due until 60 days after the Owner files a Notice of Completion and there being no liens or stop notices filed. If any lien or stop notice remains unsatisfied, the Contractor shall immediately take all steps necessary to remove all liens or stop notices before Final Payment is made. If any liens are filed or exist after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such liens, including all costs and reasonable attorneys' fees.

### **Waiver of Claims**

13.14 The making of Final Payment shall constitute a waiver of claims by the Owner except those arising from:

- .1 Liens, claims, security interests or encumbrances arising out of the Contract and unsettled;
- .2 Failure of the Work to comply with the requirements of the Contract Documents; or
- .3 Terms of the one-year guarantee period and special warranties required by the Contract Documents.
- .4 Any of the Contractor's continuing obligations under the Contract Documents.

13.15 Acceptance of Final Payment by the Contractor, a subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that

payee as unsettled at the time of final Application for Payment.

## **ARTICLE 14 - TERMINATION**

### **Termination by the Owner for Cause**

14.1 The Owner may terminate all or part of the Contract if the Contractor:

.1 Persistently fails to provide enough workers or materials to properly pursue the Work as required to complete the Work within the Contract Time;

.2 Persistently fails to perform the Work in accordance with the Contract Documents including, but not limited to providing monthly updates to the schedule of Work and monthly updates to Record Drawings, or to correct or replace Defective Work when directed to do so;

.3 Fails to make payment to subcontractors or material suppliers;

.4 Becomes insolvent, commences any form of voluntary bankruptcy proceedings, has any petition or action filed against it under any bankruptcy code or law, makes a general assignment for the benefit of creditors, or if a trustee, receiver or agent is appointed under law to take charge of Contractor's property or operations for the benefit of creditors;

.5 Persistently disregards laws, regulations, rules or orders of public bodies having jurisdiction or persistently disregards the authority of the Engineer or Owner;

.6 Fails to retain a valid Contractor's license of the required class in the applicable jurisdiction; or

.7 Otherwise commits a material breach of the Contract.

14.2 When any of the above reasons exist and without prejudice to any other rights or remedies the Owner may have, and after giving the Contractor and the Contractor's Surety 7 days written notice, the Owner may terminate the employment of the Contractor and, subject to any prior rights of the Surety, the Owner may:

.1 Take possession of the site and of all material, tools and construction equipment on the site owned by the Contractor;

.2 Accept assignment of subcontracts pursuant to paragraph 5.9; and

.3 Complete the Work by any reasonable method the Owner may select.

14.3 When the Owner terminates the Contract for cause, the Contractor shall not be entitled to further payment until the Work has been completed.

14.4 If the cost of completing the Work, including additional engineering services, attorney's fees and administrative expenses made necessary thereby, exceeds the unpaid Contract Price, the Contractor shall pay the difference to the Owner. This obligation for payment shall be binding after termination of the Contract. If the cost of completing the Work including costs for engineering, legal, and administrative services minus the Contractor's unearned overhead and profit computed in accordance with paragraphs 9.11.6 and 9.11.7, is less than the unpaid Contract Price, the difference and other consequential costs shall be paid to the Contractor.

14.5 If it has been adjudicated or otherwise determined that the Owner has erroneously or negligently terminated the Contractor for cause, then the termination shall automatically convert to a Termination by Owner for Convenience as set forth in Article 14.7

### **Suspension by the Owner for Convenience**

14.6 The Owner, without cause, may issue written order giving the Contractor 7 days notice to suspend, delay or interrupt the Work in whole or in part. The order shall fix the dates on which the work shall cease and resume.

14.7 If a suspension, delay, or interruption of the Work ordered by the Owner for convenience causes an increase or decrease in the cost of performing the Contract, the Contract Price shall be adjusted as agreed by the Owner and the Contractor or in accordance with the method for determining the cost of changes in Article 9. The Contract Price shall not be adjusted if the Contractor's performance would otherwise have been suspended, delayed or interrupted due to causes for which the Contractor is responsible.

### **Termination by the Owner for Convenience**

14.8 The Owner may terminate all or part of the Contract without cause by giving the Contractor 7 days written notice. Such termination shall not prejudice any other right or remedy the Owner may have under the Contract. If the Contract is terminated without cause, the Contractor shall be paid for all work executed as of the date of termination plus reasonable termination expenses including direct, indirect and consequential costs but the Contractor shall not be paid for anticipated profit on work not performed.

## **Contractor May Stop Work or Terminate**

14.9 If, through no act or fault of Contractor, the Work is suspended for a period of more than 90 days by the Owner or under an order of court or other public authority, or the Engineer fails to act on any Application for Payment within 30 days after it is submitted, or the Owner fails for 60 days to pay the Contractor any sum finally determined to be due, the Contractor may, upon 7 days' written notice to the Owner and the Engineer, terminate the Agreement and recover from the Owner payment for all Work performed and any expense sustained plus reasonable termination expenses. In addition and in lieu of terminating the Agreement, if the Engineer has failed to act on an Application for Payment or the Owner has failed to make any payment as aforesaid, the Contractor may, upon 7 days' written notice to the Owner and the Engineer, stop the Work until payment of all amounts then due is received. The provisions of this paragraph shall not relieve the Contractor of the obligations to carry on the Work in accordance with the progress schedule and without delay during disputes and disagreements with the Owner.

## **ARTICLE 15 - MISCELLANEOUS**

### **Method for Giving Notices**

15.1 Written notice shall only be considered to have been given if delivered in person to the individual, partner of the partnership or joint venture, or officer of the corporation for whom intended or if sent by registered or certified mail to the address given in the Agreement unless amended by written notice. Notice to the Contractor's superintendent shall be considered notice to the Contractor. Notice to the Resident Engineer shall be considered notice to the Engineer. Notice to the Owner's Project Representative or Manager shall be considered notice to the Owner.

### **Rights and Remedies**

15.2 Duties, obligations, rights and remedies prescribed by the Contract Documents shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed by or available under law.

### **Failure to Act Not a Waiver of Rights**

15.3 Except as expressly provided in the Contract Documents, no action or failure to act by the Owner, Engineer, Design Engineer or Contractor shall constitute a waiver of a right afforded or duty imposed under the Contract. No such action or failure to act shall constitute approval of or acquiescence in failure to perform in

accordance with the Contract Documents or any other breach of contract.

### **Severability of Provisions**

15.4 The finding under law that any one or more provisions or any portion of a provision in the Contract Documents is invalid, unenforceable, or illegal shall not impair the validity or enforceability of any other provision or of the Contract Documents as a whole. In the case of invalidity or enforceability of any provision or portion thereof, the provision shall be rewritten and enforced to the maximum extent permitted by law to accomplish as near as possible the intent of the original provision.

### **Right to Audit**

15.5 Maintenance, Inspection, and Audit of Records. All books, account, reports, files, correspondence, data and other records relating to this contract shall be maintained by the Contractor, its subcontractors and material suppliers and shall be subject to all reasonable times to review, inspection, and audit by the Owner, Engineer and their agents at all times during performance of the Work and for a period of five (5) years after Final Completion of the Work. Such records shall be produced by the Contractor and/or the subcontractor or Material Supplier within a reasonable time at a place designated by the Owner or Engineer, upon written notice to the Contractor.

15.5.1 Accounting System. Contactor shall exercise such controls as may be necessary for proper financial management of the Work. Such accounting and control systems shall comply with prevailing custom and practice for similar projects, be satisfactory to Owner and shall include preservation of records for a period of four (4) years after Final Completion, or for such longer period as may be required by Applicable Law.

15.5.2 Books and Records. Contractor shall keep, and shall require provisions to be included in all contracts entered into by subcontractors and suppliers requiring the subcontractors and suppliers to keep, full and detailed books, records, information, materials and data, of every kind and character (hard copy, as well as computer readable data if it exists), that have any bearing on or pertain to any matters, rights, duties or obligations relating to the Project, Work or Contract, including, without limitation, agreements, purchase orders, leases, contracts, commitments, arrangements, notes, change orders, change order requests, estimates, field orders, schedules, diaries, logs, reports, shop

drawings, samples, exemplars, drawings, specifications, invoices, delivery tickets, receipts, vouchers, canceled checks, memoranda; accounting records; job cost reports; job cost files (including complete documentation of negotiated settlements); backcharges; general ledgers; documentation of cash and trade discounts earned; insurance rebates and dividends and other documents relating in any way to any claims, charges or time extensions asserted by Contractor of any of the subcontractors.

15.5.3 Inspection and Copying. Contractor shall allow, and shall require provisions to be included in all contracts entered into by subcontractors allowing, Owner, Engineer and their authorized representative(s), auditors, attorneys and accountants, upon twenty-four (24) hour notice to Contractor, full access to inspect and copy all its aforesated books and records at a location designated by Owner or Engineer and within 200 miles of the Project.

15.5.4 Noncompliance by Contractor. Contractor's compliance with this Article 15.5 et seq, shall be a condition precedent to maintenance of any judicial or extra-judicial action by Contractor against Owner or Engineer. In addition to and without limitation upon Owner's or Engineer's other rights and remedies for breach, including any other provisions for withholding set forth in the Contract documents, Owner shall have the right, exercised in its sole discretion, to withhold from any payment to Contractor due under a current application for payment an additional sum of up to ten percent (10%) of the total amount set forth in such application for payment, until Contractor and the subcontractors have complied with any outstanding and

unsatisfied request by Owner under this Article 15.5. Upon compliance with this Article 15.5, any such monies withheld shall be released to Contractor.

15.5.5 Special Enforcement by Owner or Engineer. Contractor agrees that any failure by Contractor or any subcontractor to provide access to books and records as required by this Article 15.5 et seq. shall be specifically enforceable, by issuance of a preliminary and/or permanent mandatory injunction by a court of competent jurisdiction based on affidavits submitted to such court and without the necessity of oral testimony, to compel Contractor to permit access, inspection, audit and/or reproduction of such books and records or the require delivery of such books and records to Owner and Engineer for inspection, audit and/or reproduction.

#### **Governing Law**

15.6 The Contract shall be governed by the law of the place where the project is located.

15.7 Survival of Terms. Any indemnity, warranty or guarantee given by Contractor to Owner or Engineer under this Agreement shall survive the expiration or termination of the Agreement and shall be binding upon Contractor and their subcontractors and suppliers until any action is barred according to terms in the Agreement or by the applicable statute of limitations or statute of repose. All obligations of Contractor under this Contract shall survive the expiration or termination of this Contract.

END OF GENERAL CONDITIONS

**From:** Company Name  
Mailing Address  
City, ST Zip  
Name

**Page:** 1 of 2  
**Date:** \_\_\_\_\_  
**KJ Job No.:** \_\_\_\_\_  
**Project Name:** \_\_\_\_\_

**Request for Information**

**Originator:** \_\_\_\_\_ **Drawing Reference:** \_\_\_\_\_  
**Requested Date of Response:** \_\_\_\_\_ **Specification Section:** \_\_\_\_\_

Written requests for information will not be considered without an accompanying completed copy of this RFI. By submission of this form the Contractor represents it has carefully reviewed the Contract Documents, coordinated the Work with the appropriate subcontractors, reviewed the field conditions and hereby certifies that the information requested cannot be determined from such efforts as required by the Contract Documents.

The Contractor requests the following information in accordance with the requirements of the Contract Documents.

**Description of Requested Information**

Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

**Contractor's Proposed Method of Resolving Issue**

Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

**Contractor's Proposed Impact on Project**

Estimated Contract Cost will be increased decreased unchanged by: \_\_\_\_\_  
Estimated Contract Time will be increased decreased unchanged by: \_\_\_\_\_ days.

**Attachments**

\_\_\_\_\_

Attach supporting documentation sufficient for Engineer to evaluate Request for Information, including documentation of field conditions. Forms submitted without adequate documentation will be returned without comment for further clarification.

Contractor's signature below signifies acceptance of responsibility for accuracy and completeness of information included in this Request for Information Form.

**Authorized Signature:** \_\_\_\_\_ **Title:** \_\_\_\_\_  
**Company:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Request for Information No.: XX and Response**

**Response Date:** \_\_\_\_\_  
**Specification Section:** \_\_\_\_\_  
**Drawing Reference:** \_\_\_\_\_

**KJ Job No.:** \_\_\_\_\_  
**Project Name:** \_\_\_\_\_  
**Page:** 2 of 2

**Response**

Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

If Contractor estimates an impact on Project time or price based upon Response, submit Reply within 5 working days of receipt.

**Respondent:** \_\_\_\_\_ **Signature:** \_\_\_\_\_  
**Company:** \_\_\_\_\_ **Date:** \_\_\_\_\_  
**Issued for Kennedy Jenks by:** \_\_\_\_\_

**Contractor's Reply To Response:**

Estimated Contract Cost will be increased decreased unchanged by: \_\_\_\_\_  
Estimated Contract Time will be increased decreased unchanged by: \_\_\_\_\_ Days.

**Comments**

Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

Distribution	RFI	Response	Reply
Owner	_____	_____	_____
Engineer	_____	_____	_____
Contractor	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
File	_____	_____	_____

**Submittal No.: XX and Response**

**From:** Company Name  
 Mailing Address  
 City, ST Zip  
 Name

**Page:** 1 of 2  
**Submittal Date:** \_\_\_\_\_  
**KJ Job No.:** \_\_\_\_\_  
**Project Name:** \_\_\_\_\_

**Specification Section:** \_\_\_\_\_ **Prior Submittal:** \_\_\_\_\_

**Submittal**

A. Certification of Completeness and Accuracy

We certify that we have reviewed this submittal in detail and that the submittal is:

1. Complete and accurate and in complete compliance with the Contract Documents.
2. Compliant with the requirements of "Material and Equipment" in Section 01040, especially the subparagraph titled "Compatibility of Equipment and Material".
3. Compliant with the paragraph titled "Performance Specifications and Contractor Designed Items" in Section 01040.
4. Without any deviations from the Contract Drawings, except the following (describe deviation) which have the following advantages and disadvantages:

Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

Signed by Subcontractor: \_\_\_\_\_ Title: \_\_\_\_\_ Date: \_\_\_\_\_

Signed by Contractor: \_\_\_\_\_ Title: \_\_\_\_\_ Date: \_\_\_\_\_

**Submittal No.: XX and Response**

Response Date: \_\_\_\_\_  
 Specification Section: \_\_\_\_\_  
 Page: 2 of 2

KJ Job No.: \_\_\_\_\_  
 Project Name: \_\_\_\_\_

**Response**

Item	KJ Action	Refer to Comment	Manufacturer or Supplier	Title of Submittal / Drawing

A. The action(s) noted above have been taken on the enclosed document(s).

- NET = No Exceptions Taken
- MCN-N = Make Corrections Noted, No Resubmittal Required
- MCN-R = Make Corrections Noted, Partial Resubmittal Required
- A&R = Amend and Resubmit
- NR = Not Reviewed
- RR = Rejected, Resubmit
- RA = Receipt Acknowledged

Comment(s):

Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

B. Corrections or comments made on the shop drawings during this review do not relieve the Contractor from compliance with the requirements of the Drawings and Specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. The Contractor is responsible for: confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating its work with that of all other trades, and performing its work in a safe and satisfactory manner.

\_\_\_\_\_  
 Responder: type name here - sign above

Distribution	Submittal	Encl.	Response
Owner	_____	_____	_____
Engineer	_____	_____	_____
Contractor	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
File	_____	_____	_____

**From:** Company Name  
Mailing Address  
City, ST Zip  
Name

**Page:** 1 of 3  
**Submission Date:** \_\_\_\_\_  
**KJ Job No.:** \_\_\_\_\_  
**Project Name:** \_\_\_\_\_

**Specification Section:** \_\_\_\_\_ **Prior Submittal:** \_\_\_\_\_

**Proposed Equivalent**

- A. When the first specified item is followed by a second maker's name and "or equal," the Contractor may submit Proposed Equivalent items for the Engineer's review. Proposed Equivalent items that are in the Engineer's judgment equal to the first specified item in quality, utility, and appearance, will be Favorably Reviewed. Where a product description and first maker's name is followed by "or equal" with no second maker's name, it means the specifier knows of no equivalent product and the Contractor may submit Proposed Equivalent products by other makers for review. Where the term "or equal" is omitted, it means that the named item is required to meet the Owner's needs; no products or makers other than those specified will be considered.
- B. This request shall include adequate technical information to fully describe the function and quality of the item. Submittals of Proposed Equivalent items that are not made within 35 days of the Notice to Proceed will be rejected unless the Engineer has agreed in writing to a later submittal date and the Contractor agrees to comply with all conditions of the Engineer for the late submittal. If the Contractor's second attempt to obtain Favorable Review of a Proposed Equivalent item is unsuccessful, the Contractor shall submit the first specified item.
- C. Inclusion of a second maker's name indicates the maker is acceptable but does not necessarily indicate the maker offers a standard product equal to the first specified item. Items by the second named maker are subject to the same conditions of review and compatibility as other Proposed Equivalent items. Inclusion of a maker's name and/or model number after a specification description is not a representation that the maker will furnish an item meeting the Contract requirements at bid time or at time of need. It is the Contractor's sole responsibility to furnish items meeting the Contract requirements.
- D. The Engineer's review of Proposed Equivalent items is based solely on information provided by the Contractor and on the Contractor's warranty that the proposed item is equal in quality, utility, function and appearance to the first specified item. Favorable Review of a Proposed Equivalent item has the same meaning and is subject to the same limitations that apply to the Favorable Review of Product Data and Shop Drawings described in the Contract Documents.
- E. Submit with proposal:
  - 1. Description of item being proposed including the Manufacturer's model number.
  - 2. Manufacturer's representation that item is equal to or superior to specified item in all respects.
  - 3. Manufacturer's product data.
  - 4. Information about several recent similar installations, including project name, owner's name, address, telephone number, and name of knowledgeable person to contact for information on performance of the product.
  - 5. Whether a reduction in the Contract Price is being proposed and, if so, how much.
  - 6. Any differences between the product specified and the Proposed Equivalent, including the warranty.

**Proposed Equivalent No. XX and Response**

Submission Date:  
Project Name:  
Specification Section:  
Page 2 of 3

F. Certification of Equivalency, Completeness and Accuracy:

We certify that we have reviewed this request in detail and that the item proposed is:

1. Equal to or superior to the specified item
2. Complete and accurate and in complete compliance with the Contract Documents,
3. Compliant with the requirements of "Material and Equipment" in Section 01040, especially the subparagraph titled "Compatibility of Equipment and Material",
4. Compliant with the paragraph titled "Performance Specifications and Contractor Designed Work" in Section 01040,
5. Without any deviations from the Contract Documents, except the following (describe deviation) which have the following advantages and disadvantages:

Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

We further represent and warrant to be solely responsible for any extra cost or expense necessary to make the proposed item or service fully equivalent to and compatible with the Contract Documents and meet or exceed the design intent.

If we use the Proposed Equivalent, we agree to comply with all additional requirements imposed upon us by the Engineer and Owner.

Signed by Subcontractor: \_\_\_\_\_ Title: \_\_\_\_\_ Date: \_\_\_\_\_

Signed by Contractor: \_\_\_\_\_ Title: \_\_\_\_\_ Date: \_\_\_\_\_

**Proposed Equivalent No. XX and Response**



Response Date: \_\_\_\_\_ KJ Job No.: \_\_\_\_\_  
 Specification Section: \_\_\_\_\_ Project Name: \_\_\_\_\_  
 Page: 3 of 3

**Response**

Item	KJ Action	Refer to Comment	Manufacturer or Supplier	Title of Submittal / Drawing / Information

A. The action(s) noted above have been taken on the enclosed document(s).

NET = No Exceptions Taken      A&R = Amend and Resubmit      NR = Not Reviewed  
 MCN = Make Corrections Noted      RR = Rejected, Resubmit

**Comment(s):**

Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

B. Corrections or comments made on the submittal during this review does not relieve the Contractor from compliance with the requirements of the Drawings and Specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. The Contractor is responsible for: confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating its work with that of all other trades, and performing its work in a safe and satisfactory manner.

\_\_\_\_\_  
 Responder: type name here & sign above

Distribution	Proposed Equivalent	Encl.	Response
Owner	_____	_____	_____
Engineer	_____	_____	_____
Contractor	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
File	_____	_____	_____

**Application for Payment and Engineer's Recommendation No.:**

**9999**



<p><b>To:</b> Name _____          Mailing Address _____          City/State/Zip _____</p> <p><b>Attn:</b> Name _____</p> <p><b>From:</b> Contractor Name _____          Mailing Address _____          City/State/Zip _____</p> <p><b>Prepared By:</b> Name _____</p>	<p><b>Date:</b> Date _____</p> <p><b>KJ Job No.:</b> 000000.00</p> <p><b>Project:</b> Project Name _____</p> <p><b>Contract Date:</b> Date _____</p> <p><b>Period To:</b> Date _____</p> <p><b>Reviewed By:</b> Kennedy/Jenks Consultants, Inc.          Mailing Address _____          City/State/Zip _____</p> <p><b>Recommended By:</b> Name _____</p>	<p><b>Distribution to:</b></p> <p><input type="checkbox"/> Owner</p> <p><input type="checkbox"/> Engineer</p> <p><input type="checkbox"/> Contractor</p> <p><input type="checkbox"/> Architect</p> <p><input type="checkbox"/> _____</p>
---	---	--

Contractor's Application for Payment		
1. Original Contract Sum	_____	
2. Net Change by Change Orders	_____	
3. Contract Sum To Date (Line 1 ± 2)	_____	
4. Total Completed & Stored to Date (Column G on Page 2)	_____	
5. Retainage:		
a. _____ % of Completed Work (Column D + E)	_____	
b. _____ % of Stored Material (Column F)	_____	
Total Retainage (Lines 5a + 5b or Total in Column I)	_____	
6. Total Earned Less Retainage (Line 4 less Line 5 Total)	_____	
7. Less Previous Payments (Line 6 from prior Applications)	_____	
8. Current Payment Due (Line 6 less Line 7)	_____	
9. Balance to Finish, Including Retainage (Line 3 less Line 6)	_____	
<b>Change Order Summary</b>	<b>Additions</b>	<b>Deductions</b>
Total Changes approved by Owner in previous months		
Total approved this month		
Totals		
Net Changes by Change Order		

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief, the Work covered by this Application for Payment has been completed in accordance with the Contract Documents and that all Work for which previous payments have been received is free and clear of liens, claims, security interests or encumbrances of any kind. The Contractor further warrants that title to all Work covered by this Application for Payment will pass to the Owner no later than the time of payment.

By: \_\_\_\_\_ Date: \_\_\_\_\_  
 Contractor

**Engineer's Recommendation for Payment:** In accordance with the Contract Documents, the Engineer recommends to the Owner that the Contractor is entitled to payment in the amount recommended, subject to withholds, deductions or credits pursuant to the Contract Documents.

Amount Recommended..... \_\_\_\_\_  
 By: \_\_\_\_\_ Date: \_\_\_\_\_  
 Kennedy/Jenks Consultants, Inc.

This Certificate is not negotiable. The amount recommended is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.




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SECTION 01000

PROFESSIONAL RESPONSIBILITIES AND SEALS

COVINGTON WATER DISTRICT

May 2026

<p>The following Technical Specification Division(s) and/or Section(s) of this Project Manual:</p> <p>Division 1 with the exception of Section 01190 Division 2 Division 9 Division 11 Division 13 Division 15</p> <p>were prepared under the direction and supervision of (whose seal and signature appear to the right):</p> <p>Milton D. Larsen, PE License No. 18985 Kennedy/Jenks Consultants, Inc. 32001 32<sup>nd</sup> Avenue S., Suite 300 Federal Way, Washington 98001</p>	
---	--

<p>The following Technical Specification Division(s) and/or Section(s) of this Project Manual:</p> <p>Section 01190 Division 3 Division 5</p> <p>were prepared under the direction and supervision of (whose seal and signature appear to the right):</p> <p>Jeffrey W. Tarbell, PE License No. 25008625 Kennedy/Jenks Consultants, Inc. 32001 32<sup>nd</sup> Avenue S., Suite 300 Federal Way, Washington 98001</p>	
---	--

The following Technical Specification Division(s) and/or Section(s) of this Project Manual:

Division 16

were prepared under the direction and supervision of (whose seal and signature appear to the right):

Timothy James Kelly, PE  
License No. 24024286  
Kennedy/Jenks Consultants, Inc.  
32001 32<sup>nd</sup> Avenue S., Suite 300  
Federal Way, Washington 98001



The following Technical Specification Division(s) and/or Section(s) of this Project Manual:

Division 17

were prepared under the direction and supervision of (whose seal and signature appear to the right):

Stephan Koweluk, PE  
License No. 55808  
Kennedy/Jenks Consultants, Inc.  
32001 32<sup>nd</sup> Avenue S., Suite 300  
Federal Way, Washington 98001



The Engineer's/Architect's seals and signatures above do not apply to the documents that comprise Division 00, Bidding and Contracting Requirements unless specifically designated.

It is a violation of applicable laws and regulations governing professional licensing and registration for any person, unless acting under the direction of the licensed and registered design professional(s) indicated above, to alter in any way the Specifications in this Project Manual.

END OF PROFESSIONAL RESPONSIBILITIES AND SEALS

## SECTION 01010

### SUMMARY OF WORK

#### PART 1 - GENERAL

##### 1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. The project consists of replacing the existing onsite sodium hypochlorite generation system including the hypochlorite tank and brine tank, replacing butterfly valves, replacing the hot water tank, removing the secondary containment coating and installing a new containment coating, installing a protective coating on the facility floor, enlarging the sodium hydroxide vent piping, and installing stainless steel sodium hydroxide fill piping.

##### 1.02 WORK UNDER OTHER CONTRACTS – NOT USED

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

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

##### 1.05 ITEMS ORDERED IN ADVANCE – NOT USED

##### 1.06 PROVISIONS FOR FUTURE WORK – NOT USED

##### 1.07 WORK SEQUENCE

- A. General Requirements. The Treatment Plant is a critical source of drinking water for the area. The Contractor is to conduct work such that the Owner's ability to meet its customer demands for treated drinking water shall not be impaired or reduced in terms of the required quantity and quality of treated water. The Contractor's work must never prevent the plant from complying with the drinking water requirements established by State and Federal regulations.
1. Work Sequence and Constraints described hereinafter are critical events in work sequence which are presented to underscore the importance of proper sequencing, scheduling, and coordination so that it is integrated with the required water treatment plant production. The work sequence and constraints presented do not describe all items affecting the completion of the Work but are intended to describe important events necessary to minimize disruption of the existing facilities and to ensure compliance with water quality permit requirements.
  2. The existing facility where Contractor's work is to be done will be occupied by the Owner throughout the construction period. The Contractor shall provide all necessary access to the Owner's personnel as required to safely and efficiently operate/maintain the facilities. At all times during the Contract duration, the Contractor is to provide the Owner's personnel and representatives safe and immediate access to all process control equipment. Additionally, the Contractor is to provide for unimpeded access for all delivery vehicles transporting materials, chemicals, and equipment to the facility for the Owner's operations.
  3. The Work shall be bid, scheduled, and constructed in such a manner as to result in the least possible disruption to the operations and staff of the existing facility. Modifications that affect or may affect the operation of the

- facility shall not be made without first obtaining written permission from the Engineer. Disruptions or interference to one portion of the facility will likely affect other facility processes since they are interrelated and dependent on one another. The Contractor must fully understand any and all possible reductions on facility production and/or water quality as they plan the Work.
4. The Contractor shall note that not all valves and gates that may be used to isolate lines and facilities will completely seal. The Contractor shall allow for leakage in planning its work and may, with the Owner's concurrence, test certain valves and gates before work involving isolation is begun. The Contractor shall provide adequate temporary pumping and piping facilities to properly clear the work areas as necessary of water, chemicals, and/or sludge. The Contractor shall clean the work areas as required to perform the work. Shutdown and isolation of existing facilities by closing existing valves/gates and operating electrical control panels, or as specifically provided for in the Contract Documents, will be performed by Owner personnel.
  5. Prior to any shutdown or flow diversion all materials, fittings, supports, equipment, and tools shall be on the site and all necessary skilled labor scheduled prior to starting any connection work. The Contractor shall provide staff following shutdowns to monitor and ensure the proper operation of systems.
  6. The Contractor is advised that any shutdown of facilities will place a considerable burden on the Owner's staff before, during, and after the shutdown. If through inadequate planning, lack of preparedness, faulty or inefficient workmanship or other causes controllable by the Contractor, delays, excessive time, or additional shutdowns are required that cause the Owner to incur extra cost, said extra cost will be assessed against the Contractor. To minimize impact on plant staff, all outages shall be limited to 8-hour periods, unless otherwise noted herein.
  7. Planned utility service shutdowns to any service area or process unit of the project shall be accomplished during periods of minimum use. In some cases this will require night or weekend work, which shall be at no additional cost to the Owner. The Contractor shall program work so that service will be restored in the minimum possible time and shall cooperate with the Owner in reducing shutdowns of the utility to a minimum. No utility shall be disconnected without prior written approval from the utility owner and Engineer. When it is necessary to disconnect a utility, the Contractor shall give at least 7 days' notice to the utility owner and to the Engineer for approval of the proposed schedule.
  8. The Contractor shall note that only certain structures, tie-ins, and constraints are addressed in this Section. All work, whether or not addressed here, shall be governed by applicable parts of this Section, and schedules and procedures further submitted for approval.
- B. Construction sequencing will be constrained by existing operating facilities at the Treatment Plant. The following defines the constraints required for plant operations and staff use of the site. Within the latitude in the sequence described below, prepare a construction schedule meeting the Contractor's work needs while staying within the specified parameters.
1. Plant shutdown opportunities and constraints are as follows for any calendar year during the project duration. Additional times/durations for shutdowns must be approved by Owner in advance.

- a. During the months of November, December, January, February, March, and April, shutdowns shall not exceed 8 hours and shall be scheduled in advance with the Owner as specified in this Section.
  - b. During the months of May, June, July, August, September, and October, shutdowns shall not exceed 2 hours and shall be scheduled in advance with the Owner as specified in this Section.
  - c. The onsite hypochlorite generation system can be out of service for a maximum of 3 months between November 1 and March 31. During this period, the Owner will operate a temporary hypochlorite storage setup consisting of the existing hypochlorite storage tank and feed valve relocated outside of the Treatment Plant building. At the start of the period, the Contractor shall relocate the sodium hypochlorite storage tank to an exterior location as directed by the Owner. The Owner will provide temporary wiring and piping to the storage tank and feed valve. Contractor shall provide Owner written notice 21 days in advance of the proposed start of this period.
  - d. Sodium hydroxide vent piping and fill piping replacement must be completed in between chemical deliveries and between November 1 and March 1. Therefore, Contractor should plan to complete this work in 30 days or less. Coordinate with Owner to schedule the work based on chemical inventory and deliveries. Contractor shall provide Owner with written notice 7 days in advance of proposed piping replacement work.
  - e. Water heater may not be out of service for more than 4 hours during replacement.
- C. Some construction elements can be accomplished at any time during the contract period, but some will require coordination with other items being completed first. Therefore, a possible construction sequence is presented below to help define the probable sequence of major activities. Such a sequence may be required for the Contractor to complete the Work within the previously mentioned constraints. Other and more detailed construction sequences to complete the Work within the Contract time limits and in compliance with the specified constraints may be possible. The Contractor is responsible for phasing of the work in order to honor the constraints, complete the work, coordinate with Owner's work and operations, and meet the schedule for completion.
- 1. Onsite Sodium Hypochlorite Generation System (OSHGS) Replacement and Temporary Hypochlorite Feed Facilities:
    - a. Disconnect existing hypochlorite storage tank and relocate tank to exterior location as directed by Owner. Owner will connect temporary piping and wiring.
    - b. Remove existing hypochlorite generator, brine tank, water softeners, and associated piping. Demolish concrete housekeeping pads for hypochlorite storage tank, hypochlorite generator, and brine tank.
    - c. Construct new pads for onsite hypochlorite generator, brine and hypochlorite storage tanks..
    - d. Prepare concrete floor surface in Chemical Room (grade level non-containment area) and install chemical resistant and epoxy coating.
    - e. Install new onsite hypochlorite generation system, brine tank, and hypochlorite storage tank.
    - f. Complete commissioning of the new hypochlorite generation system in accordance with Section 01650.
    - g. Remove existing hypochlorite storage tank used for temporary feed.

2. Caustic Fill and Vent Piping Replacement:
  - a. Replace existing vent piping.
  - b. Replace existing fill piping.
  - c. Replace caustic tank overflow piping
  - d. Schedule and complete work within the constraints noted previously.
3. Other Work:
  - a. Remove unused equipment and piping in containment area to the extents noted on the Drawings.
  - b. Prepare concrete surfaces and apply new secondary containment coating in containment area.
  - c. Remove debris from chemical containment sumps and piping spools. Prepare concrete surfaces and apply new secondary containment coating in chemical containment sumps.
  - d. Replace butterfly valves in chemical containment sumps.
  - e. Remove existing water and fuel piping to the extents noted on Drawings.
  - f. Replace water heater.

#### 1.08 EARLY PARTIAL OCCUPANCY AND USE BY OWNER – NOT USED

#### 1.09 CONTRACTOR'S USE OF SITE AND OWNER'S CONTINUED OPERATIONS

- A. The Contractor shall confine its use of the site for work and storage to the Work Area Limits shown on the Contract Drawings. The Contractor's use of adjacent lands and roads for access to move onto and off of the site and for daily access of workers, material, and equipment shall be arranged and scheduled to minimize interference with the Owner's continued operations.
- B. The Owner intends to continue operation of portions of its existing facility during most of the construction period. The Contractor shall plan and schedule its work to minimize impacting the Owner's continued operations and shall, at all times, maintain safe access for the Owner's operating personnel and equipment.
- C. The Contractor shall be responsible for maintaining safe emergency exiting for the Owner's and Contractor's personnel in all areas affected by the Contractor's work.
- D. If operation of the Owner's existing facility is adversely affected by the Contractor's work, the Owner may suffer a financial loss and may make a claim against the Contractor to recover its loss.
- E. The Owner has no set schedule for chemical deliveries. During a chemical delivery, access in front of existing and/or new chemical delivery areas will be completely blocked by a delivery truck and not accessible for up to two (2) hours when a chemical truck makes a delivery. Contractor shall be prepared to provide alternate access to avoid impact to its work.

#### 1.10 DOCUMENTING EXISTING

- A. Prior to commencing the Work, tour the site with the Owner and the Engineer. Examine and document photographically and in writing the condition of existing buildings, equipment, improvements, and landscape planting on or adjacent to the site. This record shall serve as a basis for determination of subsequent damage due to the Contractor's operations and shall be signed by all parties making the tour. Record existing conditions by making a minimum of 50 digital color photographs and a video showing all areas that may be affected during the Work. Provide digital copies of photographs and video.

## 1.11 SHUTDOWN OF EXISTING UTILITIES, SERVICES, OR OPERATIONS

- A. The Work under this Contract involves modification of facilities at an existing operating facility, which must continue to meet requirements of the State and Federal regulating agencies. Therefore, those functions shall not be interrupted except as specified herein.
- B. Shutdown of existing facilities shall be coordinated between the Contractor and the Owner. Submit a shutdown request and obtain the Owner's approval at least seven (7) days prior to the shutdown of any utility, service, or operation of any existing facility unless otherwise noted herein.
- C. Schedule utility service or operations shutdowns for periods of minimum use and at the Owner's convenience. Have all required material, equipment, and workers on site prior to beginning any work involving a possible shutdown. Perform work so services will be restored in the minimum time possible. In some cases, this may require increased numbers of workers and/or premium time night or weekend work.
- D. Prepare a system shutdown and/or bypass plan indicating planned methods, length of time required to complete the operation, necessary power, controls, instrumentation, or alarms required to maintain control, monitoring alarms, labor, equipment, and Owner staff. Include a contingency plan addressing procedures in the event the temporary facilities fail or the time to complete the work cannot be met. Plan must be submitted to Owner along with shutdown request at least seven (7) days prior to the proposed shutdown. Any changes must be approved by the Owner at least 2 days prior to commencing the shutdown and/or bypass.
- E. Not all existing valves used to isolate lines and facilities may completely seal. Test valves before the Work has begun and provide measures to address leakage.

## 1.12 EXISTING UTILITIES

- A. General:
  - 1. Existing utilities are shown on the Drawings in their approximate location based on the best available information. The actual location, size, type, and quantity of utilities may differ from that shown and utilities may be present that are not shown. See the General Conditions for the Contractor's responsibilities and for differing conditions that warrant a change in Contract Price.
  - 2. Utilities are piping, valves, appurtenances, conduits, wire, cable, duct banks.
  - 3. Exercise care in avoiding damage to all utilities. Contractor shall be responsible for repairing or replacing utilities, damaged during construction, in kind or better at no cost to the Owner.
- B. Interferences:
  - 1. If interferences occur at locations other than shown on the Drawings, notify the Engineer in writing. A method to correct the interferences shall be provided by the Engineer. Payment for interferences that are not shown on the Drawings, nor which may be inferred from surface features, and the Contractor has exposed all required utilities prior to shop drawing preparation, shall be in accordance with the provisions of the General Conditions.
  - 2. Any necessary relocations of utilities, whether shown on the Drawings or not, shall be coordinated with the affected utility Owner. The Contractor shall perform the relocation only if instructed to do so in writing from the Owner.

### 1.13 REGULATORY REQUIREMENTS

- A. The codes and regulations together with local amendments when applicable adopted by the State and other governmental authorities having jurisdiction shall establish minimum requirements for this Project. This Project shall comply with the following:
  - 1. International Building Code (IBC) with Amendments adopted by the Washington State Building Code Council
  - 2. International Fire Code (IFC)
  - 3. International Mechanical Code (IMC)
  - 4. Uniform Plumbing Code (UPC)
  - 5. National Electric Code (NEC)
  - 6. NSF/ANSI/CAN Standard 60 and 61
- B. The latest editions of the requirements in effect at the date of submission of bids shall apply.
- C. General Conditions paragraph 5.11 covers the Contractor's responsibility to comply with laws and codes applicable to Means and Methods for performing the Work.
- D. General Conditions paragraph 5.14 covers the Contractor's responsibility to report code deficiencies in the design to the Engineer prior to proceeding with the Work.
- E. Paragraphs addressing Pre-Engineered Systems and Performance Specifications in other Sections cover the Contractor's responsibility to comply with code requirements when (1) performance specifications are used to describe all or portions of Work or items and (2) when pre-engineered (contractor designed) systems are specified.
- F. In cases where the Contract Documents are more restrictive than applicable codes, the Contractor shall comply with the Contract Documents.

### 1.14 REFERENCE STANDARDS

- A. When these specifications state that Work or tests shall conform to specific provisions in a referenced standard, specification, code, recommendation or manual published by an association, organization, society or agency the referenced provisions, as they apply to the Work of the Contractor only shall be considered a part of these specifications as fully as if included in total. When these specifications or applicable codes contain higher or more restrictive requirements than those contained in reference standards these specifications or applicable codes shall govern.
- B. The latest edition of a referenced standard published at the time of submission of bids shall apply unless a specific date for the referenced standard is cited in these specifications.
- C. General provisions in referenced standards, specifications, manuals or codes shall not change the specific duties and responsibilities between any of the parties involved in this work from those described in the General Conditions. Provisions in referenced standards with regard to measurement and payment shall not apply to this Work unless specifically cited. See General Conditions paragraph 2.3.

### 1.15 SPECIFICATION LANGUAGE AND STYLE

- A. Many parts of the Specifications as well as notes on the Drawings are written in the active voice and are addressed to the Contractor.

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

## 1.16 DEFINITIONS

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

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

## 1.17 ABBREVIATIONS

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

<u>Abbreviation</u>	<u>Stands for</u>
AASHTO	American Association of State Highway and Transportation Officials
AAMA	Architectural Aluminum Manufacturers Association
ABMA	American Boiler Manufacturers Association
ACI	American Concrete Institute
ADC	Air Diffusion Council
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AI	Asphalt Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association

<u>Abbreviation</u>	<u>Stands for</u>
AMPP	Association of Materials Protection and Performance
ANSI	American National Standard Institute (formerly United States of America Standards Institute)
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	ASTM International
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
CAGI	Compressed Air and Gas Institute
CBR	California Bearing Ratio
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CPSC	Consumer Products Safety Commission
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standards for the U.S. Department of Commerce
CTI	Cooling Tower Institute
DFPA	Douglas Fir Plywood Association
EIA	Electronic Industries Association
EPA	U.S. Environmental Protection Agency
ETL	Electronic Testing Laboratory
FM	Factory Mutual Insurance Company
FPS	Fluid Power Society
FS	Federal Specifications
HI	Hydraulic Institute
HMI	Hoist Manufacturers Institute
IAPMO	International Association of Plumbing and Mechanical Officials
IBC	International Building Code
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IFC	International Fire Code
IGCC	Insulating Glass Certification Council
IMC	International Mechanical Code
IPCE	International Power Cable Engineers Association
ISA	Instrument Society of America
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NCPI	National Clay Pipe Institute
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NGVD	National Geodetic Vertical Datum

<u>Abbreviation</u>	<u>Stands for</u>
NSF	National Sanitation Foundation
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Act
PCA	Portland Cement Association
RCW	Revised Code of Washington
SAMA	Scientific Apparatus Makers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Structural Steel Painting Council
TCA	Tile Council of America
UBC	Uniform Building Code
UFC	Uniform Fire Code
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code
USDC	U.S. Department of Commerce
UL	Underwriters Laboratories
WCLIB	West Coast Lumber Inspection Bureau

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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## SECTION 01040

### COORDINATION AND PROJECT REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 PROJECT COORDINATION

- A. Coordinate scheduling, submittals, and work of various Sections of the Specifications and subcontractors to assure efficient and orderly sequence of interdependent construction. Coordinate construction scheduling with plant and utility shutdowns with requirements and limitations in Section 01010. Provide accommodations for items to be furnished and installed by Owner and labeled "NIC" (not in contract) on the Drawings and for Owner-Furnished Contractor Installed (O.F.C.I.) items.

##### 1.02 MECHANICAL AND ELECTRICAL/CONTROLS COORDINATION

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

- D. Review Shop Drawings and Product Data prior to submission for the Engineer's Review to assure that physical characteristics and service requirements are compatible with contract requirements, field conditions, and other items submitted.
- E. Verify that required services such as electrical power characteristics, control wiring, and utility requirements of items and equipment submitted and furnished are compatible with services provided. Notify Engineer of potential problems prior to ordering items or equipment and prior to installing services or completing construction in areas where services would have to be installed.
- F. Schedule installation sequence of various elements of mechanical and electrical/controls work to achieve optimum compliance with requirements under Mechanical and Electrical/Controls Coordination in this Section.
- G. Conduct regular weekly coordination meetings with affected trades and Engineer to establish and maintain coordination and resolve conflicts or disputes.

### 1.03 CUTTING, FITTING, AND PATCHING

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

7. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.
8. Report any hazardous or unsatisfactory conditions to the Engineer.

#### 1.04 ALTERATION PROJECT PROCEDURES

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

#### 1.05 CONNECTIONS TO UNDERGROUND UTILITIES, CONDUITS, OR PROCESS PIPING

- A. Obtain best available current information on location, identification, and marking of existing utilities, piping, and conduits and other underground facilities before beginning any excavation. In areas where utilities participate in "Utility One-Call" for projects in Washington, contact 1-800-424-5555 for information at least 48 hours in advance of beginning work. Give Engineer 24 hours' notice before beginning work.
- B. The location of existing utilities and underground facilities known to the Design Engineer are shown in their approximate location based on information available at the time of preparing the Drawings. The actual location, size, type, and number of utilities and underground facilities may differ from that shown and utilities or underground facilities may be present that are not shown. See General Conditions Article 3 for the Contractor's responsibilities and for differing conditions that warrant a change in Contract Price.
- C. Use extreme care when excavating or working in areas that may contain existing utilities, process piping, conduits, or other underground facilities. Use careful potholing, hand digging, and probing to determine the exact location of underground installation. Some locations contain multiple pipes or conduits. Prior to performing any subsurface work, investigate, determine, and prepare a plan to turn off or disconnect each utility believed to be in the within 100 feet of the subsurface work in the event of an accidental breach of a utility conduit.
- D. Where connections to existing utilities or other underground facilities is required or where new piping or conduits may cross or interfere with existing utilities or underground facilities, carefully excavate and uncover existing installations to a point 1 foot below the pipe or conduit to determine the actual elevation and

alignment. Call the Engineer's attention to differing existing conditions that may require a clarification or change.

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

#### 1.06 FIELD ENGINEERING AND LAYOUT

- A. See General Conditions, Article 3.9 regarding reference points provided by Owner.
- B. General Conditions, Article 3.10 requires the Contractor to accurately layout the Work including the corners of buildings and other structures and the elevation of every floor, deck, roof, tank bottom, and channel.

#### 1.07 PRECONSTRUCTION MEETING

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

#### 1.08 PROGRESS MEETINGS

- A. The Engineer will conduct bi-weekly progress meetings with Contractor and Owner at job site. Attendance required by Contractor's project manager, superintendent, and affected Subcontractors and suppliers. The Engineer will prepare, maintain, and distribute agenda and dated record of: (1) actions required and taken and (2) decisions needed and made.

- B. Agenda:
1. Review critical items/action list.
  2. Review work progress. Compare actual progress with planned progress shown on Contractor's rolling 3-week and CPM Construction Schedule. Discuss corrective action required. Compare actual and projected progress with Contractor's CPM Construction Schedule, propose methods to correct deficiencies.
  3. Review status of Submittals; review delivery dates and delivery dates for critical items.
  4. Review coordination problems.
  5. Schedule needed testing and critical inspections.
  6. Review critical requirements for each trade or major piece of equipment prior to beginning work or installation.
  7. Discuss Contractor Quality Control.
  8. Discuss open items on Engineer's "Items of Concern List."
  9. Discuss impact of proposed changes on progress Schedule.
  10. Other business.

#### 1.09 PERFORMANCE SPECIFICATIONS AND CONTRACTOR DESIGNED WORK

- A. Work under this Contract may be specified by a combination of descriptive, performance, reference standard, and proprietary specifications. In the event of conflict between any of the various specification methods used to specify a single item, the order of precedence shall be the order in which the methods are listed in the preceding sentence. The terms used to describe types of Specifications are taken from the Construction Specification Institute (CSI) Handbook of Practice.
- B. Where Specifications are used to define the characteristics of Contractor designed systems, items or components, the Contractor shall be fully responsible to design, engineer, manufacture, and install the systems, items and components to meet the specified functional requirements, performance requirements, quality standards, durability standards and conditions of use as well as all applicable codes, regulations and referenced trade or industry standards. The Contractor shall perform such design by employing engineers licensed in the State in which the Work is being constructed. The Contractor's design submittals shall include calculations and assumptions on which the design is based and shall be stamped and signed by appropriately licensed engineers.
- C. In accordance with General Conditions paragraph 8.13, the Owner and the Engineer shall have the right to rely on the expertise and professional competence of the Contractor's design. Favorable review of the Contractor's design submittal shall not relieve the Contractor from full responsibility for the adequacy of the Contractor's design.

#### 1.10 MATERIAL AND EQUIPMENT

- A. General: Verify that products delivered meet requirements of Contract Documents and the requirements for Favorably Reviewed submittals.
- B. Compatibility of Equipment and Material:
1. Similar items, equipment, devices, or products furnished under a single specification section shall all be made by the same maker and have interchangeable parts.

2. In addition, but only if so stated in each affected Specification Section, similar items furnished under two or more Specification Sections shall be made by the same maker and have interchangeable parts.
  3. All similar materials or products that are interrelated or used together in an assembly shall be compatible with each other.
- C. Transportation and Handling:
1. Transport and handle products in accordance with manufacturer's instructions.
  2. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
  3. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- D. Storage and Protection:
1. Store and protect products in accordance with manufacturer's instructions. Seals and labels shall be intact and legible.
  2. Store moisture-sensitive products including finish woodwork, gypsum products, acoustical products, motors, electrical equipment, instruments and controls in weather-tight, humidity- and temperature-controlled enclosures.
  3. For exterior storage of fabricated products, place items on sloped supports, aboveground.
  4. Cover products subject to deterioration from moisture, dust, or sunlight with opaque watertight but breathable sheet covering. Provide ventilation to avoid condensation.
  5. Provide offsite storage and protection including insurance coverage when site does not permit onsite storage or protection.
  6. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
  7. Provide facilities, equipment, and personnel to store products by methods to prevent soiling, disfigurement, or damage.
  8. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.
- E. Installation Standards and Manufacturers' Recommendations:
1. Install all products and materials in strict compliance with the most restrictive of the following:
    - a. The manufacturer's or provider's written instructions or recommendations. Follow step-by-step installation procedures.
    - b. Recommendations of referenced trade associations or standards.
    - c. The Contract Specifications and Drawings.
  2. Where conflicts exist, present alternatives with advantages and disadvantages to Engineer for decision.
- F. If reference standards or manufacturer's instructions contain provisions that would alter or are at variance with relationships between the parties to the Contract set forth in the Contract Documents, the provisions in the Contract Documents shall take precedence. See General Conditions paragraph 2.3.

#### 1.11 BACKING, SUPPORTS, AND FASTENERS

- A. Provide backing, supports, bracing, fasteners, and other provisions required for the proper support and attachment of all work. Backing, supports, bracing, and fasteners shall be sized to resist vertical and horizontal loads including seismic and

wind loads required by codes listed under Regulatory Requirements in Section 01010 and in accordance with Seismic Design Requirements in Section 01190. Where finishes in existing facilities must be removed to install backing or where finishes are installed in new construction prior to installing backing the Contractor shall remove finishes, install backing and reinstall finishes.

- B. Use of explosive powder-driven fasteners is NOT PERMITTED.
- C. Low velocity, pneumatic-type, power-driven fasteners may be used only where specifically shown, specified, or approved and only where they meet the structural requirements for a particular assembly with a safety factor of at least 400 percent. Power-driven fasteners may not be used for electrical or mechanical installations or to attach any items loaded in withdrawal or subject to vibration.

## 1.12 SAFETY

- A. In accordance with generally accepted construction practice, applicable law and the General Conditions, especially paragraphs 5.3, 5.20 through 5.28 and 7.3, the Contractor shall be solely and exclusively responsible for and have control over:
  - 1. Construction means, methods, techniques, sequences, procedures, and for coordinating all portions of the Work under the Contract Documents.
  - 2. Safety of employees engaged in the Work while on and off the site.
  - 3. Safety of the Owner, the Engineer, the Design Engineer, and others who may visit or be affected by the Work.
  - 4. Safety of the Work itself including material and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor or the Contractor's subcontractors or sub-subcontractors.
  - 5. Safety of other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and underground facilities not designated for removal, relocation, or replacement in the course of construction.
  - 6. Safety programs, equipment, and protective devices required to assure the safety of persons and property for whom/which the Contractor is responsible.
- B. The Owner, the Engineer, and the Design Engineer and each of their officers, employees, agents, and consultants shall not be responsible for any construction means, methods, techniques, sequences, nor for safety in, on or about the site, nor for coordinating any part of the Work.
- C. The Contractor shall give notices and comply with applicable laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury, or loss.
- D. The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, necessary fences and other safeguards for safety and protection of persons and property on and off the site and shall: (1) post danger signs and other warnings against hazards, (2) promulgate safety regulations, and (3) notify owners and users of adjacent sites and utilities when the Contractor's operations may affect them.
- E. The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's Superintendent unless otherwise designated by the Contractor in writing to the Owner and Engineer.

- F. The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs required in connection with the Work and shall send copies of all accident, injury, or work-related illness reports and of all notices of unsafe conditions to the Engineer.
- G. The Contractor shall not load or permit heavy weights to be placed on any part of the construction or site so as to endanger its safety.
- H. The duties of the Owner, the Engineer, and the Design Engineer in conducting review of the Contractor's performance is not intended to include review of the adequacy of the Contractor's work methods, equipment, bracing, scaffolding, or safety measures in, on, or near the construction site. See General Conditions, paragraph 7.3.
- I. The Contractor is hereby informed that work on this Project could be hazardous. The Contractor shall carefully instruct all personnel working in potentially hazardous work areas as to potential dangers and shall provide such necessary safety equipment and instructions as required to prevent injury to personnel and damage to property, and to comply with all applicable laws and regulations including State OSHA, Federal OSHA, and other regulations referenced in these Contract Documents.
- J. The Contractor shall, at all times, maintain the job in a condition that is safe for the Owner, the Engineer, and their consultants to make site visits and to conduct construction reviews. If the Owner or the Engineer cannot allow personnel to visit the job because it is not safe, the Contractor is not providing required safe access to the Work as required by General Conditions paragraph 12.2.
- K. The Contractor shall prepare a Safety Plan meeting the requirements of applicable regulations. As a minimum, the Contractor's Safety Plan shall set forth definite procedures for informing workers about safety, for instructing workers in safe practices, for assuring that workers are using appropriate safety equipment and safe work practices, and for reporting accidents.

#### 1.13 EXCAVATION AND TRENCHING; WORK WITHIN CONFINED SPACES

- A. Submit specific plans to the Owner showing details of provisions for worker protection from caving ground. The detailed plans shall show the design of shoring, bracing, sloping banks, or other provisions and shall be prepared, signed, and stamped by a Civil or Structural Engineer licensed in the State of Washington retained by the Contractor. The Owner's acceptance of the detailed plans submitted is only an acknowledgment of the submission and does not constitute review or approval of the designs, design assumptions, criteria, completeness, applicability to areas of intended use, or implementation of the plans, which are solely the responsibility of the Contractor and its Registered Engineer.
- B. Work within Confined Spaces: Work within confined spaces is subject to applicable laws, regulations, and safety orders.
- C. The foregoing provisions do NOT reduce the requirement for the Contractor to maintain safety in ALL operations performed by the Contractor or its Subcontractors.

#### 1.14 CONTRACTOR'S QUALITY CONTROL

- A. The Contractor shall be fully responsible for inspecting the work of its suppliers and subcontractors to assure that the work when completed will comply with the

standards for materials and workmanship required by the Contract Documents. See General Conditions paragraph 13.9.

- B. Inspections, periodic observations, and testing performed by the Owner or the Engineer are for the Owner's benefit and information only and shall not be construed as partial or incremental acceptance of the work and shall not be deemed to establish any duty on the part of the Owner or the Engineer to the Contractor, its subcontractors, or suppliers. See General Conditions paragraphs 7.5 and 12.10.
- C. The Engineer will have authority to reject Defective Work. The Engineer will have authority to require additional inspection or testing of the Work whether or not such Work is fabricated, installed, or completed. Neither this authority of the Engineer nor a decision not to exercise such authority shall give rise to a duty or responsibility of the Engineer to the Contractor, subcontractors, material and equipment suppliers, their agents or employees, or other persons performing portions of the Work.
- D. Observations by the Engineer or tests, inspections, or approvals by others shall not relieve the Contractor from its obligation to perform the Work in accordance with the Contract Documents.
- E. The Contractor shall:
  - 1. Monitor quality control over suppliers, manufacturer, products, services, site conditions, and workmanship, to produce work of specified quality.
  - 2. Comply fully with manufacturer's installation instructions, including performing each step in sequence as recommended by the manufacturer.
  - 3. Submit a Request for Information (RFI) to the Engineer before proceeding with work when manufacturers' instructions or reference standards conflict with Contract Documents.
  - 4. Comply with specified standards as a minimum quality for the work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
  - 5. Perform work by persons specializing in the specific trade and class of work required and qualified to produce workmanship of specified quality.
  - 6. Secure products in place with positive anchorage devices designed and sized to withstand seismic, static and dynamic loading, vibration, and physical distortion or disfigurement.
- F. If reference standards or manufacturers' instructions contain provisions that would alter or are at variance with relationships between the parties to the Contract set forth in the Contract Documents, the provisions in the Contract Documents shall take precedence.
- G. The Contractor shall provide assistance required by the Engineer to adequately inspect the Work including ladders, scaffolding, lighting, ventilation, and other aids to facilitate access and provide a safe working environment.

#### 1.15 TESTING LABORATORY SERVICES AND CERTIFIED LABORATORY REPORTS

- A. Provide testing services in accordance with General Conditions Article 12 and specific requirements contained in each technical specification section. Submit Certified Laboratory Reports required by technical specification sections.
- B. Unless otherwise specified, the Contractor shall arrange and pay for tests, inspections, and approvals other than Special Inspections that are required by laws, ordinances, rules, regulations, orders of public authorities having jurisdiction

or by the Contract Documents. All such tests, inspections, and approvals shall be performed by an independent testing laboratory or inspection agency acceptable to the Engineer or to the appropriate public authority. Samples to be tested and items of work to be inspected will be selected by the Engineer or the public authority requiring the test or inspection. Test reports, inspection reports, and certificates shall be submitted directly to the Engineer by the performing laboratory or agency. The Contractor shall notify the Engineer at least two (2) days prior to all tests and inspections to permit observation by the Engineer.

- C. The Contractor shall provide access for Special Inspections and notify the Owner two (2) working days in advance of when work requires Special Inspection.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

## SECTION 01140

### ENVIRONMENTAL PROTECTION

#### PART 1 - GENERAL

##### 1.01 SCOPE

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

##### 1.02 SUBMITTALS

- A. Develop an Environmental Protection Plan in detail and submit in accordance with Section 01300 within thirty (30) days from the date of the Notice to Proceed. The Environmental Protection Plan shall include, but not be limited to, the following items:
  - 1. Copies of required permits.
  - 2. Proposed sanitary landfill site.
  - 3. Other proposed disposal sites.
  - 4. Copies of any agreements with public or private landowners regarding equipment, materials storage, borrow sites, fill sites, or disposal sites. Any such agreement made by the Contractor shall be invalid if its execution causes violation of local or regional grading or land use regulations.
- B. Distribute the favorably reviewed Environmental Protection Plan to all employees and to all subcontractors and their employees.

##### 1.03 MITIGATION OF CONSTRUCTION IMPACTS

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

C. Protection of Natural Resources:

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

3. Water Resources: Investigate and comply with all applicable federal, state, and local regulations concerning the discharge (directly or indirectly) of pollutants to the underground and natural waters. Perform all work under this Contract in such a manner that any adverse environmental impacts are reduced to a level that is acceptable to the Engineer and regulatory agencies.
  - a. Oily Substances: At all times, special measures shall be taken to prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water in such quantities as to affect normal use, aesthetics, or produce a measurable impact upon the area. Any soil or water that is contaminated with oily substances due to the Contractor's operations shall be disposed of in accordance with applicable regulations.
4. Noise Control: The following noise control procedures shall be employed:
  - a. Maximum Noise Levels within 1,000 Feet of any Residence, Business, or Other Populated Area: Noise levels for trenchers, pavers, graders, and trucks shall not exceed 90 dBA at 50 feet as measured under the noisiest operating conditions. For all other equipment, noise levels shall not exceed 85 dBA at 50 feet.
  - b. Equipment: Jack hammers shall be equipped with exhaust mufflers and steel muffling sleeves. Air compressors should be of a quiet type such as a "whisperized" compressor.
  - c. Operations: Keep noisy equipment as far as possible from noise-sensitive site boundaries. Machines should not be left idling. Use electric power in lieu of internal combustion engine power wherever possible. Maintain equipment properly to reduce noise from excessive vibration, faulty mufflers, or other sources. All engines shall have mufflers.
  - d. Scheduling: Schedule noisy operations so as to minimize their duration at any given location.
  - e. Monitoring: To determine whether the above noise limits are being met and whether noise barriers are needed, the Contractor shall use a portable sound level meter meeting the requirements of American National Standards Institute Specification S1.4 for Type 2 sound level meters. If non-complying noise levels are found, the Contractor shall be responsible for monitoring and correction of excessive noise levels.
5. Dust Control, Air Pollution, and Odor Control: Employ measures to prevent the creation of dust, air pollution, and odors.
  - a. Unpaved areas where vehicles are operated shall be periodically wetted down or given an equivalent form of treatment, to eliminate dust formation.
  - b. Store all volatile liquids, including fuels or solvents, in closed containers.
  - c. No open burning of debris, lumber, or other scrap will be permitted.
  - d. Properly maintain equipment to reduce gaseous pollutant emissions.
6. Construction Storage Areas: Storage of construction equipment and materials shall be limited to the designated Contractor's storage area.
  - a. Store and service equipment at the designated Contractor's storage area where oil wastes shall be collected in containers. Oil wastes shall not be allowed to flow onto the ground or into surface waters. Containers shall be required at the construction site for the disposal of materials such as paint, paint thinner, solvents, motor oil, fuels, resins, and other environmentally deleterious substances. No dumping of surplus concrete or grout on the site will be permitted.

7. Sanitation: During the construction period, provide adequate and conveniently located chemical sanitation facilities, properly screened, for use of construction crews, the Engineer, and visitors to the site. Facilities shall be regularly maintained.
8. Fire Prevention: Take steps to prevent fires including, but not limited to, the following:
  - a. Provide spark arrestors on all internal combustion engines.
  - b. Store and handle flammable liquids in accordance with the Flammable and Combustible Liquids Code NFPA 30.
  - c. Provide fire extinguishers at hazardous locations or operations, such as welding.

#### 1.04 DISPOSAL OPERATIONS

- A. Solid Waste Management:
  1. Supply solid waste transfer containers. Daily remove all debris such as spent air filters, oil cartridges, cans, bottles, combustibles, and litter. Take care to prevent trash and papers from blowing onto adjacent property. Encourage personnel to use refuse containers. Convey contents to a sanitary landfill.
  2. Washing of concrete containers where wastewater may reach adjacent property or natural water courses will not be permitted. Remove any excess concrete to the sanitary landfill.
- B. Chemical Waste and Hazardous Materials Management: Furnish containers for storage of spent chemicals used during construction operations. Dispose of chemicals and hazardous materials in accordance with applicable regulations.
- C. Garbage: Store garbage in covered containers, pick up daily, and dispose of in a sanitary landfill.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

## SECTION 01190

### SEISMIC REQUIREMENTS

#### 1.01 SUMMARY

- A. This Section is applicable to the following secondary structural system elements, non-structural components, and/or equipment supported by structures.
  - 1. Mechanical, electrical, and plumbing equipment and appurtenances, including, but not limited to:
    - a. Supports and other components.
  - 2. Conduit, piping, cable trays, raceways, ducts, and similar systems.
  - 3. All equipment specifically listed in this specification.
  - 4. Pipe support and anchorage.
- B. This Section is applicable to the following elements of the primary structural system:
  - 1. Other elements of the primary structural system specifically designated for design by the Contractor.

#### 1.02 REFERENCES

- A. American Society of Civil Engineers Standard, ASCE 7-16, Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- B. International Building Code 2021 Edition with Amendments adopted by the Washington State Building Code Council (WSBC).

#### 1.03 DEFINITIONS

- A. Specialty Engineer: Structural or Civil Engineer licensed in the State where the project is being built responsible for specific elements of the primary structural system, the secondary structural system, non-structural elements and/or equipment supported by structures. The Specialty Engineer shall be provided by the Contractor.

#### 1.04 GENERAL DESIGN REQUIREMENTS

- A. The Contractor and Specialty Engineer are responsible for producing structural designs that resist applicable loads including: Dead, Live, Wind, Seismic, Fluid, Snow, Rain, Earth, operational, or other special loads applicable to the component being designed.
- B. Minimum design loads shall be based on guidelines given in this Section, the Drawings, ASCE 7, WSBC Chapter 16, equipment manufacturer's recommendations and/or other industry accepted design standard for the component being designed (i.e., AWWA D100, API 650, ANSI MH16.1).

#### 1.05 SEISMIC DESIGN REQUIREMENTS

- A. The Contractor is responsible for producing designs that resist the total seismic forces in accordance with the seismic design criteria. The Contractor is responsible for coordinating between the Engineer and the Specialty Engineer. The Contractor is responsible to coordinate the favorably reviewed design in the field, and shall provide the proposed design, including any modifications required to the primary structure, at no additional cost to the Owner.

- B. The seismic design for non-structural components and equipment shall be in accordance with the WSBC Chapter 16 and the required coefficients and factors for determining the total design seismic forces are shown on the Drawings.
- C. Coordinate the layout so that adequate space is provided between items for relative motion. Provide additional supports and restraints between items of different systems when necessary to prevent seismic impacts or interaction.
- D. Design non-building structures in accordance with Chapter 15 of ASCE 7; all designs utilizing Chapter 15 of ASCE 7 shall include the design and anchorage of the entire non-building structure.
- E. Design anchorages of all elements of structures, nonstructural components, and equipment supported by structures, to resist static and dynamic operational loads, plus total seismic loads specified in the WSBC, ASCE 7 and as follows:
  - 1. For suspended equipment, multiply dead load by 1.2 and add 0.2SDS to account for vertical seismic effects in the downward direction.
  - 2. For anchorage uplift, multiply dead load by 0.9 and subtract 0.2SDS if used to reduce vertical seismic effects.
  - 3. Post-installed anchors installed in concrete shall be prequalified for seismic application in accordance with ACI 355.2.
- F. Design Basis and Coordination: Contractor shall note that the layout of the structure and equipment pads is based on the first named manufacturer and model for the equipment to be anchored.
  - 1. Contractor shall coordinate all attachments and related work and shall provide connections as noted in the favorably reviewed shop drawings.
  - 2. For all suppliers, if the dimensions required by the Contractor's submitted anchorage calculations deviate from those provided on the Contract Drawings, Contractor shall note the deviation in the submittal for review and provide the favorably reviewed pad at no additional cost to the Owner.
  - 3. If a model or manufacturer other than the first name supplier is submitted for use by the Contractor, Contractor shall coordinate all related work and deviations from the Contract Drawings.
  - 4. Where Contractor's Specialty Engineer proposes a deviation from the Contract Drawings for any manufacturer, and that deviation is favorably reviewed by the Engineer, Contractor shall provide that modification to the structure at no additional cost.

#### 1.06 DESIGN REQUIREMENTS FOR PIPING, CONDUIT, AND DUCTS

- A. The Contractor is responsible for producing designs for support of piping, conduit, duct, or other systems to resist total seismic forces based on the seismic design criteria coefficients specified above, unless shown on the Contract Documents. Except where the technical specifications give specific exemption from resistance of seismic forces, all supports shall be designed to meet seismic criteria. Support systems for piping, conduit, duct, or other systems greater than 5 inches in diameter are shown on the Contract Documents.
- B. Where possible, pipes, conduits, and their connections shall be constructed of ductile materials (e.g., copper, ductile iron, steel or aluminum and brazed, welded or screwed connections). Pipes, conduits, and their connections, constructed of nonductile materials (e.g., cast iron, no-hub pipe and plastic), shall have the brace spacing reduced to one-half of the spacing allowed for ductile material.

- C. Seismic restraints may be omitted for the following conditions, where flexible connections are provided between components and the associated ductwork, piping, and conduit:
1. Fuel piping less than 1-inch nominal pipe size.
  2. All other piping suspended by individual hangers 12 inches or less in length from the top of the pipe to the bottom of the structural support for the hanger, where the hangers are detailed to avoid bending of the hangers and their connections, or piping of 3 inches nominal pipe size and less ( $I_p=1.0$ ), or piping of 1-inch nominal pipe size and less ( $I_p$  greater than 1.0).
  3. Electrical conduit less than 2.5 inches trade size or raceways supported by individual hangers 12 inches or less in length from raceway support point to the bottom of the structural support for the hanger, where the hangers are detailed to avoid bending of the hangers and their connections.
  4. Air-handling ducts not carrying hazardous gases or used for smoke control with less than 6 square feet in cross-sectional area or weighing less than 17 pounds/foot, or ducts suspended by individual hangers 12 inches or less in length from the duct support point to the bottom of the structural support for the hanger, where the hangers are detailed to avoid bending of the hangers and their connections.
- D. All trapeze assemblies supporting pipes, ducts, and conduit shall be braced to resist the total seismic forces considering the weight of the elements on the trapeze. Pipes, ducts, and conduits supported by a trapeze where none of those elements would individually be braced need not be braced if connections from the pipe/conduit/ductwork to component or directional changes do not restrict the movement of the trapeze. If this flexibility is not provided, bracing will be required when the aggregate weight of the pipes and conduits exceed 10 pounds/foot or ducting exceeds 17 pounds/foot. The weight shall be determined assuming all pipes and conduits are filled with water.
- E. As an alternative to designing the supports and anchorage, where an approved national standard provides a basis for the earthquake-resistant design, submit standard, data, and details for piping, conduit, duct, or other systems:
1. For ductwork, mechanical piping, process piping, and electrical conduits, follow Guidelines for Seismic Restraints of Mechanical Systems by SMACNA modified as follows:
    - a. Seismically brace piping regardless of size or location. Provide transverse braces at all changes in direction and at the end of all pipe runs. Space transverse braces not more than 20 feet apart. Provide longitudinal braces at 40-foot centers.
    - b. Seismically brace all ductwork regardless of size or location. Provide transverse braces at all changes in direction and at each end of run. Space braces not over 20 feet apart. Provide longitudinal braces at 40-foot centers.
  2. For fire protection systems, follow NFPA 13 modified as in paragraph 1.b above. Ensure that no seismic interaction occurs with items of other systems.

## 1.07 SUBMITTALS

- A. Shop Drawings for non-building structures and Contractor designed components: Submit signed and sealed structural calculations and detailed drawings for the following listed elements and where required in Divisions 02 through 17 of the primary structural system and their attachments, the secondary structural system and their attachments, permanent non-structural components and their

attachments, and the attachments and anchorage for permanent equipment supported by the structure:

1. List items where entire package shall be designed by the Contractor.
  2. Any components or equipment where Contractor's Specialty Engineer had designed using Chapter 15 of ASCE 7 (i.e., which are non-building structures rather than equipment).
- B. Shop Drawings for Anchorage Calculations: Where required in the equipment specifications in Divisions 02 through 17, submit signed and sealed structural calculations and detailed drawings from the Contractor's Specialty Engineer.
- C. Structural calculations and detailed drawings shall be prepared by the Contractor's Specialty Engineer.
- D. Structural calculations and detailed drawings shall clearly show the total design seismic forces which will be transferred from the elements of the structural system, non-structural components, and/or equipment and their attachments to the primary structure. Calculations must be reviewed by Engineer for general conformance with the design criteria and building code and therefore calculations shall include:
1. Seismic and wind load criteria used to determine design lateral and uplift forces. For external equipment, a statement should be made as to whether seismic or wind forces control.
  2. Derivation of forces used, including at least one complete sample calculation, showing the process used so that Engineer may determine general compliance. Printouts of spreadsheets without explanation of calculations used to determine values are not acceptable.
  3. Adequacy of anchorage to concrete and masonry or attachment to the primary structure to transfer the design forces from the element.
  4. Detail drawings shall note:
    - a. Required concrete strength.
    - b. Anchor type, dimensions, and materials. Coordinate material selection with Section 05090.
    - c. Edge distance, spacing, embedment depth, substrate thickness, and any supplementary reinforcing required for anchors installed in concrete.
    - d. Required dimensions of equipment pads based on equipment size and edge distance. The Contractor shall coordinate dimensions of equipment pads, including any revisions required to meet the requirements of the favorably reviewed submittal by the Specialty Engineer, at no additional cost to the Owner.
- E. The Engineer's review of items within a Specification Section cannot be completed until all related items have been coordinated and submitted for review.
- F. Quality Assurance Submittals:
1. Test Reports: Submit test reports for tension testing of anchors.
  2. Verification of installation: Submit a letter from the Contractor's Specialty Engineer verifying that the installation was performed as required by the Specialty Engineer's calculations.

## 1.08 QUALITY ASSURANCE

- A. Qualifications: The Contractor is responsible for submitting signed and sealed structural calculations and detailed drawings from a Specialty Structural or Civil Engineer licensed in the State where the project is being built.

- B. Regulatory Requirements: Comply with the jurisdictional State's adopted and amended versions of the Washington State Building Code Section 1613, the referenced sections of ASCE 7, plus clarifications and additions specified in this Section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

PART 4 - FIELD QUALITY CONTROL

- A. Site Tests: Tension testing of expansion or adhesive anchors utilized for anchorage shall be done in the presence of the Owner's Representative and a report of the test results shall be submitted. See Section 05090 for additional requirements.
- B. Inspection: Special Inspection shall be provided for bolts installed in concrete and masonry. See Section 05090 for additional requirements.

END OF SECTION

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## SECTION 01200

### PRICE AND PAYMENT PROCEDURES

#### PART 1 - GENERAL

##### 1.01 TYPE OF CONTRACT

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

##### 1.02 SUBSTITUTIONS

- A. See Section 01300 paragraph 1.06 Proposed Equivalents (Substitutions) and Article 8 of the General Conditions for submission, review, and acceptance procedures and requirements.

##### 1.03 CONTRACT MODIFICATIONS

- A. Methods of modifying the Contract Documents are covered in General Conditions Article 9.
- B. The following documents may be used by the Engineer:
  - 1. Request for Quotation: Issued by the Engineer, a Request for Quotation is used to describe a proposed change and request a cost quotation from the Contractor but does not authorize a change in the Work or in the Contract Time or Price.
  - 2. Change Order: Signed by the Engineer signifying its recommendation and signed by the Contractor and Owner signifying their acceptance, a Change Order changes the Scope of Work and possibly the Contract Price and/or Contract Time.
  - 3. Work Directive Change: Signed by the Owner (and in some cases by the Contractor) signifying their acceptance and issued by the Engineer, a Work Directive Change is used: (1) to direct the Contractor to do extra work on a cost accounting basis with a fixed maximum sum when the Owner and Contractor have not agreed on the price and time for the change, and (2) to direct the Contractor to do work that the Contractor contends is not included in the contract scope. Work done under Case 1 will be converted to a Change Order when the Contractor and Owner agree on the change in price and time. The Contractor may make a claim under General Conditions Article 10 for recovery of cost and time extension for work done under Case 2; but if the claim is denied because the work is determined to be included in the contract scope, then the Contract Time and Price will not be changed. Work done under both Cases 1 and 2 shall be done in accordance with the requirements for work done on a cost accounting basis described in General Conditions paragraphs 9.11 through 9.14.
  - 4. Response to Request for Information: Issued by the Engineer, a Response to Request for Information is used to order or document minor changes in the work consistent with the intent of the Contract Documents and NOT involving a change in price or time. Information issued on a Response to Request for Information shall NOT authorize a change in Contract Price or Contract Time and shall not be considered a Constructive Change Order. If the Contractor considers that a Response to Request for Information would cause a change in Contract Price or Time, it shall notify the Engineer in writing within

fifteen (15) days of receipt of the Response to Request for Information and shall not proceed with the work. See General Conditions paragraphs 7.8, 9.9, and 9.10.

- C. The Contractor hereby expressly waives any claim or right to make a claim for an increase in Contract Time or Price without written notice to the Engineer of the Contractor's intent to make a claim 5 days prior to proceeding to execute the work or portion thereof giving rise to such claim. See General Conditions paragraph 10.4.
- D. The Contractor agrees that it shall not consider any Response to Request for Information, order, instruction, clarification, suggestion, or any other communication either written or oral, given intentionally or unintentionally by the Engineer, Owner, or any other person as authorization or direction to do any work that would cause a change in Contract Time or Price unless it is a formal written Change Order or Work Directive Change signed by the Owner.

#### 1.04 SCHEDULE OF VALUES

- A. Specific provisions are described in Article 13, paragraph 13.1 of the General Conditions.
- B. The Contractor's Schedule of Values shall be in a form acceptable to the Engineer and have at least the following level of detail: a separate line item for each technical specification section, for site mobilization, for Construction Scheduling, for bonds and insurance, for final cleanup, and for final deliverables. Subdivide final deliverables into: Record Drawings; Operation and Maintenance Manuals with Parts Lists; and Special Guarantees. Include the appropriate specification section and paragraph number for each line item. Subdivide major trades or portions of the work into multiple line items that relate to observable milestones to aid monthly progress evaluations in accordance with the following example:
  - Concrete Work
    - Foundations
    - Slab on grade
    - First floor walls and columns
    - Second floor beams and slabs
    - Second floor walls and columns, etc.
- C. The Engineer may recommend payment for the cost of making a successful Shop Drawing Product Data or Sample submittals required for Product Review not to exceed 2% of the value of the work or item submitted.

#### 1.05 APPLICATION FOR PAYMENT

- A. Applications for Payment may be made only on General Conditions Exhibit GC 4, in accordance with General Conditions paragraph 13.2. Line items on the Application for Payment shall be the same as those used on the Schedule of Values. Applications for Payment shall contain the Contractor's Certification required by General Conditions paragraph 13.2.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

## SECTION 01300

### SUBMITTALS

#### PART 1 - GENERAL

##### 1.01 SUBMITTAL PROCEDURES

- A. Accompany each submittal with a Submittal form, General Conditions Exhibit GC-2 which contains the following information:
  - 1. Contractor's name and the name of Subcontractor or supplier who prepared the submittal.
  - 2. The Project name and identifying number.
  - 3. Description of the submittal and reference to the Contract requirement or technical specification section and paragraph number being addressed.
- B. Unless otherwise specified, provide submittals in electronic PDF searchable format.
- C. Submittals which include more than one (1) item or piece of equipment shall include a Table of Contents following the standard submittal form and cover sheets.
- D. Each submittal shall include a copy of the specification section and all referenced and applicable sections with addendum updates included. For each specification section, check-mark each paragraph to indicate specification compliance with the full paragraph as a whole or marked to indicate requested deviations from specification requirements. Each deviation from the specifications requested by the Contractor shall be underlined and referenced by a unique number in the margin to the right of the identified paragraph. The submittal shall include a detailed written explanation of the reasons for requesting the deviation that is clearly labeled to correspond with the unique number provided in the margin. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal on the basis that the submittal is incomplete and will be returned to the Contractor REJECTED – RESUBMIT with no further consideration.
- E. Where applicable, a copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this Section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
- F. Project Initiation Submittals. At a minimum, provide the following project initiation submittals prior to mobilization.
  - 1. Designation of Superintendent: Include name, address, home telephone number, and a brief resume.
  - 2. List of Subcontractors and Major Suppliers: Include address, telephone number, and name of responsible party.

3. Schedule of Values, in a form acceptable to the Engineer: See General Conditions Article 13.
- G. The Contractor shall allow 30 days for the Engineer's review of each submittal and 30 days for each resubmittal unless a different period is specified by the Engineer in writing. If the Engineer requests additional information or clarification of a submittal, the 30 days shall be measured from the date the additional information or clarification is received. If the Contractor requires more than two submittals to obtain the Engineer's Favorable Review, the Contractor shall compensate the Owner for the cost of the Engineer's additional review time. The Contractor shall not perform work for which reviewed submittals are required without obtaining Favorable Review of submittals.

#### 1.02 SCHEDULE OF SUBMITTALS

- A. See General Conditions Article 5. Within 15 days after the Notice to Proceed, submit a Schedule of Submittals showing the date by which each submittal required for Product Review or Product Information will be made. Identify the items that will be included in each submittal by listing the item or group of items and the Specification Section and paragraph number under which they are specified. Indicate whether the submittal is required for Product Review of Proposed Equivalents, Shop Drawings, Product Data or Samples, or required for Product Information only.

#### 1.03 PLAN OF OPERATIONS

- A. Before beginning on site work, submit a plan showing Contractor's intended use of the site assigned to it. Show location of enclosing fence, access points, and gates. Show location for Contractor's, Subcontractor's, and Engineer's field office and parking. Show location of Contractor's and Subcontractor's work areas and storage areas.

#### 1.04 CONSTRUCTION SCHEDULE

- A. See General Conditions Article 5.
- B. The form of Construction Schedule may be selected by the Contractor, but the Schedule shall meet the minimum requirements of General Conditions Article 5.
- C. If the Construction Schedule does not reflect the format requirements, the specified work, or the Contract Time, it will be returned to the Contractor for modification.
- D. Revise the Construction Schedule and resubmit within 7 days following any monthly meeting to review Contractor's Application for Payment when Contractor's work is 15 days or more behind schedule.
- E. Accelerated Work if Required to Meet Schedule: See General Conditions Article 11 Give Engineer 3 days prior notice of construction that will take place outside of normal work hours or work days. Compensate Owner for extra inspection cost caused by Accelerated Work required to meet Schedule.
- F. Give Engineer 3 days prior notice of normal work days on which construction will not take place or of scheduled construction that will not take place. Compensate Owner for extra inspection cost resulting from failure to give notice.

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

- A. This paragraph covers submittal of Shop Drawings, Product Data, and Samples required for the Engineer's review referred to as Product Review submittals in the Technical Specifications (Divisions 2 through 17). Submittals required for information only are referred to as Product Information submittals in the Technical Specifications and are covered in paragraph 1.07. Also see General Conditions Article 8. All shop drawings, product data, and samples shall be considered as Product Review submittals unless specifically called out as a Product Information submittal in a technical specification.
- B. The Contractor shall make all Product Review submittals early enough to allow adequate time for the Engineer's review, for manufacture, and for delivery at the construction site without causing delay to the Work. Submittals shall be made early enough to allow for unforeseen delays such as:
1. Failure to obtain Favorable Review because of inadequate or incomplete submittal or because the item submitted does not meet the requirements of the Contract Documents.
  2. Delays in manufacture.
  3. Delays in delivery.
- C. Content of Submittals:
1. Each submittal shall include all of the items and material required for a complete assembly, system, or Specification Section.
  2. Submittals shall contain all of the physical, technical, and performance data required by the specifications or necessary to demonstrate conclusively that the items comply with the requirements of the Contract Documents.
  3. Include information on characteristics of electrical or utility service required and verification that requirements have been coordinated with services provided by the Work and by other interconnected elements of the Work.
  4. Provide verification that the physical characteristics of items submitted, including size, configuration, clearances, mounting points, utility connection points and service access points, are suitable for the space provided and are compatible with other interrelated items that are existing or have or will be submitted.
  5. Label each Product Data Submittal, Shop Drawing, and Sample with the information required in paragraph 1.01A of this Section. Highlight or mark every page of every copy of all Product Data submittals to show the specific items being submitted and all options included or choices offered.
  6. Additional requirements for Product Review submittals are contained in the Technical Specification sections.
  7. Designation of work as "NIC" or "by others," shown on Shop Drawings, shall mean that the work will be the responsibility of the Contractor rather than the subcontractor or supplier who has prepared the Shop Drawings.
- D. Compatibility of Equipment and Material: Verify that items contained in the same or in different submittals meet the requirements in the paragraph titled "Material and Equipment" in Section 01040 especially the subparagraphs titled "Compatibility of Material and Equipment."
- E. Requirements for Contractor Designed Items and for First Specified (Named) Items: Verify that items meet the requirements in the paragraph titled "Performance Specifications and Contractor Designed Items" in Section 01040.

- F. Requirements for the Contractor's review and stamping of submittals prepared by the Contractor or by subcontractors or suppliers prior to submitting them to the Engineer are covered in General Conditions Article 8.
- G. Submittals that contain deviations from the requirements of the Contract Documents shall be accompanied by a separate letter explaining the deviations. See General Conditions Article 8. The Contractor's letter shall:
1. Describe the deviation from the specifications requested and identify with a unique number and reference to the Specification Section paragraph or Drawing requirement. The letter shall include a detailed written explanation of the reasons for requesting the deviation that is clearly labeled to correspond with the unique number provided.
  2. Describe the proposed alternate material, item, or construction and explain its advantages and/or disadvantages to the Owner.
  3. State the reduction in Contract Price, if any, that is offered to the Owner.
- H. Engineer's Review Procedure and Meaning:
1. The Engineer will stamp and mark each Product Review submittal prior to returning it to the Contractor. The stamp will indicate whether or not the review was favorable and what action is required of the Contractor. Review categories "No Exceptions Taken" and "Make Corrections Noted" both indicate Favorable Review.
  2. At a minimum, Favorable Review is contingent on:
    - a. The compatibility of items included in a submittal with other related or interdependent items included in previous or future submittals.
    - b. Future submittal of items related to or required to be part of this submittal that were not included with this submittal.
  3. Favorable Review of a submittal does not constitute approval or deletion of items required as part of the submittal but not included with the submittal. Favorable Review of items included in the submittal does not constitute deletion of specified features, options, or accessories that were not included in the submittal.
  4. The action required by the Contractor for each category of review is as follows:
    - a. **NO EXCEPTIONS TAKEN. NO RESUBMITTAL REQUIRED.**
    - b. **MAKE CORRECTIONS NOTED:**
      - 1) **NO RESUBMITTAL REQUIRED.** The Contractor shall make corrections noted prior to manufacture.
      - 2) **PARTIAL RESUBMITTALS REQUIRED.** The Contractor shall submit related accessory or optional items as noted which are required but were not included with the submittal and/or shall resubmit unsatisfactory portions or attributes of items as noted. The Contractor may proceed to manufacture those portions of the submittal that will be unaffected by required resubmittals.
    - c. **AMEND AND RESUBMIT.** The Contractor shall amend and resubmit the submittal as noted or required to comply with the Contract Documents. The resubmittal shall clearly summarize and provide responses to all previous Owner and Engineer comments.
    - d. **REJECTED - RESUBMIT.** The item submitted does not comply with the Contract Documents. Resubmit items that comply with the requirements of the Contract Documents.

- e. **NOT REVIEWED**. The item submitted is incomplete or does not comply with the Contract Documents. The item has not been reviewed and is returned to the Contractor for correction.
  - f. **RECEIPT ACKNOWLEDGED**. Receipt of a submittal that is not subject to the Owner's review and approval is acknowledged; and, is being filed for information purposes only. Generally used in acknowledging receipt of Product Information. No further submittal activity is required by the Contractor.
5. The letter of transmittal accompanying the returned Product Review submittal may contain numbered note. Marking a corresponding number on a Shop Drawing or Product Data submittal shall have the same effect as applying the entire note to the submittal.
- I. Re-submittals that contain changes that were not requested by the Engineer on the previous submittal shall be accompanied by a letter explaining the change.
  - J. Favorable Review Required Prior to Proceeding: Do not proceed with manufacture, fabrication, delivery, or installation of items prior to obtaining the Engineers Favorable Review of Product Review submittals. See General Conditions Article 12.
  - K. Intent and Limitation on Engineer's Review:
    - 1. See General Conditions Article 8.
    - 2. The Contractor has primary responsibility for submitting and providing work that complies with the requirements of the Contract Documents. That responsibility cannot be delegated in whole or in part to subcontractors or suppliers. Neither the Engineer's Favorable Review nor the Engineer's failure to notice or comment on deficiencies in the Contractor's submittals shall relieve the Contractor from the duty to provide work, which complies with the requirements of the Contract Documents.

#### 1.06 PROPOSED EQUIVALENTS (SUBSTITUTIONS)

- A. See General Conditions Article 8.
- B. The term "first specified item" or "first named maker" refers to the first product identified in the Specifications by a model number or trade name and/or by a maker's name for a specified item. When the first specified item is followed by a second maker's name and "or equal," the Contractor may submit Proposed Equivalent (Substitution) items for the Engineer's review. Proposed Equivalent (Substitution) items that are in the Engineer's judgment equal to the first specified item in quality, utility, and appearance, will be Favorably Reviewed. Where a product description and first maker's name is followed by "or equal" with no second maker's name, it means the specifier knows of no equivalent product and the Contractor may submit Proposed Equivalent (Substitution) products by other makers for review. Where the term "or equal" is omitted, it means that the named item is required to meet the Owner's needs; no products or makers other than those specified will be considered.
- C. Submit Proposed Equivalent (Substitutions) submittal form, General Conditions Exhibit GC-3 and comply with the submittal requirements for Shop Drawings, Product Data, and Samples submitted for Product Review in another paragraph of this Section.

- D. Time of Submittal:
1. General Conditions Article 8 requires submittal of Proposed Equivalents (Substitutions) within 35 days of the Notice to Proceed. The Engineer may agree to a later submittal date if requested in writing within 35 days of the Notice to Proceed. The request shall identify the item; give the Specification reference, and proposed manufacturer and model number of the item that will be submitted and the proposed submittal date.
  2. The Engineer's agreement to a later submittal date shall be in writing and shall not be construed as Favorable Review or acceptance of the manufacturer or item proposed.
- E. Content of submittals shall be the same as that required for Product Data, Shop Drawings, and Samples submitted for Product Review in another paragraph of this Section. In addition, the Contractor shall provide information on several recent similar installations of the item to verify its suitability. The information shall include the project name and location, the Owner's name, address, telephone number, and name of a knowledgeable person to contact for information on performance of the product.
- F. When the Contractor has listed specific maker's products submitted with its Bid, no changes will be permitted without submittal of acceptable evidence justifying the change and the Engineer's written approval.
- G. If a non-equivalent substitute is submitted for review, it shall be accompanied by a proposed reduction in Contract Price which shall include the increased cost of Engineering service required to evaluate the proposed substitute (which shall be paid to the Owner whether or not the substitute is accepted) plus the greater of 1) the difference in price between the first specified item and the item submitted and 2) the difference in value to the Owner between the two items.

#### 1.07 PRODUCT INFORMATION SUBMITTALS

- A. See General Conditions Article 8. Submittal for Informational Purpose Only is an item required for the Owner's permanent records relating, in part, to future maintenance, repair, modification, replacement of work, or as otherwise required. The Contractor shall clearly separate information for Product Review from information for Product Information in submittals that include both.
- B. Make Product Information submittals prior to delivering material, products, or items for which Product Information submittals are required.
- C. The Contractor has the sole and exclusive responsibility for furnishing products and work that meets the requirements of the Contract Documents.
- D. The Engineer reserves the right to comment on any submittal and to reject any product or work delivered, installed or otherwise at any time that the Engineer become aware that it is defective or does not meet the requirements of the Contract Document. See General Conditions Article 12.

#### 1.08 OPERATION AND MAINTENANCE MANUALS AND PARTS LISTS

- A. Operation and maintenance (O&M) information shall be submitted in a format best suited for the type of manual to be provided to the Owner. Unless otherwise specified, provide information in electronic PDF searchable format.
- B. Provide operation and maintenance manuals and parts list for all equipment furnished under this Contract. Comply with the detailed requirements in Technical

Specification sections. Include instructions for delivery, storage, assembly, installation, lubrication, adjusting, startup, operation and maintenance. Provide PDF bookmarks for all items listed in subparagraphs 1 through 5 below.

1. For all equipment include:
    - a. Startup instructions.
    - b. Normal operation instructions.
    - c. Trouble shooting instructions.
    - d. Lubrication instructions.
    - e. Maintenance and reinstallation instructions, and manufacturer's recommended preventative maintenance schedule.
    - f. Parts identification.
    - g. List of spare parts recommended to have on hand.
    - h. Operator safety instructions.
    - i. Cleaning instructions.
    - j. Theory of operation to discrete component level.
    - k. Schematic diagrams, flow diagrams, wiring diagrams, logic diagrams, etc. to discrete component level.
    - l. Parts list showing all discrete components with part number.
    - m. Manufacturers' service and maintenance technical manuals.
  2. For all Electrical Equipment, provide the following additional information:
    - a. Equipment ratings.
    - b. Calibration curves and rating tables if appropriate.
  3. For Complex Equipment provide in addition:
    - a. Alternate specified operating modes.
    - b. Emergency shutdown instructions.
    - c. Normal shutdown instructions.
    - d. Long-term shutdown instructions.
  4. Operation and maintenance manuals for systems composed of separate pieces of equipment shall include a system explanation of items 1, a, b, and c, and 3a through c, as well as the instructions for each separate piece of equipment.
- C. Submit at least 15 days prior to Facility Startup and Training specified in Section 01650.
- D. When standard manufacturer's literature is used highlight or mark all copies to shop specific items and options provided.

#### 1.09 MANUFACTURER'S CERTIFICATES

- A. When specified in Technical Specification section, submit manufacturers' certificate to Engineer for review. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate. Certificates may be recent or previous test results on material or product but must be acceptable to the Engineer.

#### 1.10 CONSTRUCTION PHOTOGRAPHS

- A. Submit digital photographs in electronic JPEG format each month to Engineer with Application for Payment.
- B. Take five interior photographs to show progress of the Work. Take photographs within 5 days of each Application for Payment date.
- C. Identify photographs with date, time, orientation, and project identification.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

## SECTION 01500

### CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

#### PART 1 - GENERAL

##### 1.01 TEMPORARY UTILITIES

- A. Sanitary Facilities: Provide and maintain self-contained portable sanitary facilities for the Contractor's, subcontractor's, Engineer's, and Owner's use. Facilities shall comply with applicable regulations and shall be serviced, cleaned, and disinfected frequently.
- B. Temporary Water and Power:
  - 1. Water: Connect to existing water service and provide backflow prevention devices. Install a meter and reimburse the Owner for the cost of water used.
  - 2. Power: Connect to the existing electrical service with a service disconnect switch. Provide overcurrent and ground fault protection. Provide a meter and reimburse Owner for the cost of energy used.
- C. Temporary Heat: Use Owner's existing heating plant. Supplement with temporary heating equipment as required to maintain conditions necessary for construction operations.
- D. Temporary Ventilation: Provide equipment to ventilate enclosed areas to facilitate curing concrete, to dissipate humidity, and to prevent accumulation of dust, fumes, or gases. Utilize existing ventilation equipment and supplement with temporary fans to maintain clean air and safe conditions for construction operations. Replace or clean filters on existing or new equipment on completion of the project.
- E. Dissipation of Hazardous Fumes Prior to Completion and Occupancy by Owner: Provide high-capacity fans and heaters or use existing equipment to provide 100% fresh air at elevated temperatures for several days to dissipate hazardous fumes from new construction materials such as paint.
- F. Temporary Lighting: Provide and maintain lighting for construction operations to achieve a minimum lighting level of 20 foot-candles for rough work and 60 foot-candles for finish work.
- G. Temporary Fire Protection:
  - 1. Provide and maintain fire protection equipment, including extinguishers, fire hoses, and other equipment required by law or insurance carriers, or as necessary for proper fire protection during the course of the Work.
  - 2. Use fire protection equipment only for fighting fires.
  - 3. Locate fire extinguishers in field offices, storage sheds, tool houses, temporary buildings, and throughout the construction site.
  - 4. Comply with Fire Department Construction Site Requirements.

##### 1.02 TEMPORARY CONSTRUCTION

- A. The Contractor is solely and exclusively responsible for the design, construction, and maintenance of all temporary construction including forms, falsework, shoring, scaffolding, stairs, ladders, and all other similar items. See General Conditions paragraphs 5.3 and 5.20 through 5.28 and Section 01040.

- B. Construct adequate and safe forms and falsework to rigidly support partially completed structures. Provide temporary bridges and decking to maintain vehicular and pedestrian access. Design and construct temporary forms, falsework, bridges, and decking in accordance with applicable regulations and codes.

### 1.03 BARRICADES, FENCES, AND ENCLOSURES

- A. See General Conditions paragraphs 5.3 and 5.20 through 5.28 and Section 01040.
- B. Barricades: Provide temporary guardrails, ladders, stairs, guards, and barricades to protect persons in accordance with applicable regulations.
- C. Fences: Existing fences enclose the present facilities site. The fences are for the protection and security of the present operating facilities. If it is necessary for the Contractor to remove some of the fences for installation of new work, the Contractor shall provide equivalent temporary protection and security. Replace fencing removed by the Contractor with new fencing of equivalent quality prior to completion of the project.
- D. Enclosures:
  - 1. Provide protective dust covering at doors and other openings to contain dust within the construction area.
  - 2. Provide temporary partitions to prevent dust and moisture from entering Owner-occupied areas and to prevent damage to existing materials and equipment. Temporary partitions shall be of non-combustible construction such as metal studs and gypsum board.
  - 3. Provide temporary watertight closures for openings in exterior surfaces as required to protect interiors from weather, moisture, humidity, and extreme temperature.

### 1.04 PROTECTION OF INSTALLED WORK

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

### 1.05 SECURITY

- A. Provide security and facilities to protect the Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

### 1.06 PARKING AREAS

- A. Parking: Park workers' vehicles onsite in designated parking areas.

## 1.07 TRAFFIC REGULATION

- A. Conduct operations so as to offer the least possible obstruction and inconvenience to public traffic. Do not overload or damage paved or improved surfaces, sidewalks, curbs, or gutters.

## 1.08 FIELD OFFICES

- A. Contractor's Office at the Site: Maintain a suitable office at the site for the Contractor's Superintendent who shall be authorized to receive submittals, drawings, instructions, or other communications from the Engineer or the Owner. Provide a meeting room suitable for six people for conducting the regular construction progress meetings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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## SECTION 01650

### FACILITY COMMISSIONING, TESTING, AND STARTUP

#### PART 1 - GENERAL

##### 1.01 EQUIPMENT AND FACILITY STARTUP

- A. Commission all systems and equipment to verify performance, function, and correct operation by performing procedures to activate, startup, adjust, test, and demonstrate that the work is in operating order in accordance with the general requirements of this Section and the detailed requirements of the technical sections under the system or equipment specified. To ensure that the work is ready for full-time operation, the procedures shall include verification, balancing, calibration, witness testing, documentation, inspection by equipment manufacturers, and operator training where specified.
- B. The Contractor shall designate a Project Startup Coordinator. The Startup Coordinator shall oversee preparation of the Startup Plan, coordinate startup activities, ensure proper testing and sign-offs for various mechanical, electrical and instrumentation and controls checks, and oversee the Facility Startup and Testing requirements. The Startup Coordinator shall have experience in the coordination, startup, and testing of similar capacity water treatment or wastewater treatment facilities.
- C. Notification: Notify the Engineer 5 days prior to starting each system or piece of equipment.
- D. Coordination: During the startup period, coordinate the operation of the equipment with Engineer, subcontractors, Owner's operators, and manufacturer's representatives. Provide regular updates of construction schedule and startup activities to the Owner's PLC/SCADA Programmer West Yost (Owner's Programmer).
- E. Furnish test equipment, measuring devices, and supplies required to conduct tests.
- F. Maintain the equipment until acceptance. Provide all lubricants necessary until acceptance.
- G. Furnish all expendable supplies, gas, water, etc., required for startup, demonstration, and testing, and dispose of all waste or used supplies, water, etc.
- H. The Owner will supply chemicals for startup and testing of the facility.
- I. Favorably reviewed Operations and Maintenance (O&M) Manuals are required 20 days before the startup of new equipment/facilities.

##### 1.02 SUBMITTALS

- A. Startup Plan, Forms, and Schedule: Prepare a facility startup plan and schedule. The plan shall include test methods and procedures and sample forms for recording commission, test, and startup data. The plan and schedule shall include time for testing and debugging of the PLC control logic and HMI interface for each system. The amount of time necessary shall be coordinated with and approved by the Engineer and the Owner's Programmer.

- B. Provide Affidavits as described in paragraph 1.04 B.
- C. Submit documentation of tests, balancing reports, and the like.

### 1.03 INITIAL STARTUP AND OPERATION OF FACILITIES

- A. Portions of the work shall be started up and operated during the construction period to permit continued operation of the existing facilities or to permit demolition and conversion of existing facilities to new uses. Refer to the general work sequence and early partial use occupancy requirements of Section 01010. Perform steps 1 through 13 in paragraph B below for the initial startup and operation of the systems and equipment that shall be started up and operated during the construction period and before the entire plant work is completed.
- B. The following listing is a general sequence of startup activity steps to be used in placing facility systems into operation:
  - 1. Perform initial lubrication of equipment and have manufacturers check and adjust equipment. Provide all subsequent lubrication and maintenance, and such staff as required for test operation until the Owner assumes equipment maintenance responsibility after Step 15 below.
  - 2. Perform satisfactory testing of electrical work required prior to energizing of the electrical system.
  - 3. After completion of Step 2, perform satisfactory electrical testing required after energizing of the electrical system.
  - 4. Complete calibration of instruments.
  - 5. Satisfactorily complete system verification of instrumentation work.
  - 6. After completion of Steps 1 and 3, perform a rotational test of equipment and correct backward rotating drives.
  - 7. After completion of Steps 5 and 6, test operate the equipment by manually initiating the operation. Where manual operation bypasses alarm or safety monitoring, provide continuous supervision of such parameters. Perform this step using water in lieu of chemicals or other process liquids. Use dry air or nitrogen in lieu of hazardous gases. Following testing with water, chemical lines shall be drained and be fully dried, in accordance with the specifications, prior to introduction of chemical.
  - 8. Concurrent with Step 7, perform instrumentation and control testing and adjustments as related to the equipment being tested. Then allow time in the construction schedule for the Owner's Programmer to debug and test the PLC control logic and HMI interface. Provide personnel to assist in operation of equipment and adjustments of this system debugging and testing. All SCADA controls, interlocks, alarms, etc. including signals from other parts of the facility shall be tested. Provide simulation of inputs if needed during this step. Note: SCADA operational testing requires an approved test plan.
  - 9. Concurrent with Step 7 and where possible at this stage of startup, complete the performance testing specified for the equipment.
  - 10. Concurrent with Step 7, perform adjustments of the electrical work as related to the equipment being tested.
  - 11. Repeat Steps 1 through 10 as required for other equipment items and plant systems until all plant process components and utility systems are ready for new system(s) operation. It may be necessary for the Contractor to put portions of the newly constructed facility in service before constructing other portions of the facility or completing the Work as a whole.

12. Submit the required documentation of testing, calibration, and equipment affidavits.
13. Notify the Owner and the Engineer 45 days before new system(s) operation is to occur so that the Owner may order chemicals and make other arrangements for full-time operation. This notification shall have an accuracy of plus or minus 7 days. Notify the Owner and Engineer again, exactly 7 days before total plant operation is to begin.
14. 30-Day Plant Startup and Initial Operation Test: Upon completion of all the above steps, the new system(s) shall be started up and operated on a complete full-time basis beginning on the indicated date. The Owner will provide operating personnel, chemicals, and untreated water. For 5 consecutive days beginning with the startup day, the Contractor shall have at the plant site, during the day shift, a mechanic, an electrician, and an instrument engineer. Representatives of manufacturers of critical equipment shall also be present for these 5 days as needed or as required elsewhere in the Specifications. The Contractor shall also provide these personnel, on a 24 hour per day, "on call" basis, if necessary, to adjust, repair, and correct deficiencies as required to keep the facilities in continuous operation for a period of 30 calendar days. The Contractor shall train the operators in the proper operation and the control of the new facilities. The Contractor shall also furnish all such mechanical and electrical workers as required to make adjustments to and perform all required maintenance for the operating equipment until the end of the 30-day initial operation period. Maintenance of operating equipment shall include lubrication, adjustments, replacements, and modifications as required.
15. After successful completion of the 30-day initial operation period, the Owner will take over maintenance duties as well as operation and will begin to provide and pay for lubricants. If continuous process operation is interrupted for a period of 4 consecutive hours or more due to a failure of the equipment or work provided by the Contractor, then the counting of the 5-day and/or 30-day periods, described in Step 14 above, shall be restarted at day one if these periods have not reached satisfactory completion.
16. Following the commencement of Step 14, satisfactorily complete equipment performance testing, electrical testing and adjustments, and instrumentation/control testing and adjustments to the extent that such testing and adjustments could not be made prior to full system operation.
17. Submit any remaining documentation of testing, balancing reports, equipment affidavits, and the like commissioning before acceptance.

#### 1.04 MANUFACTURER'S FIELD SERVICE AND AFFIDAVITS

- A. Field Service: Where specified, manufacturers of equipment shall provide field service. Field service shall be provided by an authorized factory-trained and qualified manufacturer's representative for the specific equipment. Equipment shall not be considered ready for full-time operation until after the manufacturer's representative has checked and adjusted the equipment and certified by written affidavit that the equipment has been properly installed, tested, adjusted, lubricated, and calibrated, and is ready for full-time operation.

- B. Affidavits: Acceptable affidavits shall be submitted prior to completion of the work.
  - 1. Affidavits shall contain the following specific wording:

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

#### 1.05 TRAINING

- A. Submit Operation and Maintenance Manuals and Parts Lists specified in Section 01300 at least 15 days prior to the first training session.
- B. Demonstrate the operation, maintenance, and safety procedures for all systems and equipment to personnel designated by the Owner.
- C. Provide 16 hours of classroom and onsite demonstration of the onsite hypochlorite generation system and equipment.
  - 1. Illustrate classroom training with diagrams, checklists, photographs, and other visual aids as appropriate. Use video, slides, or overhead projector to present visual materials.
  - 2. Prepare a course summary illustrated with copies of visual materials. Distribute one copy to each course attendee, four copies to the Owner, and two copies to the Engineer.
- D. In addition to overall training specified above, provide special demonstration and training for specific pieces of equipment specified in the Technical Specification Sections.

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

#### PART 3 - EXECUTION

- A. Equipment reference forms attached to this Section are not specific to any piece of equipment or facility to be installed as a part of this Project. The examples are provided as a means of illustrating the level of detail required for the preparation of commission, testing, and startup forms for this project. Reference Division 16 Electrical and Division 17 Instrumentation and Control for additional commissioning, testing, and startup requirements.

## REFERENCE FORMS

<b>Title</b>
Equipment Test Report Form
Operation and Maintenance Transmittal Form
Equipment Record Form
Manufacturer's Installation Certification Form
Spare Parts / Extra Stock Chain of Custody Form

EQUIPMENT TEST REPORT FORM:

CITY OF SAMPLE

PROJECT NAME HERE

EQUIPMENT TEST REPORT

Equipment Name:  
 Equipment Number:  
 Specification Ref:  
 Location:

	Manufacturer		Owner Representative	
	Verified	Date	Verified	Date
<b>PREOPERATIONAL CHECKLIST</b>				
<u>Mechanical</u>				
Lubrication				
Alignment				
Anchor bolts				
Seal water system operational				
Equipment rotates freely				
Safety guards				
Valves operational				
Related systems operational				
O&M manual information complete				
<u>Electrical</u> (circuit ring-out and high-pot tests)				
Circuits:				
Power to MCC ??				
Control to HOA				
Indicators at MCC:				
Red (running)				
Green (power)				
Amber (auto)				
Indicators at local control panel				
Wiring labels complete				
Nameplates:				
MCC				
Control station				
Control panel				
Equipment bumped for rotation				

	Manufacturer		Owner Representative	
	Verified	Date	Verified	Date
<u>Piping Systems</u>				
Cleaned and flushed:				
Suction				
Discharge				
Pressure tests				
Temporary piping screens in place				
<u>Instrumentation and Controls</u>				
Flowmeter calibration				
Calibration Report No.				
Flow recorder calibrated against transmitter				
VFD speed indicator calibrated against independent reference				
Discharge overpressure shutdown switch calibration				
Simulate discharge overpressure Shutdown				
<b>FUNCTIONAL TESTS</b>				
<u>Mechanical</u>				
Motor operation temperature satisfactory				
Pump operating temperature satisfactory				
Unusual noise, etc.?				
Pump operation: ?? gpm/?? psig				
Measurement:				
Flow				
Pressure:		Test gage number:		
Alignment hot				
Dowelled in				
Remarks:				

	Manufacturer		Construction Superintendent	
	Verified	Date	Verified	Date
<u>Electrical</u>				
Local switch function:				
Runs in <i>HAND</i>				
No control power in <i>OFF</i>				
Timer control in <i>AUTO</i>				

Overpressure protection switch functional in both <i>HAND</i> and <i>AUTO</i>				
Overpressure protection switch set at ?? psig				
PLC ??? set at ??-hour cycle, ?? min <i>ON</i>				
<b>OPERATIONAL TEST</b>				
48-hour continuous test. Pump cycles as specified, indicators functional, controls functional, pump maintains capacity, overpressure protection remains functional, hour meter functional				

The undersigned manufacturer of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the project manual, has been provided in accordance with the manufacturer's recommendations, and that the trial operation of the equipment item has been satisfactory.

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

\_\_\_\_\_  
 Date

\_\_\_\_\_  
 Manufacturer

\_\_\_\_\_  
 Signature of Authorized Representative

\_\_\_\_\_  
 Date

\_\_\_\_\_  
 Signature of Owner's Representative

**OPERATION AND MAINTENANCE TRANSMITTAL FORM:**

Date: \_\_\_\_\_ Submittal No: \_\_\_\_\_  
 To: \_\_\_\_\_ Contract No: \_\_\_\_\_  
 \_\_\_\_\_ Spec. Section: \_\_\_\_\_  
 \_\_\_\_\_ Submittal Description: \_\_\_\_\_  
 \_\_\_\_\_ From: \_\_\_\_\_  
 Attention: \_\_\_\_\_

Checklist	Contractor		Construction Superintendent	
	Satisfactory	N/A	Accept	Deficient
1. Table of contents				
2. Equipment record forms				
3. Manufacturer information				
4. Vendor information				
5. Safety precautions				
6. Operator prestart				
7. Start-up, shutdown, and post-shutdown procedures				
8. Normal operations				
9. Emergency operations				
10. Operator service requirements				
11. Environmental conditions				
12. Lubrication data				
13. Preventive maintenance plan and schedule				
14. Troubleshooting guides and diagnostic techniques				
15. Wiring diagrams and control diagrams				
16. Maintenance and repair procedures				
17. Removal and replacement instructions				
18. Spare parts and supply list				
19. Corrective maintenance man-hours				
20. Parts identification				
21. Warranty information				
22. Personnel training requirements				
23. Testing equipment and special tool information				

Remarks: \_\_\_\_\_

\_\_\_\_\_  
 CONTRACTOR'S SIGNATURE



MANUFACTURER'S INSTALLATION CERTIFICATION FORM:

Contract No: \_\_\_\_\_ Specification section: \_\_\_\_\_

Equipment name: \_\_\_\_\_

Manufacturer of equipment item: \_\_\_\_\_

The undersigned manufacturer of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the project manual, has been provided in accordance with the manufacturer's recommendations, and that the trial operation of the equipment item has been satisfactory.

Comments: \_\_\_\_\_

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

\_\_\_\_\_  
Date

\_\_\_\_\_  
Manufacturer

\_\_\_\_\_  
Signature of Authorized Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Owner's Representative

**SPARE PARTS / EXTRA STOCK CHAIN OF CUSTODY FORM:**

(For use with loose-shipped spare parts, extra stock, or spare parts which are not permanently mounted within another piece of equipment)

**PART INFORMATION (Use a new form for each part type)**

PART NAME/DESCRIPTION:	
ID TAG.(IF APPLICABLE):	
MFR:	MFR PART/MODEL NO:
SERIAL NO (IF APPLICABLE)	
STYLE (IF APPLICABLE)	COLOR (IFF APPLICABLE)
ASSOCIATED/PARENT EQPM NAME:	
ASSOCIATED/PARENT EQPM ID TAG (IF APPLICABLE):	
SPEC REFERENCE:	QTY REQ'D:

**CHAIN OF CUSTODY**

QTY DELIVERED	DATE/ TIME/ LOCATION	RELEASED BY	RECEIVED BY
	Date:	COMPANY	COMPANY/AGENCY
	Time:	NAME/TITLE	NAME/TITLE
	Location:	SIGNATURE	SIGNATURE

**END OF SECTION**

## SECTION 01700

### CONTRACT CLOSEOUT

#### PART 1 - GENERAL

##### 1.01 FINAL CLEANUP

- A. Just prior to Final Inspection, the Contractor shall clean the entire construction area including building and other structures included in this Contract as well as all other areas affected by the performance of work under this Contract. Perform cleanup work using personnel specializing in and skilled in building cleaning and maintenance work. Perform cleaning to standards considered normal for commercial janitorial work. Accomplish repair work using personnel specializing in performing and repairing the type of work being repaired. Perform repair work to the highest trade standards applicable to that type of work. Include:
1. Remove all temporary construction, signs, tools, equipment, excess materials, and debris.
  2. Sweep clean and then wash down all exterior pavement surfaces. Avoid washing sediment or hazardous material into drainage systems. Remove all grease and oil stains on pavement caused by Contractor's equipment.
  3. Rake all landscaped area; remove debris, and cut lawns. Water and fertilize landscape materials. Replace damaged plant and landscape materials.
  4. Remove all lumps, splatters, spots, and stains caused by paint, adhesive, concrete, mortar, plaster, sealant, or other foreign material from all exposed or finished surfaces. Remove all temporary labels.
  5. Patch any holes, chips, or defects in construction including finished surfaces.
  6. Touchup painted surfaces that are soiled, chipped, spotted, or otherwise flawed.
  7. Wash all floors with cleaner recommended by flooring manufacturer. Apply sealer and initial application of floor care product recommended by flooring manufacturer. Buff with power floor machine.
  8. Remove all dust with treated dust cloth and vacuum.
  9. Polish all hardware and non-ferrous metal.
  10. Clean all lighting fixtures.

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

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

##### 1.03 SEMIFINAL INSPECTION/SUBSTANTIAL COMPLETION

- A. See General Conditions paragraphs 13.7 through 13.9. When the Contractor considers the Work nearly complete, the Contractor shall review the Contract Documents, inspect the Work, and use the Contractor's action list to prepare a Contractor's Punch List of all deficient or uncompleted items. Complete or correct the items on the Punch List. When the Work is Substantially Complete in accordance with General Conditions paragraph 13.7, notify the Engineer in writing that the Contractor has reviewed the Contract Documents, inspected the Work,

and believes that the Work is Substantially Complete and ready for Semifinal Inspection.

- B. See General Conditions paragraphs 13.9 through 13.10. On receipt of the Contractor's Punch List and notice that the Work is ready for Semifinal Inspection, the Engineer will inspect the Work. The Engineer may add additional items to the Contractor's Punch List, may find that the Work is not ready for inspection, may find that the Work is ready for inspection but not Substantially Complete, or may find that the Work is Substantially Complete. When the Engineer finds the Work is Substantially Complete, he/she will prepare a Final Punch List and a Notice of Substantial Completion, which will state the date of Substantial Completion and the time agreed to by the Owner and the Contractor (not to exceed 30 calendar days) in which the Work shall be fully complete and ready for Final Inspection.

#### 1.04 FINAL INSPECTION, FINAL COMPLETION, AND FINAL PAYMENT

- A. See General Conditions paragraphs 13.11 through 13.15. When the Contractor has completed or corrected all the items on the Engineer's Final Punch List, the Contractor shall give the Engineer written notice that the Work is ready for Final Inspection. When the Engineer finds the Work acceptable and fully complete in accordance with the Contract Documents, and upon receipt of a final Application for Payment and all final submittals, the Engineer will recommend that the Owner issue a Notice of Final Completion, make Final Payment, and Accept the Work stating that to the best of the Engineer's knowledge, information and belief, and on the basis of the Engineer's observations and inspection, the Work has been fully completed in accordance with the terms and conditions of the Contract Documents.
- B. Final Submittals include:
  - 1. Operation and Maintenance Manuals and Parts Lists.
  - 2. Record Drawings.
  - 3. Extra Materials.
  - 4. Special Guarantees.
  - 5. Insurance Certificate showing required continuation of coverage beyond Final Payment. See General Conditions paragraph 4.4.
  - 6. Release of Liens. See General Conditions paragraphs 13.2 and 13.13.
  - 7. Waiver of Claims by Contractor. See General Conditions paragraph 13.14.
  - 8. And any other submittals required by the Contract Documents and not previously received.
- C. The Owner will record the Notice of Final Completion at the County Recorders Office.

#### 1.05 RECORD DRAWINGS

- A. The Contractor shall maintain on the jobsite, a complete set of Contract Documents and a complete file of all addenda, contract modifications, and favorably reviewed submittals. The Contractor shall prepare a set of Record Drawings concurrently with the construction of the Work and in accordance with General Conditions paragraph 5.13 and the following:
  - 1. Show the invert elevation of all gravity piping and the top of pipe, top of conduit, or top of protective concrete encasement for other utilities. Elevations shall be related to a permanent visible elevation benchmark set on the building by the Contractor.

2. Show the horizontal location of underground utilities measured from permanent visible physical features such as face of building, face of tank, or centerline of manhole.
  3. Comply with detailed requirements in technical specification sections describing the type of information required on Record Drawings. The Contractor's copy of Contract Documents, Contract modifications, and Record Drawings shall be available to the Engineer for weekly verification that the records are being currently updated.
- B. Submit Record Drawings and obtain acceptance prior to completion.

#### 1.06 EXTRA MATERIALS

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

#### 1.07 SPECIAL GUARANTEES

- A. Paragraph 12.11 of the General Conditions covers the Contractor's responsibility to remedy defects due to faulty workmanship and materials, which appear within 1 year from the date of Final Completion and acceptance by the Owner.
- B. Guarantees for more than 1 year when called for in various sections of the Specifications shall be evidenced by the Contract Documents and in the form of a special guarantee written on the letterhead of the Contractor, subcontractor, or supplier doing the work and/or supplying the item to be guaranteed and countersigned by the Contractor as follows. Failure to provide the special guarantee on the letterhead shall not relieve the Contractor, subcontractor, or supplier from its obligations for the special guarantees.
- C. Special Guarantee:

We hereby guarantee that the \_\_\_\_\_ which we have provided in the \_\_\_\_\_, Project, was done in accordance with the Drawings and Specifications, and that the work, as installed, will fulfill the requirements of the guarantee included in Specification Section \_\_\_\_\_. We agree to repair or replace any or all of our work, together with any other adjacent work which may be damaged or displaced by so doing, that may prove to be defective in workmanship or material (with the exception of defects due to ordinary wear and tear, and unusual abuse or neglect) within a period of \_\_\_\_\_ years from the date of acceptance of the abovenamed facility, without any expense whatsoever to the Owner. In the event of our failure to comply with the above-mentioned conditions within the period set forth in Article 12 of the General Conditions after being notified in writing by the Owner, we, collectively or separately, do hereby authorize the Owner to proceed to have said defects repaired and made good at our expense, and we will honor and pay the costs and charges therefore upon demand. We understand that the provisions of General Conditions paragraphs 12.15 and 12.16 apply to this Special Guarantee.

Signed \_\_\_\_\_  
(Subcontractor or Supplier)

Company \_\_\_\_\_

Address \_\_\_\_\_

Telephone Number \_\_\_\_\_

Countersigned \_\_\_\_\_  
(Contractor)

- D. Submit two notarized original signed copies of each required Special Guarantee prior to completion.

#### 1.08 TWELVE-MONTH INSPECTION

- A. Thirty (30) days prior to the expiration of the 1-year guarantee period described in General Conditions Article 12, the Contractor shall tour the project with the Engineer and/or the Owner to prepare a list of corrective work required under the 1-year guarantee. The Contractor shall correct all items found to be defective within 7 days of receipt of the list of items to be corrected.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

## SECTION 02516

### DISINFECTION

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section Includes:
  - 1. Clean, flush, and disinfect all surfaces with which the process water may come in contact in the following equipment, structures, tanks, pipelines, and accessories, including:
    - a. Treatment equipment and pumping structures.
    - b. Water storage facilities.
    - c. Small pipelines:
      - 1) Hot and cold domestic water piping.
      - 2) Plant water.
  - 2. Dispose of disinfection solution.

##### 1.02 REFERENCES

- A. American Water Works Association (AWWA):
  - 1. C651 AWWA Standard for Disinfecting Water Mains
  - 2. C653 AWWA Standard for Disinfection of Water Treatment Plants
  - 3. C655 AWWA Field Dechlorination
  - 4. C670 AWWA Online Chlorine Analyzer Operation and Maintenance
- B. Standard Methods for Examination of Water and Wastewater:
  - 1. 9221 - Multiple Tube Fermentation Technique
  - 2. 9222 - Membrane Filter Technique
  - 3. 9223 - Chromogenic Substrate Coliform Test
- C. National Sanitation Foundation (NSF)/American National Standards Institute (ANSI):
  - 1. NSF/ANSI/CAN Standard 60: Drinking Water Treatment Chemicals - Health Effects
  - 2. NSF/ANSI/CAN Standard 61: Drinking Water System Components - Health Effects

##### 1.03 SCHEDULING

- A. Schedule and coordinate the work with the Owner and Engineer. Once disinfection has been satisfactorily accomplished, no further entry to the interior of the facilities will be allowed unless entry must be made to perform repairs, in which case repeat disinfection on a localized basis at no additional cost to the Owner. The Contractor shall be responsible for maintaining security of the disinfected facilities.
- B. Disinfect equipment, tanks, and pipelines following successful pressure testing.

##### 1.04 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Submit a Disinfection Plan in the Product Review category including the procedures, methods, materials, and schedules proposed for disinfecting the required surfaces, and method of disposal of chlorinated water.

## 1.05 QUALITY ASSURANCE

- A. Laboratory testing related to disinfection will be performed by and paid for by the Owner.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Potable Water: Use potable water to flush and disinfect.
- B. Chlorine: See the respective AWWA Standards and paragraph 3.02 below for forms of chlorine that may be used for disinfecting operations.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Provide all necessary appurtenances required for the disinfection procedures including taps, temporary piping, connections, and shutoff valves. Submit data on appurtenances which will be permanently installed for review by the Engineer.
- B. The Contractor is advised that precautions taken to keep surfaces clean during construction and avoiding the entry of deleterious substances on the work during construction will facilitate achieving the disinfection requirements of this Project.
- C. Prior to disinfecting, thoroughly clean accessible surfaces of dust, dirt, foreign matter, and deleterious substances. Remove any oil by contact with absorbents. Use water sprays, steam cleaning, vacuum cleaning, swabbing, hand brushing, or a combination of methods and rinsing to effect the cleaning, but do not use any method that will be detrimental to the finish surfaces. Flush inaccessible surfaces clean.

### 3.02 APPLICATION

- A. After completing all construction activities, disinfect the required surfaces with chlorine solutions in accordance with the following procedures. Following disinfection and flushing, the Owner will take water samples for chlorine residual and bacteriological analysis of the water. If the specified chlorine residual and bacteriological requirements are not satisfied, repeat disinfection procedure until the requirements are met. The Contractor shall pay for the additional sampling and testing at no additional cost to the Owner, until disinfection requirements are met.
- B. Brine Tank:
  - 1. Standard: AWWA C653 as amended herein.
  - 2. Forms of Chlorine: Sodium hypochlorite or calcium hypochlorite.
  - 3. Method: Walls: Method 2 (brush or spray) in accordance with AWWA C652.
    - a. Testing and Verification: After completing the disinfection procedure and before placing the facility in service, two or more samples will be collected from the facility at least 30 minutes apart and will be tested for the presence of total coliform bacteria.
    - b. The facility may be placed into service if none of the samples show the presence of total coliform bacteria.

- c. If any of the samples show the presence of total coliform bacteria, one or more of the following procedures shall be followed before placing the facility in service:
    - 1) Repeat samples shall be collected at least 24 hours apart until consecutive samples do not show the presence of total coliform bacteria.
    - 2) Repeat disinfection process and resample.
- C. Small Pipelines:
1. Preparation: Provide the system with a 1-inch minimum service cock or valve or other means to inject chlorine solution at a point within 2 or 3 feet of its junction with the supply source. When system is complete, thoroughly flush it by fully opening every outlet until clear water flows from all of them.
  2. Disinfecting Agent: Sodium hypochlorite or calcium hypochlorite in sufficient quantities to produce chlorine concentration of at least 50 parts per million in the system.
  3. Disinfecting Procedure:
    - a. Connect a hand-operated pump, or other means of injecting the disinfecting agent, to 1-inch minimum service cock or valve or other injection device. Pump must provide a pressure greater than that of supply of system.
    - b. With system completely full of water and supply valve open, proceed to adjust every outlet of system so that a trickle of water flows from each.
    - c. Inject disinfectant slowly and continuously at an even rate, not in slugs, until a test at each outlet shows a free chlorine residual concentration of at least 50 parts per million (ppm).
    - d. Close all outlets and valves, including valve connecting to supply line and 1-inch minimum service cock on solution injection connection. Maintain condition for 24 hours. After 24 hours, test for residual chlorine at each outlet. The free residual chlorine concentration indicated should be not less than 10 ppm. If the indicated free chlorine concentration is less than 10 ppm, repeat disinfection procedure until an approved result is obtained.
    - e. When the above procedure has been completed to the satisfaction of the Engineer, flush out entire system with fresh water until tests at all outlets show a residual of not more than 0.5 ppm.

### 3.03 FIELD QUALITY CONTROL

- A. Chlorine Residual Testing: AWWA C651, Appendix A, DPD Drop Dilution Method, except where otherwise specified. Testing shall be performed by the Contractor.
- B. Bacteriological Analyses of Water: After the completion of disinfecting procedure, including the final flushing as described in AWWA C651 and heretofore, the Owner's Laboratory will obtain water samples from this system for bacteriological analyses.
- C. Requirements for satisfactory disinfection of process equipment, tanks, pipelines, and associated elements are:
  1. Bacteriological analyses indicate that water samples are negative for coliform organisms; and
  2. Heterotrophic plate count (standard plate count) is less than 100 colony forming units per milliliter.

3. If bacteriological analyses do not satisfy the above requirements, then repeat disinfection procedure until these requirements are met.

#### 3.04 DISPOSAL OF DISINFECTION SOLUTION

- A. Dechlorinate and dispose of disinfection solution in the sanitary sewer. Take care to assure that chlorinated water is not spilled into drains.

#### 3.05 PROTECTION OF DISINFECTED STRUCTURES

- A. If required to re-enter a disinfected structure, the work shall be conducted using techniques and work methods as necessary to maintain the disinfected status. This shall include use of disinfected foot coverings, tools, and the like. In the event the Contractor contaminates the facilities, additional flushing and disinfection of the affected system shall be performed at no additional cost to the Owner.

END OF SECTION

## SECTION 03935

### REPAIR OF DEFECTIVE CONCRETE

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section Includes: Repair of defective concrete.

##### 1.02 REFERENCES

- A. American Concrete Institute (ACI):
1. ACI 117 Standard Tolerances for Concrete Construction and Materials
  2. ACI 301 Specifications for Structural Concrete
  3. ACI 308 Guide to External Curing of Concrete
  4. ACI 318 Building Code Requirements for Structural Concrete
  5. ACI 347 Guide to Formwork for Concrete
- B. ASTM International (ASTM) Standard Specification or Test Method for:
1. ASTM C881 Epoxy-Resin-Base Bonding Systems for Concrete
  2. ASTM C882 Bond Strength of Epoxy-Resin Systems Used with Concrete By Slant Shear
  3. ASTM C883 Effective Shrinkage of Epoxy-Resin Systems Used with Concrete
  4. ASTM C928 Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
  5. ASTM C1107 Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
  6. ASTM D570 Water Absorption of Plastics
  7. ASTM D638 Tensile Properties of Plastics
  8. ASTM D695 Compressive Properties of Rigid Plastics
  9. ASTM D732 Shear Strength of Plastics by Punch Tool
  10. ASTM D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

##### 1.03 SUBMITTALS

- A. Product Data:
1. When stains, rust, efflorescence, and surface deposits must be removed, submit the proposed materials and manufacturer's instructions for removal.
  2. When crack repair is required, submit the proposed materials and manufacturer's method of repair.
- B. Shop Drawings:
1. Repair Plan: After defects are identified and investigated, prepare and submit a repair plan that includes a listing of repairs to be made and the detailed surface preparation, products, methods, curing and finishing requirements of repair to be used at each location.
  2. Submit manufacturer's technical literature on products proposed for use. Include the manufacturer's installation and/or application instructions.
- C. Samples: Submit any item of Product Data not fully assembled by a single manufacturer.

#### 1.04 QUALITY ASSURANCE

- A. No existing structure or concrete shall be shifted, cut, removed, or otherwise altered until authorization is given by the Engineer.
- B. When removing materials or portions of existing structures and when making openings in existing structures, take all precautions and erect all necessary barriers, shoring and bracing and other protective devices to prevent damage to the structures beyond the limits necessary for the new work, protect personnel, control dust and to prevent damage to the structures or contents by falling or flying debris. Unless otherwise permitted, shown or specified, sawing and/or line drilling will be required in cutting existing concrete.
- C. Manufacturer's Qualifications: Minimum of 10 years' experience in the manufacture of the products specified and an ongoing program of training, certifying and technically supporting the Contractor's personnel.
- D. Contractor Qualifications: Complete a program of instruction in the application of the approved manufacturer's material specified in this Section and provide certification from the manufacturer attesting to their training and status as an approved applicator.
- E. Certifications: Certification that the materials meet the requirements of this Section and have the manufacturer's current printed literature on the specified product.

#### 1.05 APPLICATION

- A. General purpose Non-Shrink Grout: Use at all locations where non shrink grout is called for on the plans except for base plates greater in area than 3-foot wide by 3-foot long and except for the setting of anchor rods, anchor bolts or reinforcing steel in concrete.
- B. Flowable Non-Shrink Grout: Use under all base plates greater in area than 3-foot by 3-foot. Use at all locations indicated to receive flowable non-shrink grout by the Drawings. Substitution of flowable non-shrink grout for general purpose non-shrink grout may be considered provided it meets the manufacturer's recommendations and acceptable to the Engineer.
- C. Non-Shrink Epoxy Grout: Use for the setting of anchor rods, anchor bolts and reinforcing steel in concrete and for all locations specifically indicated to receive epoxy grout.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver the specified products in original, unopened containers displaying the manufacturer's name, labels, product identification, and batch numbers.
- B. Store and condition products as recommended by the manufacturer.

### PART 2 - PRODUCTS

#### 2.01 CEMENT REPAIR MORTAR

- A. Cement repair mortar may be either site-mixed Portland-cement repair mortar for small repairs or commercial cement repair mortar patching products for larger areas.

- B. Site Mixed Portland-Cement Repair Mortar:
1. Mix repair mortar using the same materials as concrete to be patched with no coarse aggregate. Do not use more than one-part Portland cement to two parts sand by damp loose volume.
  2. For repairs in exposed concrete, make trial batches and check color compatibility of repair material with surrounding concrete. Prepare several trial batches and make test samples in an inconspicuous location for review. When the repair is too dark, substitute white portland cement for a part of the gray cement to produce a color and texture closely matching the surrounding concrete.
  3. Use a repair mortar at a stiff consistency with no more mixing water than is necessary for handling and placing. Mix the repair mortar and turn the mortar frequently with a light trowel without adding water. Use mortar at a stiff consistency.
  4. For concrete removal resulting in cavities exceeding 3 inches in depth and 1 square foot in area, pack the void with a mixture of cement, concrete sand and pea gravel proportioned as follows:

<u>Material</u>	<u>Volumes</u>	<u>Weights</u>
Cement	1.0	1.0
Sand	1.0	1.0
Pea Gravel	1.5	1.5

- C. Commercial Cement Repair Mortar:
1. Portland-cement mortar modified with a latex bonding agent conforming to ASTM C1059 Type II.
  2. Epoxy mortars and epoxy compounds that are moisture-insensitive during application and that, after curing, embody an epoxy binder conforming to ASTM C881 Type III. The type, grade, and class shall be appropriate for the application as specified in ASTM C881.
  3. Shrinkage-compensating or non-shrink portland-cement grout conforming to ASTM C1107.
  4. Packaged dry concrete repair materials conforming to ASTM C928.
  5. Products: Poly-Patch by Euclid Chemical Company; Emaco R310 by BASF Chemical Company; Sikarepair-222, Sikatop 122 Plus by Sika Chemical Corporation or approved equal only if approved by the Engineer for use and for color match.
- D. Provide cement repair mortar with strength and modulus of elasticity compatible with the parent concrete.

## 2.02 EPOXY PASTE

- A. Two-component, solvent-free, asbestos free, moisture insensitive epoxy resin material used to bond dissimilar materials to concrete and shall comply with the requirements of ASTM C881, Type I, Grade 3. It may also be used to patch existing surfaces where the glue line is 1/8 inch or less.
- B. Provide grey colored epoxy paste.
- C. Products: Sikadur 31 Hi-mod Gel by Sika Corporation, Lyndhurst, NJ; Concreative Paste LPL by BASF, Shakopee, MN; or approved equal.

## 2.03 NON-SHRINK GROUT AND NON-SHRINK EPOXY GROUT

- A. Non-Shrink Cementitious Grout (Non-Shrink Grout):
  - 1. Non-shrink cementitious grouts shall meet or exceed the requirements of ASTM C1107, Grades B or C and CRD C-621. Grouts shall be portland cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents and shall require only the addition of water. Non-shrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.
    - a. General purpose non-shrink cementitious grout shall conform to the standards stated above and shall be SikaGrout 212 by Sika Corp.; Euco NS by The Euclid Chemical Co.; Five Star Grout by Five Star Products, Inc.; or approved equal.
    - b. Flowable (Precision) non-shrink cementitious grout shall conform to the standards stated above and shall be Hi-Flow Grout by the Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Five Star Grout by Five Star Products, Inc.; or approved equal.
- B. Non-Shrink Epoxy Grout:
  - 1. Non-shrink epoxy-based grout shall be a pre-proportioned, three-component, 100% solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of 14,000 psi in 7 days when tested in conformity with ASTM D695 and have a maximum thermal expansion of 30 x 10<sup>-6</sup> inch per inch per degree F when tested in conformity with ASTM C531. The grout shall be Five Star HP Epoxy Grout by Five Star Products, Inc.; Sikadur 42 Grout-Pak by Sika Corp.; E3-G Epoxy Grout by the Euclid Chemical Co.; or approved equal.
- C. Water: Potable water, free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.
- D. Like materials in areas of common viewing shall be the products of one manufacturer or supplier in order to provide standardization of appearance. Baseplate grout thicknesses are typically shown on the Drawings; confirm that the selected grout product is recommended for the grout thicknesses shown.

## 2.04 STRUCTURAL CRACK REPAIR EPOXY ADHESIVE

- A. Two-component, solvent-free, moisture insensitive epoxy resin material suitable for crack grouting by injection or gravity feed. Formulate for the specific size of opening or crack being repaired.
- B. For standard applications: Sikadur 35 Hi-Mod LV by Sika Corporation, Lyndhurst, NJ; SCB Concrecive 1380 by BASF, Shakopee, MN; or approved equal.
- C. For applications thinner than allowed by Hi-mod LV: Sikadur 35 Hi-Mod LV LPL by Sika Corporation, Lyndhurst, NJ; SCB Concrecive 1360 by BASF, Shakopee, MN; or approved equal.

## 2.05 FLEXIBLE CRACK REPAIR EXPANDING POLYURETHANE CHEMICAL GROUT

- A. High solids, hydrophobic polyurethane, liquid chemical grout suitable for pumping into cracks and voids (honeycombed) to stop water infiltration. Formulate for the specific size of opening or crack being injected. One component product with accelerator. Permanently flexible product.

- B. Products: SikaFix HH by Sika Corporation, Lyndhurst, NJ; Concrevice 1230 IUG by BASF, Shakopee, MN; or approved equal.

## 2.06 ADHESIVE ANCHORS

- A. See Section 05090.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Inspect concrete surfaces immediately after carefully removing forms. Repair tie holes and surface defects immediately after formwork removal. Defective work includes concrete out of line, level or plumb; cracks; poor joints; rock pockets; honeycomb; voids; spalls and exposed reinforcing. Patch minor defects, including form tie holes, before the concrete is thoroughly dry. Do not interrupt the curing program. Ensure that repairs match the existing surface for color and texture.
- B. Large areas involving voids or rock pockets extending through the section may be cause for rejection of the work. If acceptable repairs can be made without adversely affecting the structural integrity of the work, cut out the section and either dry pack, or reform and re-pour to match the adjacent concrete. Do not cut the reinforcing but cut keyways into the adjacent sound concrete to securely fasten the patch to the original work.
- C. Plug tie holes except where stainless steel ties, noncorroding ties, or acceptably coated ties are used, except plug tie holes in concrete surfaces exposed to liquid. When Portland-cement patching mortar is used for plugging, clean and dampen tie holes before applying the mortar. When other materials are used, apply them in accordance with manufacturer's recommendations.
- D. Cut, repair, remove, or otherwise modify parts of the existing structures or appurtenances, as indicated on the Drawings, specified, or necessary to complete the work. Finishes, joints, reinforcements, sealants, etc., are specified in their respective sections.
- E. Store, mix and apply commercial products in strict compliance with the manufacturer's recommendations.
- F. Preserve the isolation between components on either side of the joint in cases where concrete is repaired in the vicinity of an expansion joint or control joint.
- G. When drilling holes for dowels/bolts, stop drilling if rebar is encountered. As approved by the Engineer, relocate the hole to avoid rebar. Do not cut rebar without prior approval by the Engineer. Identify rebar at all locations where possible, prior to drilling using nondestructive rebar locator equipment so that drill hole locations may be adjusted to avoid rebar interference.
- H. Keep rebar a minimum of 1 inch away from all embedded metallic piping, wall thimbles, spools, sleeves, and similar metals to avoid the creation of an electrically continuous path.
- I. Remove stains, rust, efflorescence, and surface deposits.

### 3.02 CONCRETE REMOVAL

- A. Line drilling at limits of removal followed by chipping or jack-hammering, concrete designated to be removed to specific limits as directed by the Engineer. Proceed carefully to avoid damage to reinforcement. When chipping is necessary, leave chipped edges perpendicular to the surface or slightly undercut. Do not feather edges. Remove concrete in such a manner that surrounding concrete and existing reinforcing to be left in place and existing in place equipment are not damaged. Only sawcut at limits of concrete to be removed after obtaining written approval from the Engineer.
- B. Apply a coating or surface treatment of epoxy paste to a thickness of 1/4-inch where existing reinforcing is exposed due to saw cutting/core drilling and no new material is to be placed on the cut surface.
- C. Saw cut to a 1-inch depth on exposed surfaces of the existing concrete where the joint between new concrete or grout and existing concrete will be exposed in the finished work
- D. Repair concrete specified to be left in place in accordance with repair notes above.

### 3.03 CONCRETE SURFACE PREPARATION AND REPAIR

- A. Prepare connection surfaces as specified below for concrete areas requiring patching, repairs or modification as directed by the Engineer.
- B. Remove all deteriorated materials, dirt, oil, grease, and all other bond inhibiting materials from the surface by mechanical or physical means, i.e. – water blasting, chipping, etc. Uniformly roughen the concrete surface to approximately 1/4-inch amplitude with pointed chipping tools. Thoroughly clean surface of loose or weakened material by sandblasting or air blasting. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into parent concrete.
- C. If honeycomb exists around reinforcement or if reinforcing steel is exposed, it must be mechanically cleaned to remove all loose material, contaminants, rust, etc. If half of the diameter of the reinforcing steel is exposed, chip out behind the steel. The distance chipped behind the steel shall be a minimum of 1 inch. Reinforcing to be incorporated in new concrete shall not be damaged during the removal operation.
- D. The following are specific concrete surface preparation and repair "methods" to be used where directed by the Engineer.
  - 1. Method A: After the existing concrete surface at connection has been roughened and cleaned, thoroughly saturate with water and maintain saturation for a period of at least 12 hours. Dampen the area to be patched, plus another 6 inches around the patch area perimeter. Prepare bonding grout by mixing approximately one part cement and one-part fine sand with water to the consistency of thick cream. Thoroughly brush bonding grout into the surface. When the bonding grout begins to lose water sheen, apply cement repair mortar, and thoroughly consolidate mortar into place. Strike off mortar, leaving the patch slightly higher than the surrounding surface to permit initial shrinkage. Leave the patch undisturbed for 1 hour before finishing. Keep the patch damp for 7 days.
  - 2. Method B: After the existing concrete surface has been roughened and cleaned, apply epoxy bonding agent at connection surface. Comply with the

manufacturer's recommendations for the field preparation and application of the epoxy bonding agent. Place new concrete or grout mixture within time constraints recommended by the manufacturer to ensure bond. Thicker repairs may require build-up in successive 1-1/2-inch layers on successive days. From surfaces as required to prevent sagging.

3. Method C: Install adhesive anchors or dowels; strictly comply with the manufacturer's recommendations.
4. Method D: Combination of Methods B and C.

### 3.04 GROUTING

#### A. General:

1. Mix, apply, and cure products in strict compliance with the manufacturer's recommendations and this Section.
2. Have sufficient manpower and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.
3. Maintain temperatures of the foundation plate, supporting concrete, and grout between 40°F and 90°F during grouting and for at least 24 hours thereafter or as recommended by the grout manufacturer, whichever is longer. Take precautions to minimize differential heating or cooling of baseplates and grout during the curing period.
4. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the materials in contact with grout are outside of the 60°F and 90°F range.
5. Install grout in a manner which will preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or control joint.
6. Continue all existing underlying expansion, control and construction joints through the grout.
7. Equipment shall be supported during alignment and installation of grout by shims, wedges, blocks or other approved means. The shims, wedges and blocking devices shall be prevented from bonding to the grout by appropriate bond breaking coatings and removed after grouting unless otherwise approved by the Owner's Representative.

#### B. Non-Shrink Grouts:

1. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel or admixtures without prior approval by the Owner's Representative.
2. Avoid mixing by hand. Mixing in a mortar mixer (with moving blades) is required if recommended by the manufacturer. Pre-wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.
3. Placements greater than 3 inches in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.

4. Place grout into the designated areas in a manner which will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement shall proceed in a manner which will ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
  5. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (retemper) after initial stiffening.
  6. Just before the grout reaches its final set, cut back the grout to the substrate at a 45-degree angle from the lower edge of bearing plate unless otherwise approved by the Owner's Representative. Finish this surface with a wood float (brush) finish.
  7. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer. Saturate the grout surface by use of wet burlap, soaker hoses, ponding or other approved means. Provide sunshades as necessary. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.
- C. Non-Shrink Epoxy Grouts:
1. Mix in accordance with the procedures recommended by the manufacturer. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not overmix. Mix full batches only to maintain proper proportions of resin, hardener and aggregate.
  2. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60°F or above 90°F.
  3. Place grout into the designated areas in a manner which will avoid trapping air. Placement methods shall ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
  4. Minimize "shoulder" length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.
  5. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.
  6. Epoxy grouts are self-curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placing, or longer if recommended by the manufacturer.

### 3.05 CRACK REPAIR

- A. Repair cracks in liquid containing concrete structures with widths greater than 0.010 inches and cracks 1/32 inch or wider in other surfaces. Repair leaking cracks.
- B. Repair cracks on horizontal surfaces by gravity feeding crack repair epoxy adhesive into cracks per manufacturer's recommendations. Pressure inject if cracks are less than 1/16 inch in width.

- C. Repair cracks on vertical surfaces by pressure injecting crack repair epoxy adhesive or expanding polyurethane chemical grout through valves sealed to surface with epoxy paste per manufacturer's recommendations.
- D. For structural nonmoving cracks that require structural bonding of cracked surfaces, use epoxy adhesive injection materials and methods.
- E. For leaking cracks and cracks that have movement, use expanding polyurethane chemical grouts that have been premixed and injected into the structure in accordance with manufacturers' recommendations.
- F. Complete crack repairs before conducting the hydrostatic leakage test.

### 3.06 FINISHES

- A. See Structural Drawings and ACI 301.

### 3.07 CURING

- A. See Structural Drawings and ACI 308.
- B. Record procedures and equipment are available for controlling concrete and grout temperature during hot and cold weather conditions.
- C. Record actual time of application of curing materials for each placement.
- D. Follow the manufacturer's instructions for curing.

### 3.08 CLEANUP

- A. Upon completion of all work performed under this Section, remove from the site all excess materials, storage facilities and temporary facilities. Smooth and clean of debris all areas that were used or occupied during concrete construction operations and leave in first-class condition.

END OF SECTION

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## SECTION 05090

### ANCHORS IN CONCRETE AND MASONRY

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This section is applicable for anchors, anchor category, anchor groups, anchor systems in concrete and masonry construction. This includes, but is not limited to:
1. Cast-in-place anchors bolts, welded headed anchors, and anchor studs.
  2. Post-installed adhesive anchors.
  3. Post-installed adhesive steel reinforcing bars (rebar).
  4. Post-installed mechanical anchors.
  5. Post-installed screw anchors.
  6. Anchors intended to be used as part of a deferred submittal.
- B. All post-installed anchors and adhesive for reinforcement shall be rated for use and installation in cracked concrete and cracked masonry. Post-installed anchors and adhesives for reinforcement rated only for uncracked concrete and uncracked masonry will not be permitted for use.

##### 1.02 REFERENCES

- A. American Concrete Institute (ACI):
1. ACI 318 Building Code Requirements for Structural Concrete and Commentary
  2. ACI 350 Code Requirements for Environmental Engineering Concrete Structures and Commentary
  3. ACI 355.2 Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary
  4. ACI 355.4 Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary
- B. American National Standards Institute (ANSI):
1. ANSI/ASME B1.1 Unified Inch Screw Threads (UN, UNR, and UNJ Thread Forms)
  2. ANSI/ASME B18.2.2 Square and Hex Nuts
  3. ANSI/ASME B18.22.1 Plain Washers
  4. ANSI/AMSE B212.15 Cutting Tools – Carbide-Tipped Masonry Drills and Blanks for Carbide-Tipped Masonry Drills
- C. ASTM International (ASTM), Standard Specification for:
1. ASTM A29 General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
  2. ASTM A108 Steel Bar, Carbon and Alloy, Cold-Finished
  3. ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  4. ASTM A193 Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications
  5. ASTM A563 Carbon and Alloy Steel Nuts (Inch and Metric)
  6. ASTM A615 Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

7. ASTM A706 Deformed and Plain Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
  8. ASTM A1044 Steed Stud Assemblies for Shear Reinforcement of Concrete
  9. ASTM B633 Electrodeposited Coatings of Zinc on Iron and Steel
  10. ASTM B695 Coatings of Zinc Mechanically Deposited on Iron and Steel
  11. ASTM C881 Epoxy-Resin-Base Bonding Systems for Concrete
  12. ASTM F436 Hardened Steel Washers Inch and Metric Dimensions
  13. ASTM F593 Stainless Steel Bolts, Hex Cap Screws, and Studs
  14. ASTM F594 Stainless Steel Nuts
  15. ASTM F844 Washers, Steel, Plain (Flat), Unhardened for General Use
  16. ASTM F1554 Anchors Bolts, Steel, 36, 55, and 105-ksi Yield Strength
  17. ASTM F1941 Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric
  18. ASTM F2329 Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
- D. Federal Specifications A-A-1922A Type 2 only, A-A01923A Type 4 only and A-A-55614 for Expansion and Shield-Type Anchors
- E. International Code Council (ICC) Evaluation Service, Acceptance Criteria (AC) for:
1. AC 01 Mechanical Anchors in Cracked and Uncracked Masonry Elements
  2. AC 58 Adhesive Anchors in Cracked and Uncracked Masonry Elements
  3. AC 60 Anchors in Unreinforced Masonry Elements
  4. AC 106 Predrilled Fasteners (Screw Anchors) in Masonry
  5. AC 193 Acceptance Criteria for Mechanical Anchors in Concrete Elements
  6. AC 308 Post-Installed Adhesive Anchors in Concrete Elements
  7. AC 495 Cold-Formed Steel Structural Beams with Steel Angle Anchors Acting Compositely with Cast-in-Place Concrete Slabs
  8. AC 510 Seismic Qualification of Post-Installed Anchors in Concrete
- F. International Standards Organization (ISO):
1. ISO/IEC 17011 Conformity Assessment – General Requirements for Accreditation Bodies.
  2. ISO/IEC 17025 General Requirements for the Competence of Calibration and Testing Laboratories.
  3. ISO/ASQ/ASNI 9000 Quality Management Systems – Fundamentals and Vocabulary
- G. TMS 402/602 Building Code Requirements and Specifications for Masonry Structures, The Masonry Society (TMS)

### 1.03 SUBMITTALS

- A. Product Data:
1. Anchor bolts, anchor studs, anchorage devices, and threaded rods, shall include at minimum the following:
    - a. Diameter(s)
    - b. Material grade designation, hardness, coatings, minimum yield and minimum tensile strength consistent with the Contract Documents and/or favorably reviewed deferred submittals.
    - c. Overall length, including extension length.

- d. Embedment length consistent with the Contract Documents and/or favorably reviewed deferred submittals.
  - e. Stand-offs and/or leveling nuts type, dimensional properties, material properties, grade, and location.
  2. Submit material grade, thickness, and dimensional data for nuts and washers.
  3. Adhesives.
  4. Mechanical anchors, expansion anchors.
  5. Concrete screw anchors.
  6. Other fasteners embedded in concrete and masonry as indicated within the Contract Documents and/or favorably reviewed submittal.
- B. Accepted Criteria:
1. ICC Evaluation Service Reports (ICC-ESR), or equivalent IAPMO-UES evaluation reports, for all anchor products submitted, demonstrating compliance WSBC applicable ACI acceptance criteria.
  2. A submittal without a relative and current evaluation report will not be accepted.
- C. Anchor Installation Plan:
1. List of all anchors installed including location, diameter, material type, number, and length of anchors.
  2. For post-installed anchors include a description of the drilling equipment, hole cleaning and preparation procedure, adhesive injection or mechanical anchor insertion technique, preparation for rebar dowels and threaded rods, and torquing procedure.
  3. Testing plan for anchors, including percentage of anchors to be tested and proof loads for anchors (see Verification Testing below).
  4. Certified Verification Testing Report:
    - a. Detailing results of field testing required in Tests and Additional Tests below.
    - b. Certified by an independent testing laboratory or registered Professional Civil or Structural Engineer licensed to practice in the State where the project is being constructed.
- D. Anchorage in Concrete and Masonry as a Deferred Submittal:
1. Complete calculations, details, and complete reference drawings that are required to be submitted as part of a deferred submittal and as defined in the WSBC and within the Contract Documents, shall be prepared, stamped, signed, and furnished by a Professional Civil or Structural Engineer licensed to practice in the State where the project is being constructed.
  2. Comply with Section 01190.
  3. Deferred submittal calculations and details shall be prepared and designed in accordance with the applicable codes referenced within the Contract Documents. Anchors shall be assumed to see a maximum short-term service temperature of 130°F and a long-term service temperature of 110°F, unless otherwise specified.
  4. Minimum Calculation and Reference Drawing Requirements:
    - a. Calculations shall be comprehensible and complete. When evaluating the structural strengths, indicate stress for comparing with strengths or show the demand versus capacity ratio in the structural elements. Evaluating the results by stating "Okay by Inspection" is not acceptable.
    - b. Derivation of forces used, including at least one complete sample calculation, showing the process used so that Engineer of Record may determine general conformance. Printouts of spreadsheets without explanation of calculations used to determine values are not acceptable.

- c. Submittal calculations and details shall demonstrate a complete vertical and lateral load path and shall clearly indicate all forces imposed on the supporting structure. Include all load combinations used in the design shall be referenced and include a clear indication whether service level or strength level was used in the design.
  - d. Reference drawings shall include plans, sections, details, and equipment information as necessary for calculations. Indicate the location of the equipment on plan which is necessary for the development of load calculations.
  - e. The Engineer's review of the deferred submittal items identified in Contract Documents cannot be completed until all related items have been coordinated and submitted for review. Submittals will be returned without review if:
    - 1) The calculations and details are not sealed and signed by a Professional Civil or Structural Engineer licensed to practice in the State where the project is being constructed.
    - 2) Submittals include only calculations without reference drawings.
    - 3) Calculations have no sheet numbers or sheets are missing.
    - 4) Calculations or reference drawings are illegible.
    - 5) Calculations are made based on wrong information, assumptions, or design parameters.
    - 6) Information in reference drawings is insufficient for calculations or review.
    - 7) No details of the anchorage are provided.
5. Anchorage Details as a Deferred Submittal:
- a. Anchorage details shall be prepared, stamped, signed, and furnished by a Professional Civil or Structural Engineer licensed to practice in the State where the project is being constructed.
  - b. Anchorage details shall include the required concrete strength and masonry strength consistent with the Contract Documents, anchor bolt diameter, embed, spacing, maximum grout pad height, and edge distances consistent with the favorably reviewed submittal calculations.
  - c. Include anchoring methods and leveling criteria for equipment consistent with manufacturer's recommendations.
6. Coordination and Other Shop Drawings:
- a. The Contractor is responsible for coordinating the final foundation sizes with the final size of equipment and final anchorage calculations, including the coordination for any required edge distance as noted in the favorably reviewed anchorage submittal.
  - b. Deferred submittals that require anchor reinforcement or supplementary reinforcement identified in a favorably reviewed submittal or the Contract Documents shall be included in that specific shop drawing submittal.
  - c. Deferred submittals that require edge distance that exceeds the available edge distance noted on the Contract Drawings, shall notify the Engineer prior to ordering or fabricating any materials.
- E. Quality Assurance Submittals:
- 1. The Contractor shall be qualified to install cast-in-place and post-installed anchors.
  - 2. Certification of Installation:
    - a. For Post-Installed Anchors: Submit a certification of completion of each individual installing the anchors consistent with the Contract Documents or favorably reviewed deferred submittal.

3. Evaluation Reports:
  - a. Submit the current and relative ICC-ESR or IAPMO-UES reports used in the design of anchorage. A submittal without a relative and current ICC-ESR or IAPMO-UES report will be rejected.
4. Verification of Installation:
  - a. Special Inspection reports or documentation verifying the anchor installation was performed in accordance with the Contract Documents and favorably reviewed deferred submittal.
  - b. Anchorage as a Deferred Submittal: Submit a letter from the Contractor's Engineer indicating the installation was performed as required by the favorably reviewed deferred submittal and ICC-ESR or IAPMO-UES report.
5. Test Reports:
  - a. Submit test reports for testing of anchors in accordance with the Contract Documents.

#### 1.04 QUALITY ASSURANCE

##### A. General:

1. Contractor Qualifications: Five (5) years of experience installing similar anchors in concrete and masonry structures.
2. Anchors shall be manufactured under a certified quality system meeting the requirements of the ISO 9000 quality management system or equivalent.
3. All anchors shall be tested and evaluated under an approved quality assurance program with following-up by an inspection agency under ISO/IEC 17020 by a recognized accreditation body conforming to the requirements of ISO/IEC 17011.
4. Anchors shall be stamped with identifying marks and colors.
5. Installer Training:
  - a. Complete a thorough training with the manufacturer or the manufacturer's representative for the submitted product. Training shall consist of a review of the complete installation process for drilled-in anchors, including but not limited to:
    - 1) Hole drilling procedure(s),
    - 2) Hole preparation and cleaning technique(s),
    - 3) Adhesive injection technique(s), dispenser training and maintenance,
    - 4) Reinforcing steel dowel preparation and installation procedures,
    - 5) Proof loading and torquing.
  - b. Individuals that have not completed the quality assurance requirements of this Section will not be permitted to install anchors without qualifications specific to the products intended for use.

##### B. Special Inspection and Testing:

1. General:
  - a. The Owner or Owner's authorized agent, independent of the Contractor, shall employ one or more approved agencies to provide special inspections and testing in accordance with the Contract Documents, Chapter 17 of the WSBC, and the current and relative ICC-ESR or IAPMO-UES.
  - b. Special Inspections and Testing shall be independent of the Contractor.
  - c. Special Inspections and Testing shall govern the quality, workmanship, and requirements for materials covered with in the Contract Documents.
  - d. Materials of construction and testing shall conform to the applicable standards listed in the referenced building code and Contract Documents.

2. Special Inspections:
  - a. Special Inspections shall comply with the Contract Documents and schedules identified on the Drawings. Unless otherwise specified within the Contract Documents, at a minimum the special inspection of anchors in concrete and masonry shall comply with Chapter 17 of the WSBC and ICC-ESR or IAPMO-UES evaluation reports.
  - b. At a minimum, the Special Inspector shall visually inspect the following, but not limited to: required substrate type and thickness, presence of moisture on the substrate, anchor bolt layout, hole cleaning procedures, product identification and expiration date, product installation procedures, anchor bolt location, embedment, anchor size, anchor spacing, minimum edge distance, and installation temperature.
  - c. Unless specifically identified elsewhere within the Contract Documents, all special inspections of anchors in concrete and masonry shall be continuous.
3. Verification Testing:
  - a. Cast-in-place anchors are not required to be tested after installation.
  - b. Anchors to be tested shall be selected at random by the Special Inspector or as requested by the Engineer.
  - c. Testing is not required for post-installed anchors attached to interior partition walls or non-participating structural wall elements.
  - d. Adhesive Anchors: Proof Loading (Pull Test)
    - 1) Test Type: Unconfined
    - 2) Load Level: Proof load levels shall not exceed the lesser of 50 percent of the expected peak load based on adhesive bond strength or 80 percent of the anchor yield strength.
    - 3) Frequency: 10% of all post-installed adhesive anchors or a minimum of 2, whichever is greater.
    - 4) Duration: Maintain proof load at the required load level for a minimum of 10 seconds.
  - e. Expansion Anchors: Torque Testing:
    - 1) General:
      - a) If the application of torque for an anchor is specified by the manufacturer, torque shall follow the manufacturer requirements. If no torque for the anchor is specified by the manufacturer, the anchor shall be finger-tight before testing and tested as outlined below.
      - b) If the specified torque is not achieved within the required number of turns, the anchor shall be removed or abandoned.
    - 2) Test Type: Calibrated Torque Test, having a measured error within  $\pm 5$ -percent of the specified torque.
    - 3) Load Level: 50 percent of the installation torque.
    - 4) Frequency: 10% of all post-installed expansion anchors or a minimum of 2, whichever is greater.
    - 5) Duration: 10-minute wait time after install torquing with calibrated torque wrench.
  - f. Displacement-Controlled Expansion Anchors:
    - 1) Test Type: Prior to installation, verify by placing the setting tool into the anchor body to verify the full set prior to installation of the bolt or threaded rod. Verify recommended testing requirements with the manufacturer.
    - 2) Frequency: 10% of all post-installed expansion anchors or a minimum of 2, whichever is greater.

- 3) Duration: In accordance with the manufacturer's requirements.
  - 4) Set displacement-controlled expansion-type anchors to the recommended displacement. If the concrete cracks during installation of the anchor, the anchor shall be removed or abandoned.
  - g. Undercut anchors that allow visual confirmation of full installation shall not require testing.
- C. Additional Tests:
1. Anchors, washers, and nuts that require repair or are required to be replaced due to faulty work performed during installation shall be clearly identified, replaced, and re-tested at no additional cost to the Owner.
  2. All materials and all additional documentation to substantiate any faulty or damaged anchors, washers, and nuts in an effort to avoid replacement shall be at no additional cost to the Owner.

## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Handle, ship, and store material in a manner that will prevent distortion, rust, damage to the shop coat or any other damage.
- B. Store material in a clean, properly drained location out of contact with the ground, and in accordance with the manufacturer's recommendations.
- C. Ensure that dissimilar metals are not in contact with each other.
- D. Replace or repair all damaged material to an equal product. Do not install damaged anchor bolts.
- E. Anchors and reinforcing steel bars shall be straight (no bends) and free of indentations or other defects along their length and threads.

## PART 2 - PRODUCTS

### 2.01 GENERAL REQUIREMENTS

- A. General
1. Provide only named adhesive anchor products, mechanical anchors products, and anchor material types where specified within this Section or the Contract Documents.
  2. Product and anchor type deviations will only be considered provided the deferred submittal anchorage design calculations for the proposed products include supporting documentation consistent with this Section and the Contract Documents.
    - a. Provide a clear explanation to substantiate any proposed deviations.
    - b. The Engineer will decide whether to accept or reject any proposed deviations.
    - c. Proposed deviations without a relative and current ICC-ES, or IAPMO UES evaluation report will not be accepted.

### 2.02 EXPOSURE AND FINISH

- A. The following table summarizes the minimum criteria for anchor material and hardware finishes for the specified exposure condition, unless otherwise specified in the Contract Documents:

Exposure Condition	Finish Type
Interior/ Exterior: Dry conditions. Interior and exterior locations not subjected to high moisture environments.	Hot-Dip Galvanized per ASTM F2329 OR ASTM A153 or ASTM A193, Grade B7, or equal
High Moisture: Exposed to extreme weather conditions or high moisture environments not subjected to submerged conditions or placement in earth.	AISI 304, Type 304 Stainless-Steel or ASTM A193, Grade B8 Class 2, or equal
Submerged and/or Buried: All submerged and buried conditions, conditions where fasteners will be continuously or intermittently wet, exposed to corrosive chemicals, exposed to earth, or as required by other Specification Sections.	AISI 316, Type 316 Stainless-Steel or ASTM A193, Grade B8M Class 2, or equal

- B. Do not install hot-dip galvanized or zinc coated anchors in high moisture, submerged, and buried conditions.

### 2.03 NUTS AND WASHERS

- A. Nuts and washer shall be used for the installation of all anchors, anchor bolts and anchor rods, for both cast-in-place and post-installed conditions. Comply with the following:
1. Size nuts and washers to accommodate galvanizing and plate threads where required.
  2. Do not oversize nuts or washers.
  3. Nuts shall be hex or heavy hex and shall meet the dimensional requirements of ASME B18.2.2, unless otherwise specified. Where a manufacturer specifies a type and finish of nut for a specific anchor, the manufacturer recommended nut shall be used.
  4. Washers shall be circular (round) and meet the dimensional requirements of ASME B18.21.1, unless otherwise specified. Where a manufacturer specifies a type and finish of washer for a specific anchor, the manufacturer recommended washer shall be used.
- B. The following hardware schedule summarizes the minimum criteria for nuts and washers to be used with the specified anchor material. Unless otherwise specified in the Contract Documents or a favorably reviewed submittal, the following shall apply to all anchor types:

**Hardware Schedule for Nuts and Washers**

Anchor Material	Nuts	Washers
ASTM F1554, Grade 36 Hot-Dip Galvanized, or Zinc Coated	ASTM A563, Grade A Hex or Heavy Hex Head	ASTM F844 or ASTM F436
ASTM A913, Grade B7 Alloy Steel	ASTM A194, Grade 2H Heavy Hex	ASTM F436, Type 1
ASTM F1554, Grade 55 or 105, Hot-Dip Galvanized	ASTM A563, Grade DH Heavy Hex Head (or ASTM A194, Grade 2H)	ASTM F436, Type 3 (Round SAE Pattern)

### Hardware Schedule for Nuts and Washers

Anchor Material	Nuts	Washers
Type 304 Stainless-Steel	ASTM F594, Alloy Group 1 CW1 (F594C) & CW2 (F594D)	AISI 304 (Type 304 Stainless-Steel)
ASTM A193, Grade B8 Class 2	ASTM A194, Grade 8 (Stainless AISI 304 Heavy Hex)	AISI 304 (Type 304 Stainless-Steel)
Type 316 Stainless-Steel	ASTM F594, Alloy Group 2 CW1 (F594G) & CW2 (F594H)	AISI 316 (Type 316 Stainless-Steel)
ASTM A193, Grade B8M Class 2	ASTM A194, Grade 8M (Stainless AISI 316 Heavy Hex)	AISI 316 (Type 316 Stainless-Steel)

C. Leveling nuts used below base plates shall conform to the dimensions and materials used for nuts.

#### 2.04 ANCHORS AND STEEL REINFORING BAR MATERIALS

A. Headed Anchor Bolts (Cast-in-Place):

1. All headed anchor bolts shall be cast-in-place, and conform to the following, unless specified elsewhere in the Contract Documents or favorably reviewed submittal:

#### Headed Anchor Bolts (Cast-in-Place)

Anchor Type	Material Grade	Minimum Yield Strength	Minimum Tensile Strength
Standard: (Low-Carbon)	ASTM F1554, Grade 36	36 ksi	58 ksi
High-Strength: Low Alloy Alloy, Heat Treated	ASTM F1554, Grade 55 Grade 105	55 ksi 105 ksi	75 ksi 125 ksi
Stainless-Steel Type 304: Alloy Group 1 CW1 Alloy Group 1 CW2	ASTM F593C ASTM F593D	65 ksi 45 ksi	100 ksi 85 ksi
Stainless-Steel Type 316: Alloy Group 2 CW1 Alloy Group 2 CW2	ASTM F593G ASTM F593H	65 ksi 45 ksi	100 ksi 85 ksi

B. Welded Headed Studs (Cast-in-Place):

1. Welded headed studs shall be cast-in-place, welded directly to plates and secured in place. Welded headed studs shall conform to the following, unless specified elsewhere in the Contract Documents:

### Welded Headed Studs (Cast-in-Place)

Material	Grade or Type	Minimum Yield Strength	Minimum Tensile Strength
ASTM A29	Type B, 1010, 1020	65 ksi	51 ksi
ASTM A1044	Type 1	65 ksi	51 ksi
Stainless Steel Type 304 or Type 316	ASTM A276 or ASTM A493	35 ksi	70 ksi

2. Elongation: 20-percent in 2-inches minimum.
  3. Reduction of area: 50-percent minimum.
  4. Mechanical requirements for carbon steel welded headed studs shall comply with AWS D1.1.
  5. Welded headed studs shall be attached with a stud welding gun. Fillet welding of welded headed studs will not be acceptable. Do not fillet weld headed studs.
  6. Mechanical requirements for stainless-steel welded headed studs shall comply with AWS D1.6.
  7. Avoid dissimilar metals. Plate material welded to the welded headed studs shall be compatible with the studs.
  8. Hot-dip galvanize carbon steel welded head studs after welding. Do not galvanize prior to welding.
  9. Products: Headed Anchors by Nelson Stud Welding, Inc., Tru-Weld Steel Headed Stud Anchors by TFP Corporation, or equal.
- C. Threaded Anchor Rods (Cast-in-Place and Post-Installed):
1. Intended for cast-in-place and post-installed adhesive anchors, threaded anchor rods shall be straight, fully threaded, and comply with ANSI B1.1 UNC coarse thread series.
  2. For cast-in-place threaded anchor rods, provide double nuts with a washer between nuts at the embedded end of the threaded rod. Nuts and washer material shall comply with the hardware schedule for nuts and washers.
  3. Threaded anchor rods shall conform to the following, unless specified elsewhere within the Contract Documents or favorably reviewed submittal:

### Threaded Anchor Rods (Fully Threaded)

Anchor Type	Material Grade	Minimum Yield Strength	Minimum Tensile Strength
Standard (Low-Carbon)	ASTM F1554, Grade 36	36 ksi	58 ksi
ASTM A913, Grade B7 Alloy Steel	ASTM A193, B7 (AISI 4140/ 4142)	105 ksi	125 ksi
High-Strength Low Alloy Alloy, Heat Treated	ASTM F1554, Grade 55 Grade 105	55 ksi 105 ksi	75 ksi 125 ksi
Stainless-Steel Type 304: Alloy Group 1 CW1 Alloy Group 1 CW2	ASTM F593C ASTM F593D	65 ksi 45 ksi	100 ksi 85 ksi
A193, Grade B8 (Stainless-Steel AISI 304)	ASTM A193, Grade B8 Class 2	60 ksi	100 ksi

### Threaded Anchor Rods (Fully Threaded)

Anchor Type	Material Grade	Minimum Yield Strength	Minimum Tensile Strength
Stainless-Steel Type 316: Alloy Group 2 CW1 Alloy Group 2 CW2	ASTM F593G	65 ksi	100 ksi
	ASTM F593H	45 ksi	85 ksi
A193, Grade B8M (Stainless-Steel AISI 316)	ASTM A193, Grade B8M Class 2	50 ksi	90 ksi

D. Reinforcing Steel Bars (Post-Installed):

1. Reinforcing steel bars used for anchoring or post-installed conditions shall be used with an adhesive anchoring system approved for use in cracked concrete and cracked masonry.
2. Reinforcing steel shall be deformed bars conforming to the following:

#### Steel Reinforcing Bars (for use with Adhesives)

Anchor Type	Material Grade	Minimum Yield Strength	Minimum Tensile Strength
ASTM A615 (Plain-Carbon Steel)	ASTM A615 Grade 60	60 ksi	90 ksi
ASTM A706 (Low-Alloy Steel)	ASTM A706 Grade 60	60 ksi	80 ksi

3. The embedded portion of reinforcing steel bars shall be straight, and free of mill scale, rust, mud, oil, and other coatings that may impair the bond with the adhesive.
4. Provide 45-degree chisel or cut point on embedded end.
5. Do not bend reinforcing steel bars before or after installation.
6. Heating of reinforcing steel bars is not permitted.
7. Do not use ASTM A615, Grade 40 reinforcing steel bars unless approved by the Engineer.

## 2.05 POST-INSTALLED ADHESIVE ANCHORS

A. Post-Installed Adhesive Anchoring Systems in Concrete:

1. General:
  - a. Adhesive anchoring systems for concrete shall be qualified per ACI 318 and ACI 355.4.
  - b. Adhesive anchoring systems shall have a relative and current evaluation report by ICC-ES and/or IAPMO-UES. Evaluation reports for adhesive anchoring systems shall be qualified for cracked concrete in Seismic Design Categories A through F. Do not use adhesive anchoring systems specified for masonry only in concrete.
  - c. Adhesive anchors shall be installed in concrete having a minimum age of 21 days, has not been exposed to water for the preceding 14 days, and has a minimum compressive strength of 2,500 psi at the time of anchor installation. Do not drill into concrete prior to 21 days.

2. Epoxy Adhesives in Concrete:
  - a. A two-component, epoxy-based, injectable, cartridge-type system meeting the requirements of ASTM C881 Type IV, Grade 3, Class B and C.
  - b. The adhesive shall be supplied in manufacturer's standard side-by-side cartridge and dispensed through a static-mixing nozzle supplied by the manufacturer.
  - c. Products:

**Epoxy Adhesive Products in Concrete**

Supplier	Products	Compliance
Adhesives Technology Corporation (ATC)	Ultrabond HS-1CC	ACI 318, ACI 355.4, ICC-ESR, IAPMO-UES
DeWalt	Pure110+, or equal	
Hilti, Inc.	HIT-RE-500 V3, or equal	
Simpson Strong-Tie Company, Inc.	SET-3G, SET-XP, or equal	
Other	Approved Equal	

- B. Post-Installed Adhesive Anchoring Systems for Grouted Masonry (CMU):
  1. General:
    - a. Adhesive anchoring systems for masonry shall be qualified per TMS 402/602.
    - b. Adhesive anchoring systems shall have a relative and current evaluation report by ICC-ES and/or IAPMO-UES. Evaluation reports for adhesive anchoring systems shall be qualified for use in masonry resisting seismic and wind forces. Do not use adhesive anchoring systems specified for concrete only in masonry.
    - c. Adhesive anchors shall be installed in masonry having a minimum age of 28 days and a minimum compressive strength of 1,500 psi at the time of anchor installation. Do not drill into masonry prior to 28 days.
  2. Adhesives:
    - a. A two-component high-solids resin and hardener material. The adhesive shall be supplied in manufacturer's standard side-by-side cartridge and dispensed through a static-mixing nozzle supplied by the manufacturer.
    - b. Products:

**Adhesive Products in Grouted Masonry (CMU)**

Supplier	Products	Compliance
DeWalt	AC100+Gold, or equal	TMS 402/602, ICC-ESR, IAPMO-UES
Hilti, Inc.	HIT-HY 200-R HIT-HY-270, or equal	
Simpson Strong-Tie Company, Inc.	SET-3G, SET-XP, ET-HP or equal	
Other	Approved Equal	

2.06 POST-INSTALLED MECHANICAL ANCHORS

A. Post-Installed Mechanical Anchors in Concrete:

1. General

- a. Applicable to torque-controlled expansion anchors, displacement-controlled expansion anchors, screw anchors, and undercut anchors placed into predrilled holes and anchored in concrete by mechanical means.
- b. Post-installed mechanical anchoring systems for concrete shall be qualified per ACI 318 and ACI 355.2.
- c. Post-installed mechanical anchoring systems shall have a relative and current evaluation report by ICC-ES and/or IAPMO-UES. Evaluation reports for mechanical anchoring systems shall be qualified for cracked concrete in Seismic Design Categories A through F. Do not use mechanical anchoring systems specified for masonry only in concrete.
- d. Post-installed anchors shall be installed in concrete having a minimum age of 21 days unless specifically identified by the manufacturer's written literature, and meets the minimum compressive strength required per the Contract Documents at the time of anchor installation. Do not drill into concrete prior to 21 days.

B. Mechanical Expansion Anchors in Concrete:

- 1. Mechanical expansion anchors shall be pre-assembled expanding sleeve or wedge type, threaded at one end and a tapered mandrel at the other end enclosed by a three-section expansion element, with nuts and washers.
- 2. Anchors shall meet the description of Federal Specification A-A 1923A or A-A 1922A, Type 4.
- 3. Every anchor, if available in one or more length per anchor diameter, shall be marked with the actual numerical length or with the length marking that is visible and legible after installation. The length identification code shall comply with ACI 355.2.
- 4. Provide hex head stud style anchors unless flat or rod coupler styles, unless otherwise noted on Drawings or in a favorably reviewed deferred submittal.
- 5. Carbon steel expansion anchors shall receive manufacturer's most corrosion resistant zinc coating. Zinc coating in accordance with ASTM B633, SC1, Type III or B695, or F1941.
- 6. Products:

**Mechanical Expansion Anchors in Concrete**

Anchor Type	Material	Products	Compliance
Carbon Steel	Anchor: ASTM A568, Carbon Steel, or equal  Expansion Part: ASTM A240, Grade 316 or AISI 304/316,  Hex Nuts: ASTM A563, Grade A  Washers: ASTM F844	Hilti, Inc. Kwik Bolt-TZ2  Simpson Strong-Tie Strong-Bolt 2,  DeWalt Power-Stud SD6,  or equal	ACI 318, ACI 355.2, ICC-ESR, IAPMO-UES

### Mechanical Expansion Anchors in Concrete

Anchor Type	Material	Products	Compliance
Stainless Steel	Anchor and Expansion Part: AISI 304 or 316  Hex Nuts: ASTM F594, or Type 304, Type 316  Washers: Type 304 or Type 316	Hilti, Inc. Kwik Bolt-TZ2  Simpson Strong-Tie, Strong-Bolt 2,  DeWalt Power-Stud SD6,  or equal	ACI 318, ACI 355.2, ICC-ESR, IAPMO-UES

#### C. Screw Anchors in Concrete

1. Concrete screw anchors shall be comprised of a body with hex washer head. The hex head shall be larger than the diameter of the anchor and is formed with serrations on the underside. The anchor body is formed with threads along the length of the embedded body.
2. Every anchor, if available in one or more length per anchor diameter, shall be marked with the actual numerical length or with the length marking that is visible and legible after installation. The length identification code shall comply with ACI 355.2.
3. Carbon steel screw anchors shall receive manufacturer's most corrosion resistant zinc coating. Zinc coating in accordance with DIN EN ISO 4042, ASTM B633, SC1, Type III or ASTM B695M, Class 65 Type I, or ASTM B695, Class 55 (mechanically galvanized zinc).
4. Products:

#### Screw Anchors in Concrete

Anchor Type	Material	Products	Compliance
Carbon Steel (Heat-Treated)	SAE J403, Grade 10B21	DeWalt, Screw-Bolt+, Hilti, Inc., KH-EZ, Simpson Strong-Tie, Hiten HD, or equal	ACI 318, ACI 355.2, ICC-ESR, IAPMO-UES
Stainless Steel	AISI 316	Hilti, Inc. KH-EZ, Simpson Strong-Tie Hiten HD, or equal	

#### D. Post-Installed Mechanical Anchors in Grouted Masonry (CMU):

1. General:
  - a. Applicable to torque-controlled expansion anchors, displacement-controlled expansion anchors, and screw anchors placed into predrilled holes and anchored in masonry by mechanical means.
  - b. Post-installed mechanical anchors for masonry shall be qualified per TMS 402/602.
  - c. Post-installed mechanical anchors shall have a relative and current evaluation report by ICC-ES and/or IAPMO-UES. Evaluation reports for post-installed mechanical anchors shall be qualified for use in masonry resisting seismic and wind forces. Do not use post-installed mechanical anchors specified for concrete only in masonry.

- d. Post-installed mechanical anchors shall be installed in masonry having a minimum age of 28-days and a minimum compressive strength of 2,000 psi at the time of anchor installation. Do not drill into masonry prior to 28 days.
- E. Mechanical Expansion Anchors in Grouted Masonry (CMU):
1. Mechanical expansion anchors shall be pre-assembled expanding sleeve or wedge type, threaded at one end and a tapered mandrel at the other end enclosed by a three-section expansion element, with nuts and washers.
  2. Anchors shall meet the description of Federal Specification A-A 1923A or A-A 1922A, Type 4.
  3. Every anchor, if available in one or more length per anchor diameter, shall be marked with the actual numerical length or with the length marking that is visible and legible after installation.
  4. Provide hex head stud style anchors unless flat or rod coupler styles, unless otherwise noted on Drawings or in a favorably reviewed deferred submittal.
  5. Carbon steel expansion anchors shall receive manufacturer's most corrosion resistant zinc coating. Zinc coating in accordance with ASTM B633, SC1, Type III or B695, or F1941.
  6. Products:

**Mechanical Expansion Anchors in Grouted Masonry (CMU)**

Anchor Type	Material	Products	Compliance
Carbon Steel	Anchor: ASTM A568, Carbon Steel, or equal  Expansion Part: ASTM A240, Grade 316 or AISI 304/316,  Hex Nut: ASTM A563, Grade A  Washers: ASTM F844	Hilti, Inc. Kwik Bolt-TZ2  Simpson Strong-Tie Strong-Bolt 2,  or equal	TMS 402/602, ICC-ESR, IAPMO-UES
Stainless Steel	Anchor and Expansion Part: AISI 304 or 316  Hex Nut: ASTM F594, Type 304 or Type 316  Washers: Type 304 or Type 316	Hilti, Inc. Kwik Bolt-TZ2  Simpson Strong-Tie, Strong-Bolt 2,  or equal	

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

**A. General:**

1. Comply with this Section and the Contract Documents.
2. Provide grout pads below base of equipment and bearing plates using non-shrink non-metallic grout having a minimum thickness of 3/4 inch and maximum not to exceed thickness of 1 inch, unless otherwise noted. Do not exceed the limits of grout pad thickness without approval from the Engineer.

3. Provide leveling nuts on anchor bolts, below base plates, and adjust to the correct elevation prior to grouting.
  4. Do not increase any baseplate or equipment mounting hole diameter, or slot length without the Engineer's approval.
  5. Post-Installed Anchors or Post-Installed Reinforcement:
    - a. Where drilling into new or existing concrete or masonry is required, locate, and avoid all reinforcing steel at least 14 days prior to drilling.
    - b. Notify Engineer of any conflicts immediately upon discovery.
    - c. Do not drill through or cut any reinforcing steel without Engineer's approval.
  6. Deviations:
    - a. For post-installed anchors (mechanical or adhesive) proposed as a substitute to cast-in-place anchors, submit request for deviation in accordance with the Contract Documents. Submit product data, evaluation reports, and anchorage calculations demonstrating equivalence, sealed, and signed by a Civil or Structural Engineer licensed in the State in which the project is located.
- B. Cast-In-Place Anchors:
1. Set all anchor bolts by template, with provisions to hold bolts rigid and in correct position with respect to plan and elevation.
  2. Do not wet-set cast-in-place anchors in concrete and masonry. Wet-setting anchors will not be accepted.
  3. Post-installed anchors shall not be substituted for cast-in-place anchors without Engineer's approval.
  4. Where anchor straps are shown on the Drawings, do not substitute to anchors without approval from the Engineer.
- C. Post-Installed Adhesive Anchoring Systems:
1. Install adhesive anchors or adhesive reinforcing steel in accordance with the applicable ICC-ES or IAPMO-UES, evaluation report for the specific anchor and manufacturer's instructions.
  2. Drill holes only after concrete and masonry has achieved full design strength. Do not drill over-sized holes.
  3. Holes shall be drilled perpendicular to the concrete and masonry surface unless shown otherwise on the Drawings.
  4. Shim installed anchors to center in holes as necessary.
  5. Anchors installed in overhead conditions shall be installed using the manufacturer's recommended piston-plug and nozzle extension tubing.
  6. Adhesive anchors are not allowed in overhead applications unless specifically authorized by the Engineer.
- D. Post-Installed Mechanical Anchoring Systems:
1. Install mechanical anchors in accordance with the applicable ICC-ES or IAPMO-UES evaluation report for the specific anchor and manufacturer's instructions.
  2. Drill holes only after concrete and masonry has achieved full design strength. Do not drill over-sized holes.
  3. Holes shall be drilled perpendicular to the concrete and masonry surface unless shown otherwise on the Drawings.
- E. Repair and Modification of Connections and Anchorages:
1. The Contractor shall pay for all necessary work and material, all redesign work by the Engineer, and all additional Special Inspections and Testing made on

welds, bolts, and anchors required to repair or replace faulty work performed during the original fabrication and during erection.

2. Anchors, washers, and nuts that require repair or are required to be replaced due to faulty work performed during installation shall be clearly identified, replaced, and re-tested at no additional cost to the Owner.
3. All materials and all additional documentation to substantiate any faulty or damaged anchors, washers, and nuts in an effort to avoid replacement shall be at no additional cost to the Owner.

### 3.02 FIELD QUALITY CONTROL

- A. Comply with the requirements of this Section and the Drawings.
- B. Anchoring systems shall be installed in accordance with the applicable ICC-ES or IAPMO-UES, evaluation report for the specific anchor and manufacturer's instructions.
- C. All post-installed anchoring systems shall be Special Inspected in accordance with the Contract Documents. Testing of anchoring systems shall comply with paragraph 1.04.B. Anchoring systems that fail to meet the testing or installation requirements shall be regarded as malfunctioning and shall be considered defective.
- D. Special Inspections and testing shall be independent of the Contractor.
- E. Anchors should exhibit no discernable movement during load testing.
- F. Drilled holes that do not set properly or fail during testing may not be reused and shall be abandoned. Notify the Engineer and fill the holes with non-shrink non-metallic grout or epoxy grout. Do not drill additional holes near abandoned drilled holes without the Engineer's approval.

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## SECTION 09679

### CHEMICAL RESISTANT COATING

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section Includes: Chemical-resistant, pigmented urethane concrete based resin seamless coating system with Novolac epoxy topcoat for application on floor and secondary containment spill areas with an integral cove base. See the Drawings.

##### 1.02 REFERENCES

- A. Association for Materials Protection and Performance (AMPP):
1. AMPP-QP 8 Standard Procedure for Evaluating the Qualification of Contracting Firms That Install Polymer Coatings or Surfacing on Concrete and Other Cementitious Surfaces.
  2. Coating Inspection Certifications.
- B. ASTM International (ASTM):
1. ASTM D638 Standard Test Method for Tensile Properties of Plastic
  2. ASTM D695 Standard Test Method for Compressive Properties of Rigid Plastics
  3. ASTM D822/D822M Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
  4. ASTM D4060 Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
  5. ASTM D4263 Standard Test Method for Indication Moisture in Concrete by the Plastic Sheet Method
  6. ASTM E162 Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source
  7. ASTM F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
  8. ASTM F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes
- C. International Concrete Repair Institute (ICRI):
1. ICRI 310.2R Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair
- D. National Association of Corrosion Engineers International (NACE):
1. NACE SP0188 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
  2. NACE SP0288 Inspection of Lining Application in Steel and Concrete Equipment
  3. NACE SP0892 Coatings and Linings over Concrete for Chemical Immersion and Containment Service
- E. American Concrete Institute (ACI):
1. ACI 350.2R Concrete Structures for Containment of Hazardous Materials

## 1.03 SUBMITTALS

- A. Submit in accordance with Section 01300:
1. Product Data: Fully describe all products proposed for use. Provide complete installation requirements including concrete moisture vapor emission rate (MVER) limits and concrete relative humidity requirements.
  2. Samples: Finished flooring and standard line of colors and textures. Include a 3- by 3-inch square sample of the proposed system. Sample color, texture, and thickness shall be representative of overall appearance of finished system subject to normal tolerances.
  3. Test Reports: Independent laboratory test results of specified physical characteristics and chemical resistance.
  4. Installer's Qualifications:
    - a. Material manufacturer's written approval of installer including verification of the coating manufacturer's training of the installer.
    - b. Provide a list of at least five similar installations completed by installer within last 2 years. Provide contact names of the facility owner's personnel knowledgeable of the installation with their current telephone numbers, along with background data on the coating system installed with the reference.
    - c. Installer's Jobsite Foreman's Qualifications.
  5. Submit a list of similar installations performed by the foreman in the last 5 years.
  6. Submit training record of the foreman by the coating manufacturer.
  7. Applicator's QC personnel: Provide written verification of AMPP certified concrete coating inspector (minimum CCI Level 1 Certification) for this Project.
  8. If admixtures or curing compounds are proposed for use, the Contractor shall submit a written statement to the Engineer that the use of the proposed admixtures and curing compounds will not interfere with the bond or cure of the specified coating system. The written statement shall be signed by the Contractor, coating applicator, and coating manufacturer.
  9. Comply with state and federal VOC and the indoor air quality regulations.
  10. Manufacturer's affidavit of proper installation.

## 1.04 QUALITY ASSURANCE

- A. Qualifications:
1. The coating work shall be provided by a licensed specialty contractor who is engaged primarily in the installation of chemical resistant epoxy coatings, has satisfactorily completed at least five similar installations within the last 2 years, and approved by the chemical resistant epoxy coating material manufacturer.
  2. The applicator's foreman shall have received trained by the coating manufacturer and have experience in the installation of manufacturer's coating systems.
  3. The applicator's foreman, or the applicator's QC personnel, or the chemical resistant coating manufacturer's representative shall be an AMPP certified concrete coating inspector. The AMPP certified concrete coating inspector shall visit the site as required to sign off on the surface preparation and coating installation.
  4. Qualified journeymen proficient in epoxy coating application shall perform all work.

- B. Comply with the manufacturer's recommendations and installation instructions of the coating material.

#### 1.05 PRODUCT DELIVERY

- A. Deliver materials in manufacturer's labeled, unopened containers, clearly identified with the product type and batch number.
- B. Copies of Safety Data Sheets (SDS) for all components shall be kept onsite for review by the Engineer or other personnel.

#### 1.06 PROJECT CONDITIONS

- A. Unless approved, in writing, by Contractor, coating applicator, and coating manufacturer, do not use admixtures in concrete slabs to receive epoxy coating, which might interfere with bond or cure of epoxy coating. Do not use concrete curing compounds; any concrete curing compound used to be removed in its entirety prior to epoxy coating applications.
- B. Maintain substrate temperature at 70°F for at least 48 hours before and after installation.
- C. All concrete surfaces (horizontal and vertical) to be coated shall comply with the coating manufacturer's MVER and concrete relative humidity requirements.

#### 1.07 WARRANTY AND SPECIAL GUARANTEE

- A. The warranty for all products and work shall comply with the requirements of the Contractor's General Warranty and Guarantee described in the General Conditions and the Supplementary Conditions.
- B. Special Guarantee: In addition to the General Warranty and Guarantee, provide a written 2-year special guarantee signed by the installer, material manufacturer, and Contractor covering the repair or replacement of the entire coating system to correct shrinkage cracks, bond failure, or surface deterioration resulting from causes other than abuse. Refer to Section 01700 Subsection 1.07.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Provide a coating system consisting of a skim coat, base coat, flint aggregate, and two topping coats consisting of epoxy resins which cure to a hard, dense finish, having the physical characteristics specified herein.
- B. Manufacturers: Dex-O-Tex by Crossfield Products Corporation; Sherwin Williams Inc. or equal.
- C. Sole Source Responsibility: Obtain chemical resistant secondary containment system materials from a single manufacturer.

#### 2.02 SYSTEM DESCRIPTION

- A. Products of the first-named maker are used to establish the type and quality of product required. Equivalent products by other makers may be submitted for evaluation.

- B. Flooring and Containment System:
  - 1. Substrate preparation as recommended by manufacturer.
  - 2. Skim coat/Primer: Tek-Crete.
  - 3. Base coat: Tek-Crete SL or Poly-Crete SL.
  - 4. Aggregate 30/40 mesh flint shot.
  - 5. Top coats: Clear Posi-Tred CR (two coats) or Resufloor 3741 at 10-15 mils DFT/coat.

## 2.03 CONTAINMENT SYSTEM PHYSICAL CHARACTERISTICS

- A. The base coat shall have the following physical characteristics when fully cured:
  - 1. Adhesion, ASTM D4541: 400 psi or concrete failure.
  - 2. Compressive Strength, ASTM C579: 6,100 psi.
  - 3. Tensile Strength, ASTM C307: 1,000 psi.
  - 4. Flexural Strength, ASTM C580: 2,000 psi.
  - 5. Microbial Resistance, ASTM G21: Passes.
  - 6. Water Adsorption, MIL-D-3134: 0.64%.
  - 7. VOC: 0 g/L.
  - 8. MVER limits: 20 lbs./1000 sq. ft./24 hours.
  - 9. Relative Humidity limits: up to 99%.
- B. The top coats shall have the following physical characteristics when fully cured:
  - 1. Surface Hardness, ASTM D2240, Shore A: 75 to 80, or Shore D 80.
  - 2. Adhesion: ACI503R Cohesive concrete failure.
  - 3. Microbial Resistance, ASTM G21: Passes Rating 1.
- C. Chemical Resistance:
  - 1. Provide a coating system that shows little or no damage after 72-hour immersion in 50% Sodium Hydroxide (NaOH), 8,000 mg/L Sodium Hypochlorite (NaOCl), and similar chemicals.
  - 2. Provide a floor system that shows little or no damage (no swelling, softening, loss of adhesion, discoloration, or deterioration) from acids, alkalis, salts, and solvents tested in accordance with a test procedure similar to Crossfield Corporation Laboratories' test procedure using 36 different chemicals.

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. Allow concrete slabs to cure for at least 28 days before applying epoxy coating.
- B. Verify that concrete surfaces are dry. Determine concrete MVER per ASTM F1869 and relative humidity per ASTM F2170. MVER and relative humidity shall comply with coating manufacturer's requirements.
- C. Examine substrates for defects that will adversely affect the execution and quality of the work.
- D. Do not start the work until all unsatisfactory conditions are corrected.

### 3.02 PREPARATION

- A. General:
  - 1. New and existing concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, and bituminous products.

2. **Moisture Testing:** Perform tests recommended by manufacturer and as follows:
    - a. Perform relative humidity test using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 99% relative humidity level measurement.
    - b. If the relative humidity exceeds 99%, then the Owner and/or Engineer shall be notified and advised of additional cost for the possible installation of a vapor mitigation system that has been approved by the manufacturer or other means to lower the value to the acceptable limit.
  3. **Mechanical Surface Preparation:**
    - a. Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded accumulations of containment coatings, paint, toppings hardened concrete layers, laitance, power trowel finishes, and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 4-5 as described by the International Concrete Repair Institute.
    - b. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness, and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
    - c. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 3/16-inch-deep and 1/4-inch-wide key cut shall be made to properly seat the system, providing a smooth transition between areas. The detail cut shall also apply to drain perimeters and expansion joint edges.
    - d. Cracks and joints (non-moving) greater than 1/8 inch wide are to be chiseled or chipped-out and repaired according to the manufacturer's recommendations.
  4. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufacture's recommendations
- B. Protect existing equipment, piping, and surfaces not receiving the chemical resistant coating.

### 3.03 APPLICATION SCHEDULE

- A. Provide coatings for the following locations:

<b>Room</b>	<b>Area</b>	<b>Chemical</b>
Chemical Room	Sodium hydroxide containment area below elevation 537.0	50% NaOH 0.8% NaOCl
Chemical Room	Sodium hypochlorite sump below the grating	0.8% NaOCl Brine
Exterior Vaults	Below the grating	50% NaOH 0.8% NaOCl Brine
Chemical Room	Entire floor	0.8% NaOCl Salt Brine

### 3.04 INSTALLATION

- A. Install in strict conformance with the coating manufacturer's requirements.
- B. Remove ladder from hypochlorite containment sump. Remove existing coating and abrade concrete surfaces. Fill joints and cracks as required by the manufacturer.
- C. Apply skim coat at the rate of 15 mils.
- D. Apply urethane concrete base coat at a minimum thickness of 3/16 to 1/4 inch to the floor and other horizontal surfaces. Build a 1/4-inch radius cove at the junction with the walls and extend up the walls at a thickness of 1/8 inch.
- E. Broadcast flint shot onto the wet urethane concrete base.
- F. Apply two coats of Posi-Tred CR or Resuflor 3741 coating at a thickness of 10 to 15 mils each to the floor and other horizontal surfaces and at a minimum thickness of 6 mils each to the vertical surfaces.
- G. Coating installation shall be a first-class application with no runs.
- H. Reinstall chemical piping and containment sump ladder to allow proper operation of the facility.

### 3.05 PROTECTION

- A. Protect epoxy coating from damage by subsequent construction operations. Prohibit all foot and wheel traffic for at least 7 days. Cover horizontal and vertical surfaces with heavy-duty, non-staining construction paper, taped in place for at least 7 days.
- B. Before final acceptance, remove paper and wipe surfaces clean with damp cloths.

END OF SECTION

## SECTION 11001

### GENERAL EQUIPMENT AND MECHANICAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section Includes: The general requirements for all of the Equipment and Mechanical work in the scope of the Project, included in Divisions 11, 13, 14, and 15) and elsewhere wherever specifically mentioned in these Specifications.
- B. Direct the attention of all subcontractors and suppliers of equipment and related appurtenances for the work to the applicable provisions in the Contract Documents wherever they may occur.

##### 1.02 REFERENCES

- A. American Gear Manufacturers Association (AGMA).
- B. American Institute of Steel Construction (AISC).
- C. Hydraulic Institute.
- D. National Electrical Manufacturers Association (NEMA).
- E. Occupational Safety and Health Act (OSHA).
- F. Washington Industrial Safety and Health Act (WISHA)

##### 1.03 STANDARDS FOR THE WORK

- A. Complete Systems: Provide pipe, fittings, wiring, and supports to produce complete, operable systems with all elements properly interconnected. If a specific dimensioned location is not shown for interconnections or smaller system elements, select appropriate locations and show them on Shop Drawing submittals for review.
- B. Provide equipment and material new and without imperfections. Erect in a neat and workmanlike manner; aligned, leveled, cleaned and adjusted for satisfactory operation; installed in accordance with the recommendations of the manufacturers and the best standard practices for this type of work so that connecting and disconnecting of piping and accessories can be readily made and so that all parts are easily accessible for inspection, operation, maintenance, and repair. Locate oil and lubrication fittings clear of and away from guards, base, and equipment and within reach from the operating floor. Coordinate location of all motor connections in order to properly orient encased electrical conduits. In order to meet these requirements with equipment as furnished, minor deviation from the Drawings may be made as favorably reviewed by the Engineer.
- C. The recommendations and instructions of the manufacturers of products used in the work are hereby made part of these Specifications, except as they may be superseded by other requirements of these Specifications.

##### 1.04 SUBMITTALS

- A. Shop Drawings: Show sizes and arrangement of equipment, foundations, and anchor bolts required; performance characteristics; fan curves and pump curves;

control diagrams; wiring diagrams; motor data sheets; methods of assembly; pipe hanging details; ductwork layouts; and connections to other work. Date and sign drawings as certified for use in construction of this project. The arrangement of mechanical equipment and appurtenant piping shown on the Drawings may be varied as necessary to fit the favorably reviewed certified manufacturer's installation drawings. However, manufacturers' drawings shall not deviate in substance from the Contract Drawings and Specifications as to location, size, type, and design of equipment. The following minimum requirements shall accompany all equipment submissions:

1. Overall dimensions.
  2. Mounting arrangement and dimensions.
  3. Description of materials.
  4. Connection sizes and orientation.
  5. Capacity and location of lifting eyes.
  6. Motor arrangement showing location of electrical connections.
  7. Rating data - Mechanical and Electrical as applicable.
  8. Detail electrical wiring diagrams, showing component designation and rating.
  9. Seismic design certifications and anchorage descriptions as required by Section 01190.
  10. Motor data as specified in Section 16050.
  11. List of special tools and/or spare parts to be furnished, if any.
- B. Each piece of equipment, for which certified witnessed or non-witnessed performance tests are required, shall be accompanied by a completed form containing at least the following information:
1. Owner's name and location of project.
  2. Contractor's name and subcontractor if applicable.
  3. Name of item being submitted.
  4. Specification reference by section, paragraph and page.
  5. Data on item (manufacturer, general descriptive data, dimensions, size of connections, speeds, performance curves, serial number). A specific list of the test results plus a list, which shows the values that differ from Specifications.
  6. Motor data, type, voltage, frequency, phase, full load amperes, starting method, frame size, enclosure insulation type (NEMA Code letter), dimensions, service factor, serial number.
  7. Date and signature of person certifying the performance.
- C. Operations and Maintenance Manuals: Prepare and submit manuals covering installation, operation and maintenance of all equipment and machinery specified in Divisions 11, 13, and 15).
- D. Manufacturers' Affidavits: Where called for in the Specifications, each equipment manufacturer, or their authorized representative, shall submit an affidavit conforming to the requirements of Section 01650.

#### 1.05 RESPONSIBILITY AND CARE OF EQUIPMENT

- A. The Contractor shall be responsible for the equipment included in this Contract until it has been finally inspected, tested, and accepted in accordance with the requirements of these Specifications.
- B. The Contractor shall make his own provisions for properly storing and protecting all material and equipment against theft, injury, or damage from any and all causes. Damaged material and equipment shall not be used in the work.

## PART 2 - PRODUCTS

### 2.01 DESIGN

- A. General: Design all equipment for the service intended, of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and during continuous or intermittent operation. Adequately stay, brace and anchor, and install equipment in a neat and workmanlike manner. Give consideration to appearance and safety, as well as utility, in the design of details. Use cathodically compatible materials of construction.
- B. Seismic: Refer to Section 01190 of the Specifications for the seismic design criteria.
- C. Controls: Unless noted otherwise, the design of the electric control of any equipment system and/or equipment package shall be the responsibility of the manufacturer of the equipment system and/or equipment package. The elementary control diagrams as shown on the Electrical Drawings and the diagrams shown on the Instrumentation Drawings are illustrative of control and monitoring requirements pertaining to various equipment of this project. The manufacturers shall design their own functional electric control devices and circuitry, in consultation with the specific elementary control diagrams and other project specifications, to meet the equipment control requirements. All such systems and package controls shall be furnished by the equipment manufacturer, except that controls shown in motor control centers and process controllers, remote control devices, and their interconnecting wiring shall be provided under Divisions 16 and 17. Provide heating, ventilating, and air conditioning controls, both 24-volt and line voltage type, by a HVAC controls specialist.

### 2.02 MATERIALS AND STANDARD SPECIFICATIONS

- A. Materials: Design, fabricate, and assemble equipment and systems with new materials and in accordance with acceptable modern engineering and shop practices. Manufacture individual parts to standard sizes and gauges so repair parts can be installed in the field.
- B. Uniformity: Unless otherwise specified, equipment or material of the same type or classification used for the same purpose shall be the product of the same manufacturer and shall be the same model.

### 2.03 LUBRICATION

- A. Provide lubricants of types recommended by equipment manufacturers, in quantities sufficient for consumption prior to completion, testing, and final acceptance.

### 2.04 EQUIPMENT BASES AND BEDPLATES

- A. Mount equipment assemblies on a single heavy cast iron or welded steel bedplate unless otherwise shown or specified. Provide bases and bedplates with machined support pads, tapered dowels for alignment or mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits. Round or chamfer and grind smooth all corners. Continuously weld seams and contact edges between steel plates and shapes, and grind welds smooth. Do not support machinery or piping on bedplates other than that which is factory installed. Provide jacking screws in equipment bases and bedplates to aid in leveling prior to

grouting. Mount all equipment bases and baseplates on reinforced concrete pads at least 3 inches high.

## 2.05 ANCHORS

- A. Each equipment manufacturer shall furnish an anchor bolt pattern and the required anchor bolts, nuts, and washers of adequate design for securing bases and bedplates to concrete bases. Provide anchor bolts of sufficient length to allow for 1-1/2 inches of grout under baseplates and adequate anchorage into structural concrete unless otherwise shown or specified.
- B. Provide anchor and assembly bolts and nuts of ample size and strength for the purpose intended. All bolts shall be standard machine bolts, with cold pressed hexagon nuts. Provide suitable degauling compounds for bronze and stainless steel threaded components. Any space wholly or partially underground, or having a wall or ceiling forming part of a water channel, is classified as a moist location. Unless otherwise specified or noted on the Drawings, provide materials as follows:
  - 1. Bolts and nuts in submerged locations or submerged and embedded in concrete or buried in earth: Type 304 stainless steel.
  - 2. Bolts and nuts for supports or equipment in dry or moist locations: Galvanized steel (hot-dipped), with oversize nuts.
  - 3. Use other bolting materials where specifically called for in the Specifications or on the Drawings.
- C. Anchor all motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive. Do not provide expansion type anchors for motor-driven equipment.
- D. Anchor all non-motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive except that, where specifically allowed by note on the Drawings, expansion type anchors may be used.
- E. Refer to Section 05090 for technical specification requirements for cast-in-place and post-installed anchors.

## 2.06 SAFETY GUARDS

- A. Cover belt or chain drives, fan blades, couplings, nip points, exposed shafts, and other moving or rotating parts on all sides with safety guards conforming to all federal, state, and local codes and regulations pertaining; conform to the most restrictive requirement. Design guards for easy installation and removal, complete with necessary supports, accessories, and fasteners, all hot-dip galvanized. Design guards in outdoor locations to prevent entrance of rain and dripping water. Provide tachometer test opening in line with ends of shafts. Typically, guards shall be expanded metal on a structural steel frame except that outdoor guards may be of solid material. Provide hinged doors with latch for service and lubrication access.
- B. Cover all pipes, manifolds, heaters, and other surfaces which have a surface temperature sufficient to burn human tissue with a thermal insulating material or otherwise guard against contact.
- C. Guards to comply with WISHA and OSHA.

## 2.07 LIFTING EYES

- A. Supply all equipment weighing over 100 pounds with lifting eyes. Parts of equipment assemblies which are normally serviced separately, such as motors, to have lifting eyes of their own.

## 2.08 DRIVES

- A. General: Provide all drive units with an AGMA rating and service factor suitable for 24 hours per day operation under the operating load.
- B. Electric Motors: Conform to the requirements of Section 16050.
- C. V-Belt Drives: Equip each V-belt drive with suitable tension adjustment. Provide drives having a service factor of at least 1.6 with arc length correction at maximum torque using nameplate rating of driving motor.

## 2.09 NAMEPLATES

- A. Manufacturer's Nameplate: Furnish each piece of equipment and its driver with a corrosion-resistant metal nameplate fastened to the item in a readily readable position. This nameplate to contain the manufacturer's name, equipment rating, capacity, size, model, serial number, and speed. All information written or printed to be in English.
- B. Direction of Rotation: Furnish each piece of rotating equipment with a direction of rotation arrow.
- C. Functional Identification: Label each piece of equipment using a plastic laminate label with the functional name and number of the equipment.
  - 1. Fasten labels to the equipment, its base, or other acceptable location:
    - a. Letters: At least 1/2 inch high with the border trim on all sides not less than 1/4 inch.
    - b. Color: Green background with white letters.
    - c. Fasteners: Brass or stainless steel screwed into inserts, anchor shields, or tapped holes in equipment or base.

## 2.10 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, provide suitable insulation between adjacent surfaces so as to eliminate direct contact and any resultant electrolysis. Connections of dissimilar piping materials shall utilize dielectric unions, flanges, couplings, or bushings.

## 2.11 SPECIAL TOOLS

- A. For each type of equipment to be furnished, provide a complete set of all special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation, and maintenance of such equipment.

## 2.12 FINISHES

- A. Factory Painting: On pumps, motors, drives, starters, control panels, and other similar self-contained or enclosed components, apply a factory protective paint system unless otherwise noted. Paint or otherwise protect surfaces that are inaccessible after assembly by a method which provides protection for the life of the equipment.

- B. Shop Priming: Except where field sandblasting is required, apply one or more shop coats of metal primer on surfaces to be finish painted at the site, of sufficient thickness to protect surfaces until finished. Primer shall be compatible with finish coat.
- C. Rust Preventive: Coat machined, polished, other ferrous surfaces, and non-ferrous surfaces which are not to be painted with rust preventive compound.

## 2.13 NOISE AND VIBRATION

- A. Mechanical and electrical equipment, as installed in this project, shall not create sound levels that are in excess of the noise requirements listed in the technical specifications or in excess of that permitted by WISHA for 8 hours per day worker exposure unless otherwise noted for the specific piece of equipment involved. If the required sound level cannot be achieved by bare equipment in its designated environment, provide sound attenuating enclosures. Sound attenuating enclosures shall have necessary ventilation to prevent equipment overheating and shall be constructed for easy removal to permit maintenance. Devices necessary for day-to-day operation shall pierce the enclosure or otherwise be accessible without need to remove the enclosure.
- B. Equipment which when operating has obvious excessive vibrations shall be repaired or replaced as directed by the Engineer. Baseline vibration measurements shall be made where specified.

## 2.14 FACTORY TESTS

- A. Perform factory tests for each piece of equipment where specifically called for in the section specifying that equipment. Note that factory tests are inherent in many reference standards. The requirement for a factory test in a referenced standard is hereby made a part of these Specifications. Conduct factory tests at the same speeds and other conditions at which the equipment will operate in the field, except as noted.
- B. Where specifically noted, performance tests shall be witnessed by the Engineer. Inform the Engineer in sufficient time to allow arrangements to be made for witness of such tests. When non-witnessed tests are performed, supply certified results.
- C. Perform factory testing of pumps in accordance with the requirements and standards of the Hydraulic Institute.
- D. Tests of other equipment shall conform to the requirements set forth in these Specifications.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Inspect each item of equipment for damage, defects, completeness, and correct operation before installing.

### 3.02 PREPARATION

- A. Prior to installing equipment, ensure that the areas are clean. Maintain the areas in a broom-clean condition during installation operations. Clean, condition, and

service equipment in accordance with the approved Instruction Manuals and specific recommendations of the equipment manufacturer.

### 3.03 INSTALLATION

- A. Structural Fabrications: Conform to the AISC Code
- B. Equipment: Conform to approved Operations and Maintenance Manuals. Employ skilled craftsmen experienced in installation of the types of equipment specified. Use specialized tools and equipment, such as precision machinist levels, dial indicators, gauges, and micrometers, as applicable. Produce acceptable installations free of vibration or other defects. Align and pin to common bedplate equipment and drivers connected by flexible couplings.
- C. Anchor Bolts: Deliver bolts with templates or setting drawings and verify that bolts are correctly located before structural concrete is placed.
- D. Base and Bedplate Grouting: Do not place grout until initial fitting and alignment of connected piping is completed. Level and align equipment on the concrete foundations, then entirely fill the space under base or bedplates with grout. Bevel exposed grout at 45 degree angle, except round exposed grout at horizontal surfaces for drainage. Trowel or point exposed grout to a smooth, dense finish and damp cure with burlap for 3 days. When grout is fully hardened, remove jacking screws and tighten nuts on anchor bolts. Check the installation for alignment and level, and perform approved corrective work as required to conform to the tolerances given in the applicable Instruction Manual.
  - 1. Make an allowance of at least 1-1/2 inches for grout under the equipment bases, whether or not shown on the Drawings. Use steel shims to level and adjust the bases. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise approved, all grout shall be a favorably reviewed non-shrink, non-metallic grout.
  - 2. Grout: Dimensionally stable, inorganic, premixed and resistant to acids, alkalies, and salt water, and unaffected by water and oil. It shall have high strength even when used as a pourable mixture, and shall bond well with steel and cured concrete or be compatible with a suitable bonding agent which shall then be used to effect the bond. Use in strict accordance with the manufacturer's recommendations. Provide Five Star Grout as manufactured by U.S. Grout Corporation, Bonsal Construction Grout as manufactured by Bonsal Company, or equal. Submit for favorable review by the Engineer prior to use.
  - 3. Where practicable, place the grout through the grout holes in the equipment base and work outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.
- E. Architectural Metals: Handrails, guardrails, stairs, and other architectural metals furnished as a part of equipment shall conform to the requirements of Division 5.

### 3.04 EQUIPMENT STARTUP AND ADJUSTMENT

- A. Arrange for an authorized factory-trained representative of the company or companies supplying the various items of equipment to check the installation and adjust and test the equipment. Said representative shall be experienced and knowledgeable of the equipment being tested. Furthermore, the representative

shall assist and instruct the operating staff in adjusting and operating the equipment during the initial plant operation period.

1. Provide initial lubrication for all equipment.
2. Test and demonstrate to the Engineer that all equipment operates properly and specified performance has been attained. For pumps, include measurement of suction and discharge pressure at the pump and measurement of pumping rate by volumetric means or through a suitably calibrated meter for two points on the performance curve. For adjustable-speed pumps, conduct tests at a minimum of two speeds. Furnish any test equipment or measuring devices required which are not part of the permanent installation.
3. In addition, demonstrate that the entire facility is in full operating condition prior to the acceptance of the work. Should any equipment or part thereof fail to operate as intended, immediately remove and replace it, all at the Contractor's expense. Pay for all tests involved in this Section.
4. Pressure test equipment and connections thereto as required by these Specifications.

### 3.05 PERFORMANCE TESTS

- A. Upon completion of the work, and after all systems are set and balanced, conduct performance tests in accordance with Division 1 and other applicable sections of these Specifications. Submit test conditions, test data, and results to the Engineer for review.

### 3.06 SOUND LEVEL TESTING

- A. Measure the sound level developed by all mechanical and electrical equipment provided. Perform testing as required by the technical specifications during the final operation test program with all equipment operating. Use OSHA approved instrument and record the highest sound level developed when measured according to OSHA standards in each room and space. Deliver a copy of records to the Engineer.

### 3.07 TOOLS, LOOSE PARTS, AND LUBRICANTS

- A. Tools and Loose Parts Supplied: Provide an inventory of tools and loose parts required to be supplied under the project. Turn over inventory and parts to the Owner. The Owner's written acknowledgment of receipt is required for project completion. Loose parts are defined as items such as special tools, keys, safety equipment, and portable equipment. Refer to Section 01700 and relevant technical sections of these Specifications for additional instructions.
- B. Recommended Spare Parts: Furnish a complete list of recommended spare parts and supplies for each equipment furnished with current prices and a source of supply.
- C. Provide a list of all recommended lubricants not listed in the Operations and Maintenance Manuals.

END OF SECTION

## SECTION 11263

### ONSITE SODIUM HYPOCHLORITE GENERATION SYSTEM (OSHGS)

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section Includes: The supply and installation of the onsite sodium hypochlorite generation system including the sodium hypochlorite generation cells, brine proportioning system, brine tank, hydrogen dilution blowers and air flow sensor, hydrogen detector, control cabinet with programmable logic controller, interconnecting piping and valves, solenoid control valves, and all other appurtenances necessary for a complete and operable system, except the chemical feed pumps. The chemical storage tank and brine tank are part of the onsite generation equipment supplier's scope of supply and are specified in Section 13416. Provide complete, tested, and operating system as shown on the Drawings and as specified herein.

##### 1.02 REFERENCES

- A. ASTM International (ASTM):
1. ASTM D1784 Specifications for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
  2. ASTM D1785 Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120
  3. ASTM D2467 Specification for Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
  4. ASTM D2855 Standard Practice for Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings
- B. Chlorine Institute:
1. Pamphlet 96: Sodium Hypochlorite Manual
- C. National Electric Code.
- D. NSF/ANSI/CAN:
1. Standard 60: Drinking Water Chemicals-Health Effects
  2. Standard 61: Drinking Water System Components-Health Effects

##### 1.03 SYSTEM DESCRIPTION

- A. Design Requirements: The generation system shall consist of an integrated skid for the onsite production of a 0.8% (+/- 0.05%) sodium hypochlorite solution through the electrolysis of brine. The skid shall be capable of producing 130 pounds per day of sodium hypochlorite as available chlorine.

##### 1.04 SUBMITTALS

- A. Shop Drawings and Product Data: Submit the following as a single complete initial submittal in accordance with Section 01300:
1. Product data fully describing all items proposed for use to demonstrate that the equipment conforms to the Specifications including catalog, capacity, and performance data for each product.

2. Bill of materials and recommended spare parts list.
  3. Flow diagrams of systems showing relative location of equipment, devices, pipe sizes, materials of construction, and pertinent manufacturer's data.
  4. Brine pump, blower, and motor data.
  5. Drawings showing dimensions, fabrication, assembly, installation, and wiring diagrams.
  6. Seismic anchorage certification and related sketch stamped by an Engineer registered in the State of Washington. Seismic anchorage shall conform to the requirements of Section 01190 and Drawing S-1.
  7. Factory test results.
  8. Piping and Instrumentation Diagrams (P&IDs) showing location of all instruments, valves, and auxiliary equipment, and process loop descriptions showing and describing the operation and control of the system.
  9. Elementary and connection wiring diagrams clearly showing external connections to other equipment including:
    - a. Point-to-point component interconnection diagrams showing wire numbers and/or color coding and terminal numbers.
    - b. Scaled cabinet assembly and layout drawings including internal and external views.
    - c. Control panel front elevation showing all face-mounted instruments.
    - d. Control panel ladder diagrams.
- B. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists. Include a copy of the Safety Data Sheet (SDS) for sodium hypochlorite.
- C. Affidavits: Submit affidavits from the manufacturer stating that the equipment has been properly installed, adjusted, and tested and is ready for full-time operation. Affidavits of compliance with referenced standards and codes.

#### 1.05 QUALITY ASSURANCE

- A. Qualifications: Equipment furnished under this Section shall be supplied by a manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least 10 years of similar capacity to the equipment specified herein. Demonstrate to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers named herein.
- B. Regulatory Requirements:
  1. Comply with NEC, UL, and WISHA requirements.
  2. Equipment shall comply with NSF/ANSI/CAN 61 and produce sodium hypochlorite complying with NSF/ANSI/CAN 60.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Immediately upon delivery to job site, place materials in area protected from weather. Use non-marring slings for loading, unloading, and handling units to prevent rope or cable damage to surfaces and protective wrappings.

#### 1.07 WARRANTY

- A. The system shall be free from defects in materials and workmanship for a period of 12 months from Final Acceptance of the system.

- B. Anode plates shall be warranted for a period of 7 years as follows:
  - 1. The anode warranty shall cover the full anode replacement cost for the first 2 years of operation.
  - 2. The anode warranty shall cover the anode replacement cost on a prorated basis from the 3<sup>rd</sup> to the 7<sup>th</sup> year of operation.
- C. Performance: Performance requirements shall be as listed herein.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURER

- A. The hypochlorite generator shall be OSEC® B-PAK 130 as manufactured by Evoqua Water Technologies/Wallace & Tiernan, no equals.

### 2.02 GENERAL

- A. Provide one onsite hypochlorite generation system including heat exchanger, brine proportioning system, brine tank, electrolytic cell assemblies, hydrogen dilution blower and air flow sensor, hydrogen detector, power supply, control panel, hypochlorite storage tank, and all necessary interconnecting piping, wiring, and hardware.
- B. The brine proportioning system, electrolytic cell assemblies, and power supply panel and control panel shall be skid-mounted in the factory. The skid frame shall be constructed of welded coated carbon steel or stainless steel.
- C. The system shall be capable of producing at least 130 lbs./day equivalent available chlorine as 0.75 to 0.85% sodium hypochlorite solution automatically and on-demand.
- D. The production of the sodium hypochlorite solution shall utilize (solar crystal salt with at least 99.6% purity), water, and electrical power. The generation system shall automatically start and stop based on the hypochlorite storage tank levels (set in the PLC for system operation).
- E. The system shall have no waste products associated with its use other than hydrogen gas, which is to be vented to the atmosphere. A hydrogen dilution blower will be used to purge all residual hydrogen out of the system and storage tanks.

### 2.03 HYPOCHLORITE GENERATION SKID

- A. Functional Requirements:
  - 1. Except for the brine saturator tank, hypochlorite storage tank, and hydrogen dilution blower the generation skid shall include all the components required to safely operate the hypochlorite generation system.
  - 2. The skid design shall allow for maintenance access for every component without the need to remove other components.
  - 3. The skid shall include all valves, instruments, and accessories necessary to reduce the brine concentration from 26% to 3% (by weight).
- B. Materials:
  - 1. The skid base shall be corrosion resistant epoxy painted steel with a high-density polyethylene top cover.
  - 2. Equipment and piping support shall be corrosion resistant epoxy coated steel.
  - 3. All interconnecting piping shall be Schedule 80 PVC.

- C. Features:
1. The skid shall have a maximum footprint of 67" L x 30" W (1690 mm x 750 mm).
  2. The skid shall weigh no more than 995 pounds (450kg).
  3. The skid shall meet seismic requirements on Drawing S-1.
  4. The skid shall include the following instruments and accessories:
    - a. One water flow meter.
    - b. One water safety solenoid valve activated on hi-hi tank level.
    - c. Two water flow control valves, self-adjusting orifice type.
    - d. One brine back pressure valve.
    - e. One brine flow meter.
    - f. One electrolyzer outlet temperature sensor.
    - g. One electrolyzer inlet temperature sensor.
    - h. Valve for product sampling.
    - i. Hydraulic connection for acid cleaning and draining of cell.
    - j. Electrical connection for control of acid cleaning system.

## 2.04 WATER SOFTENER

- A. Functional Requirements:
1. Potable water fed to the system shall first pass through a water softener to reduce the potential of hardness fouling of electrode surfaces inside the electrolyzer cells. The softened water shall be dispensed to both brine saturator tank and hypochlorite generator.
  2. The water softener shall be sized to reduce the hardness to < 17 mg/L as CaCO<sub>3</sub> for a minimum flow rate of 30 gpm.
  3. The softener shall be appropriate for continuous use with water of the following quality:
 

a. Water pressure (min – max):	30 to 90 psi
b. Water temperature (min – max):	55°F to 80°F
c. Water pH (min – max)	6 to 9
d. Water hardness mg/L as CaCO <sub>3</sub> :	50 to 65 mg/L
e. Chlorine residual	2 mg/L (max)
  4. Each softener shall ensure uninterrupted supply of softened water. The softener shall include two tanks (dual bed) and not be designed to operate in overdrive.
  5. The regeneration cycle shall be based on water flow; electric timers and gear motors are not acceptable. The regeneration cycle should last a maximum of 90 minutes and consume a maximum of 142 gallons of saturated brine.
  6. Each softener shall use brine from the saturator tank for the regeneration cycle. The regeneration waste shall be disposed to a sanitary drain.
- B. Materials:
1. The softener vessels material shall be engineered plastic.
  2. The softener flow meter shall have a polypropylene turbine.
  3. Softener connections shall be PVC.
- C. Features:
1. The softener shall not require electrical power to operate.
  2. The softener shall be located on the skid.
  3. The softener vessels shall be designed for 125 psig max. working pressure and hydrostatically tested at 300 psig.
  4. Vessels shall be NSF approved.

D. Manufacturer: Kinetico model CP213sOD or approved equal.

## 2.05 BRINE FEED PUMP

### A. Functional Requirements:

1. The saturated brine shall be pumped from the brine saturator tank to the hypochlorite generator at a constant flow rate to ensure stable and efficient production of sodium hypochlorite.
2. The brine feed pump shall be designed to feed a constant saturated brine flow rate at a maximum pressure of 150 psi.
3. The brine feed pump shall be a diaphragm metering pump.
4. Brine pump performance shall be reproducible within +/- 2% of maximum capacity.
5. The brine pump shall have a maximum suction lift of 10 feet once primed.
6. The brine pump shall perform at a maximum room temperature of 125°F.
7. The brine pump shall be powered from the system control panel.
8. The brine pump shall receive a start/stop signal from the system control panel.
9. The flow rate shall be field calibrated by manually adjusting the pump's stroke length.

### B. Materials:

1. PVC pump head.
2. Pump check valves: PVC seats, Teflon balls.
3. Diaphragm: Teflon faced, fabric reinforced, elastomer back with a metal insert.

### C. Features:

1. 1/2-inch NPT suction and 1/2-inch NPT discharge connections.
2. The brine pump shall meet the following standards: NEMA 4X, UL listed, and CSA approved.

## 2.06 POWER TRANSFORMER/RECTIFIER

### A. Functional Requirements:

1. A switching-mode type transformer/rectifier shall be furnished to provide direct current power to each hypochlorite generator.
2. Input to transformer/rectifier shall be 460V +/-5%, 3 Ph, 60 Hz.
3. Output from transformer/rectifier shall be 800A at 15VDC.
4. The transformer rectifier shall have a minimum efficiency of 85% at rated output and normal operating conditions.
5. The transformer rectifier shall be designed for a 100% duty cycle (24 hours/day and 7 days per week).
6. The transformer/rectifier shall be appropriate for use at altitudes of less than 3,300 feet above sea level.
7. The transformer/rectifier shall be air cooled. Maximum room temperature shall be 104°F (40°C). Cooling air shall be free from corrosive fumes.

### B. Materials:

1. NEMA 1 (IP 20) stainless steel enclosure.
2. Silver plated copper, protected busbar connections.

### C. Features:

1. Skid mounted.

2. The transformer rectifier shall include the following protection features:
  - a. D.C. current and voltage limit.
  - b. Fan failure detection.
  - c. The power supply will automatically shut down in the event of a fault.
3. Output voltage and current shall be monitored by in-built digital voltmeter and ammeter. These instruments shall have accuracy of 1% or better.
4. Voltage imbalance indicator.
5. Outputs: Rectifier fault, rectifier running, rectifier voltage (4-20 mA), rectifier current (4-20 mA).

D. Manufacturer: AME Electroplating GmbH or equal.

## 2.07 ELECTROLYZER

### A. Functional Requirements:

1. The electrolyzer casing shall be 8-inch-diameter clear acrylic pipe to allow for visual inspection of electrodes, with removable PVC end caps to allow access to electrode plates.
2. The electrolyzer shall be hydraulically tested at 60 psi for a minimum of 30 minutes per manufacturer's standard testing protocol prior to final assembly and shipment to jobsite.
3. The electrolyzer shall be mounted horizontally on the hypochlorite generator skid.
4. Anode and cathode plates shall be mounted on a PVC/titanium chassis. Anode and cathode plates shall be vertically oriented to allow hydrogen gas removal.
5. Anodes shall be DSA type, with precious metal oxide coating on a titanium substrate.

### B. Features:

1. The electrolyzer shall include an integral electrolyte low level switch, to prevent operation of the system if the cell level is low.
2. The electrolyzer shall include an inner water delivery tube to allow for concentration and temperature control inside the electrolyzer. About 50% of the water consumed by the electrolyzer is fed through the water delivery tube.

## 2.08 SYSTEM CONTROL PANEL

### A. Functional Requirements:

1. PLC based control panel including:
  - a. Siemens S7-300 PLC with Ethernet & RS-485 Communication Ports, ProfiBus enabled.
  - b. Siemens TP177B Touch Screen HMI interface, display area 5.7", Active Color Matrix TFT.
2. Control panel discrete inputs: brine flowmeter, water flowmeter, low cell level, hydrogen leak, low air flow, rectifier running, rectifier fault, containment area leak detection, acid cleaning system connected, external interlock.
3. Analog inputs: diluted brine (generator inlet) temperature, hypochlorite (generator outlet) temperature, hypochlorite tank level, rectifier voltage, rectifier current. Display and trend power by multiplying DC voltage by DC current.
4. Intrinsic barriers for the following inputs: diluted brine (generator inlet) temperature, hypochlorite (generator inlet) temperature, low cell level.

5. Discrete outputs: brine pump start/stop, rectifier start/stop, water solenoid valve open/close, safety solenoid valve open/close, hydrogen blower start/stop.
    - a. HMI alarm display: low brine flow, low brine temperature, low water flow, rectifier improper voltage, rectifier fault, low cell level, high outlet temperature, hypochlorite tank overflow, hypochlorite tank low level, low air flow, hydrogen leak, external interlock open, loss of analog signal.
  6. HMI operating parameter display: brine pump status, water solenoid valve status, rectifier status, diluted brine (generator inlet) temperature, hypochlorite (generator outlet) temperature, blower status, hypochlorite tank level.
  7. Remote monitoring contacts: brine pump running, water solenoid valve open, rectifier running, blower running, generator running, minor alarm, priority alarm, hydrogen leak alarm.
- B. Materials: The control panel enclosure shall be powder-coated steel or polycarbonate NEMA 4X with lockable disconnect.
- C. Features:
1. Input power shall be 460 VAC, 3 phase, 60 Hz.
  2. Control voltage shall be 120 VAC / 24VDC.

## 2.09 ACCESSORIES

- A. The following accessories shall be furnished by the vendor for installation by the Contractor: Provide acid cleaning system, brine saturator tank with level instrumentation, sodium hypochlorite tank with level instrumentation, hydrogen blower, hydrogen leak detector.

## 2.10 SPARE PARTS AND SPECIAL TOOLS

- A. Furnish the following spare parts: complete set of spare fuses, dilution water solenoid valve, brine metering pump recommended spare parts, electrolytic cell level switch, electrolytic cell temperature sensor, air flow switch assembly.
- B. Furnish all special tools required for the proper installation, operation, and maintenance of any component of the system.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install equipment in strict conformance with the manufacturer's installation instructions.

### 3.02 COMMISSIONING AND STARTUP

- A. Inspect equipment installation, piping, and wiring to ensure proper installation of each component. Make any modifications required to meet Equipment Supplier installation recommendations. Provide a written statement from the Equipment Supplier certifying that the equipment has been properly installed and interconnected.
- B. The Equipment Supplier shall coordinate commissioning of the system and verify that each component of the system is ready for operation. System commissioning shall include testing and calibration of each component of the system. Provide a

written statement certifying that the system has been commissioned and is ready for operation.

- C. Equipment Supplier shall coordinate initial system startup to ensure operating procedures are followed in accordance with approved submittal's instructions manuals

### 3.03 PERFORMANCE TEST

- A. Conduct a consecutive 8-hour performance test.
- B. Pre-requisites for the Test:
  - 1. System has been started up to the satisfaction of Owner and manufacturer.
  - 2. System must be running before the test period starts.
  - 3. Incoming water temperature is higher than 55°F, but lower than 80°F.
  - 4. Incoming water hardness is less than 17 mg/L.
  - 5. Solar salt with a minimum sodium chloride (NaCl) content of 99.5%.
  - 6. Brine pump has been calibrated.
  - 7. Ultrasonic level sensor in hypochlorite tank has been calibrated.
  - 8. Power meter (by others) measuring AC feed to rectifier has been calibrated.
- C. Measure the following performance parameters:
  - 1. Hypochlorite Solution Concentration:
    - a. Sample sodium hypochlorite solution at the outlet of the hypochlorite generator.
    - b. Take samples every hour during the 8-hour testing period.
    - c. Analyze samples for available chlorine concentration using titration procedures per AWWA B300 Section 5.2.2 "Testing for Available Chlorine in Sodium Hypochlorite."
    - d. The test shall be deemed successful if the average chlorine concentration is between 0.75 and 0.85% (7.5 to 8.5 g/L).
  - 2. Generation Capacity:
    - a. Determine the generation capacity of the system by multiplying the volume of solution generated by the system during the 8-hour testing period by the average of the eight hypochlorite concentrations measured (reported in g/L or lb./gal).
    - b. Measure the volume of solution generated during the testing period by comparing the liquid level in the hypochlorite storage tank before and after the 8-hour test as measured by the tank level sensor.
    - c. The generator capacity shall be reported in pounds per day.
    - d. The test shall be deemed successful if the generator capacity is greater than 130 lb./day.
  - 3. Salt Consumption:
    - a. Sample brine at the inlet of the hypochlorite generator every hour during the 8-hour testing period.
    - b. Measure temperature and specific gravity for each sample to determine salt concentration, expressed in mg/L.
    - c. Determine brine feed rate by calibrating the brine feed pump before the testing period starts.
    - d. Determine salt consumption during the 8-hour testing period by multiplying brine flow rate times the average of the salt concentrations, and dividing by the total mass of chlorine produced in the 8-hour testing period.

- e. Report the salt consumption in pounds of salt per pound of equivalent chlorine.
  - f. The test shall be deemed successful if the salt consumption is less than 3.0 lb. of salt per lb. of equivalent chlorine.
4. Power Consumption:
- a. Use a kilowatt meter or HMI power readings to measure incoming AC power to the transformer/rectifier.
  - b. Record AC power consumption, expressed in kW every hour during the 8-hour testing period.
  - c. Determine the total power consumption by multiplying the average kW reading by 8 hours and dividing the product by the total mass, pounds available chlorine produced in the 8-hour period.
  - d. The test shall be deemed successful if the power consumption is less than 2.0 kWh per lb. of equivalent chlorine.
- D. If the equipment fails to meet the performance test requirements, the Equipment Supplier shall at its own cost make any modifications required to achieve successful test results.

### 3.04 FIELD SERVICE

- A. The Equipment Supplier shall supply a competent field service engineer to provide on-the-job training of operators including safety procedures, operating instructions, preventive maintenance procedures, and troubleshooting for each system component. Furnish a minimum of two 8-hour days of training.

END OF SECTION

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## SECTION 13416

### POLYETHYLENE CHEMICAL STORAGE TANKS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section describes indoor single-wall polyethylene tanks for sodium hypochlorite and brine. Provide complete, tested, and operating tanks as shown on the Drawings and as specified herein, including shipping any "over-sized" loads to the project site.
- B. The tanks shall be part of the onsite sodium hypochlorite system vendor's scope of supply.

##### 1.02 REFERENCES

- A. ASTM International (ASTM).
  - 1. C177 Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties
  - 2. C273 Test Method for Shear Properties in Flatwise Plane of Flat Sandwich Constructions or Sandwich Cores
  - 3. D638 Tensile Properties of Plastics
  - 4. D618 Conditioning Plastics and Electrical Insulating Materials for Testing
  - 5. D746 Impact Brittleness Temperature
  - 6. D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
  - 7. D883 Standard Definitions of Terms Relating to Plastics
  - 8. D1505 Density of Plastics by the Density-Gradient Technique
  - 9. D1525 Test Method for Vicat Softening Temperature of Plastics
  - 10. D1621 Test Method for Compressive Properties of Rigid Cellular Plastics
  - 11. D1622 Test Method for Apparent Density of Rigid Cellular Plastics
  - 12. D1623 Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
  - 13. D1693 ESCR Specification Thickness 0.125" F50-10% Igepal
  - 14. D1998 Standard Specification for Polyethylene Upright Storage Tanks
  - 15. D3892 Practice for Packaging/Packing of Plastics
  - 16. E84 Test Method for Surface Burning Characteristics of Building Materials
  - 17. F412 Definitions of Terms Relating to Plastic Piping Systems
- B. ANSI Standards:
  - 1. B16.5 Pipe Flanges and Flanged Fittings
  - 2. B14.3 American National Standard for Ladders-Fixed-Safety Requirement
- C. Occupational Safety and Health Administration (OSHA) Standards: 29 CFR 1910.106, Occupational Safety and Health Administration, Flammable and Combustible Liquids.
- D. Washington Building Code (WBC).
- E. Washington Administrative Code (WAC) 296-876-099-500 Fixed ladder design and construction installed on or after December 1, 2006.

- F. ARM (Association of Rotational Molders) Standards: Low Temperature Impact Resistance (Falling Dart Test Procedure).

1.03 SUBMITTALS

- A. Shop Drawings: Submit the following as a single complete initial submittal in accordance with Section 01300 in the Product Review category. Sufficient data shall be included to show that the products conform to Specification requirements. Provide the following additional information:
  1. Shop drawings showing tank dimensions, orientation of tank fittings, nozzles, vents, manways, and other appurtenances.
  2. Details of tank construction and fittings. Indicate wall thicknesses.
  3. Anchorage and lateral restraint details and calculations prepared by and stamped by a structural engineer, registered in the State of Washington.
  4. Tank design calculations as specified, including material properties used in design and loading conditions (handling, vertical loading, discontinuity, and seismic loading).
  5. Tank manufacturer's corrosion resistance charts for the specified chemicals of the chemical concentrations indicated below, in percentage by weight of solution.

Chemical	Concentration	Design Specific Gravity
Sodium Hypochlorite	0.8%	1.9
Brine	Saturated	1.5

- 6. Form of warranty.
- B. Submit results of shop testing for review. Do not ship tanks until favorable review of tests is received.
- C. Submit results of field testing.
- D. Manuals: Furnish manufacturer's installation, operation and maintenance manuals, bulletins, and spare parts lists. Furnish a local 24-hour emergency number for repairs in case of tank damage.
- E. Affidavits: Furnish affidavits from the manufacturer stating that the tanks have been installed to the manufacturer's requirements and are ready for full-time storage of the specified chemicals.
- F. Submit chain-of-custody certification.
- G. Submit manufacturer's supporting documentation stating the complete tank system is certified to meet NSF/ANSI/CAN Standard 61 – Drinking Water System Components, for the specified water treatment chemicals.

1.04 QUALITY ASSURANCE

- A. Products of the same material furnished under this Section shall be supplied by a single manufacturer who has been regularly engaged in the design and manufacture of the tanks for a minimum of 10 years. Demonstrate to the satisfaction of the Engineer that the quality is equal to tanks made by the manufacturers named herein.
- B. Products shall be manufactured at a manufacturing facility that meets or exceeds ISO 9000 quality standards.

- C. Comply with the following Reference Standard: Standard Specification for Polyethylene Upright Storage Tanks, ASTM D1998 except as modified herein.
- D. Comply with the following Regulatory Standards:
  - 1. Washington Fire Code with local amendments, if any.
  - 2. Washington Building Code, with local amendments, if any.
- E. Tank shall be manufactured from new materials and shall not be stored for more than 3 months prior to delivery.
- F. Impact test results must meet the requirements of ASTM D1998, Section 11 - Test Methods.

1.05 WARRANTY

- A. The tank shall be warranted for three (3) years for 100% replacement against defects in materials, workmanship and chemical attack and an additional three (3) years prorated warranty for a total warranty of six (6) years. Copy of warranty must be present on tank or on invoice with instruction sheets accompanying fittings.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Tanks shall be as manufactured by Poly Processing or equal.

2.02 POLYETHYLENE STORAGE TANKS

- A. Tanks shall comply with ASTM D1998 Polyethylene Upright Storage Tanks, except where modified in this specification.
- B. Tanks shall be designed in accordance with the Seismic Requirements on the structural drawings.
- C. In addition to the minimum design requirements as specified, the tanks shall be designed for the stated specific gravity conditions, maximum ambient temperature of 90°F, and maximum operating temperature of 90°F. All components shall be compatible with the specified chemicals.
- D. Resin used in the brine tank manufacture shall be high-density linear polyethylene (HDLPE) Grade 8600 as manufactured by ExxonMobile Chemical. Resin used for the manufacturer of the sodium hypochlorite storage tank shall be cross-linkable polyethylene (XLPE) PAXON 7000 Series as manufactured by ExxonMobile Chemical; or equal. For the sodium hypochlorite tank liner, provide a medium density resin with four times the antioxidant properties of standard polyethylene. The tank material shall be rotationally molded and meet or exceed the following properties:

Property	High Density Linear Polyethylene Value	Cross-linked Polyethylene Value	ASTM Test
Density, gm/cc	0.942-0.944	0.938-0.944	D1505
Environmental Stress Cracking Resistance, F50, hours	400-1000	>1,000	D1693

Property	High Density Linear Polyethylene Value	Cross-linked Polyethylene Value	ASTM Test
Tensile Strength, Ultimate psi, 2-inch/minimum	2,620	2,600	D638 Type IV Specimen
Elongation at Break, % 2-inch minimum	350	400	D638 Type IV Specimen
Vicat Softening Point	235°F	~248°F	D1525
Impact Brittleness temperature	-175°F	<-180°F	D746
Flexural Modulus, psi	97,000-103,000	100,000	D790

- E. Each tank shall have weatherability equal to PAXON 7000 Series for cross-linked or Exxon 8660 for high-density linear polyethylene resin with UV-8 stabilizer.
- F. Wall thickness for a given hoop stress is to be calculated in accordance with ASTM D1998. Tanks shall be designed using a hoop stress no greater than 600 psi. Wall thickness calculations shall assume that all tank contents have a specific gravity of not less than specified in paragraph 1.03.
- G. Manufacturer shall have the capability of issuing gel test results using the method described in ASTM D1998. The percentage gel level for Cross-link Polyethylene Tanks on the inside 1/8-inch of the wall shall be a minimum of 60%.
- H. Tank colors shall be natural (unpigmented).
- I. Manways shall be 17 inch diameter or greater and equipped with an emergency pressure relief device.
- J. Fittings shall be of the following type suitable for the service:
  1. Fittings shall be compression type, tank adapters with standard National Pipe Thread to be compatible with associated plumbing. Fittings shall be made vertically on sloping tank tops. Compression type fittings are not permitted for submerged service or below the top head of the tank.
  2. Bolted Fittings shall be double flange fittings with two 150-lb flanges. Use bolts with internal polyethylene injection molded encapsulated heads compatible with the chemical stored. Provide gaskets for bolts sealing surface on inner flange.
  3. Provide BOSS fittings on the sidewall of the sodium hypochlorite tank. Coordinate any concrete tank pad blockout requirements with installer.
  4. Gaskets shall be a minimum of 1/4 inch thickness and constructed of 60-70 durometer Viton.
  5. Fitting, gasket and bolt materials shall be as follows:

Chemical	Fitting Material	Gasket Material	Bolt Material
Sodium Hypochlorite	PVC	Viton	Hastelloy
Brine	PVC	Viton	Hastelloy

6. All tank fitting attachments on the lower one-third of the sidewalls shall be equipped with flexible couplers designed to deflect based upon tank loading, chemical temperature, and storage time duration. Tank piping flexible couplers shall be designed to allow 4% design movement.

## 2.03 TANK ACCESSORIES

### A. Ladders:

1. Fiberglass access ladders shall be provided with the polyethylene sodium hypochlorite chemical storage tank at locations as shown. Use chemical duty bolts described above where anchorage to tank top or boss is required.
2. Extend the ladder side rails 3'-6" above the top rung and provide a return bend anchored to the tank top no less than 1'-0" horizontally from the top rung.
3. The ladders shall have a platform that extends to the primary containment tank and is located approximately 30 inches below the level of the tank access.
4. Ladders must be mounted to the tank to allow for tank expansion and contraction due to temperature and loading changes. All top ladder mounts shall be connected to integrally molded attachment or bolted lugs that allow for tank movement.
5. All ladders shall be designed to meet applicable WISHA and OSHA standards. Reference: OSHA 2206; 1910.27; fixed ladders and WAC 296-876-500.

- B. **Site Level Gage:** Provide site level gage constructed from flexible polyethylene tubing. Attach site level gauge to tank with two 1/4-inch fittings. Provide isolation valves and a drain valve.

## 2.04 SEISMIC

- A. Tank restraint system shall be supplied and the design for same certified by a Structural Engineer registered in the State of Washington. Design shall conform to the most recent edition of the IBC refer to Structural Drawing S-1. All components of the restraint system shall be Type 316 stainless steel.

## 2.05 CHEMICAL STORAGE TANK SCHEDULE:

<b>Tank</b>	<b>T-1</b>	<b>T-2</b>
<b>Service</b>	<b>Sodium Hypochlorite</b>	<b>Brine</b>
Resin Type	XLPE	HDPE
Volume (gals)	1715	425
Diameter (max.)	6'1"	5'2"
Sidewall Height (max.)	8'0"	3'10"
Type	Dome Top	Open Top
Connections		
Fill	1 ¼"	½" Softened Water
Discharge	1" BOSS	½" Brine Solution
Level Sensor	Radar	Yes
Drain	2" BOSS	Yes
Vent (top)	4"	No
Hydrogen Blower Connection (top)	4"	No
Pump Relief	No	No
Overflow	2"	Yes
Vapor Recovery	No	No
OR-1000 Antioxidant Lining System	Yes	No
Manway (min.)	17"	No
Site Level Gauge	Yes	No
Ladders	3	No
Polyurethane PolyBase Pad	No	No

## 2.06 SHOP TESTING

- A. Perform gel and impact tests in accordance with ASTM D1998 on samples cut from each polyethylene chemical storage tank.
- B. Submit certified shop test results to the Engineer, whether or not tests were witnessed by the Engineer. Do not ship tanks until favorable review of shop testing submittal is received.

## PART 3 - EXECUTION

### 3.01 DELIVERY, STORAGE, AND HANDLING

- A. Provide all shipping and other arrangements required to transport tanks to the project site and ship tanks per manufacturer's recommendations.
- B. The tanks shall be marked with adhesive-backed laminated tags or engraved stainless steel tank ID plate to identify the product, date (month and year) of manufacture, capacity, and serial number.
- C. All packing, packaging and marking provisions of ASTM D3892 shall apply.
- D. All fittings shall be installed and, if necessary, removed for shipping and shipped separately.
- E. Upon arrival at the destination, inspect for damage in transit. If damage has occurred, the manufacturer shall be notified. Do not install damaged tank.

### 3.02 INSTALLATION

- A. Install tanks and fittings in strict accordance with the manufacturer's instructions and with favorably reviewed shop drawings.
- B. The manufacturer's trained technician shall conduct an onsite inspection of the installation to verify proper installation and provide a proper installation certificate. The technician shall also train operations personnel on serving and maintenance of the tanks.

### 3.03 IDENTIFICATION

- A. Identification of the health, flammability, and reactivity of hazardous materials is required for each tank.

### 3.04 FIELD TESTING

- A. Notification: Provide the Engineer with 2-working days' notice prior to field tests so that the Engineer may elect to witness the testing.
- B. Field Testing: Provide a 48-hour static leak test for each tank. The tanks shall be leak tested with water to the overfill level. A passing test result shall be no leakage from the tank. If a leak is detected, the tank shall be repaired or replaced in a manner satisfactory to the Engineer. Such repairs shall be performed only by the tank manufacturer, at no additional cost to the Owner. After repairs, retest the tank until a passing result is achieved. Demonstrate that all tank accessories are working properly.

### 3.05 CLEANING

- A. After satisfactory completion of field testing, drain the testing water. Rinse the inside of the tanks with clean, potable water. Hand wipe and dry as required to leave the tank interior clean, dry and ready for storage of the chemical. Clean the tank exterior and accessories and leave in good condition.

END OF SECTION

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## SECTION 15050

### PIPING, VALVES, AND ACCESSORIES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section Includes: Provide all piping, including fittings, valves, supports, and accessories as shown on the Drawings, described in the Specifications and as required to completely interconnect all equipment with piping for complete and operable systems, including equipment drains.

##### 1.02 REFERENCES

- A. Air-Conditioning and Refrigeration Institute (ARI)
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- C. ASTM International (ASTM)
- D. American Society of Mechanical Engineers (ASME)
- E. American National Standards Institute (ANSI)
- F. American Water Works Association (AWWA)
- G. American Welding Society (AWS)
- H. Cast Iron Soil Pipe Institute (CISPI)
- I. U.S. Department of Transportation (DOT)
- J. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
- K. National Fire Protection Association (NFPA)
- L. NSF/ANSI/CAN Standard 61 and 372

##### 1.03 SUBMITTALS

- A. Shop Drawings:
  - 1. Verify by excavation, inspection and measurement all installation conditions, including existing utilities and structures, for all pipe before preparation of Shop Drawings. Submit field measurements and photos with Shop Drawings where exposed conditions are significantly different than indicated on the Drawings.
  - 2. Layouts and Schematics: Submit detailed installation drawings of all piping. Schematics may be submitted for piping 4 inches and smaller. The Drawings and schematics shall include: pipe support locations and types, fittings, valves, other appurtenances. (Product Review).
  - 3. Submit data to show that the following items conform to the Specification requirements:
    - a. Pipe, fittings and accessories (Product Review).
    - b. Pipe couplings and flexible pipe pieces (Product Review).
    - c. Valves and Accessories (Product Review).

4. Pipe, fittings and joint fabrication details for shop fabricated and field-welded pipe (Product Review).
  5. Submit procedures for welding shop-fabricated and field-welded joints and welder qualifications (Product Review).
  6. Submit samples of gaskets and other materials where required by the detailed specifications.
  7. Submit certified test reports as required herein and by the referenced standard specifications (Product Information).
  8. All items utilized on systems supplying or producing drinking water , including, but not limited to, pipe and valve linings, solvent cements, welding materials, gaskets and gasket lubricants, and additives in concrete or cement mortar shall comply with the Safe Drinking Water Act and NSF requirements for use in water systems in accordance with Washington requirements. Submit proof of NSF certification for each item.
  9. Testing data for welded joints.
  10. Submit leak and pressure testing plan in accordance with this specification.
- B. Manuals: Furnish manufacturer's installation and operation manuals, bulletins, and spare parts lists for the following items:
1. Valves 4 inches and larger and all actuated valves.
  2. Air Valves.
  3. Pneumatic/motorized actuators, including positioners and I/P converters. Include the actuator manuals for the valves requiring them.
  4. Pressure regulators.
- C. Affidavits: Furnish affidavits from the manufacturers for the following equipment:
1. Valves, motorized.
  2. All motorized or calibrated equipment.
- D. Field test reports as required in Part 3.

#### 1.04 DELIVERY, HANDLING, AND STORAGE

- A. Exercise great care to prevent injury to or scoring of the pipe lining and coating, as applicable, during handling, transportation or storage. Do not store pipe on rough ground and do not roll, drag, or otherwise handle the pipe in a manner damaging to the coating.
- B. All materials delivered to the job site shall be new, free from defects, and marked to identify the material, class, and other appropriate data such as thickness for piping.
- C. Store pipe so that it is off the ground, adequately supported on suitable supports such as wooden sleepers, rubber tires or sandbags and securely blocked. Avoid compression damage or deformation to the ends.
- D. Where possible, store pipe in unit packages provided by the Pipe Manufacturer.
- E. Stack pipe in accordance with the Pipe Manufacturer's recommendations.
- F. Do not roll, drag, or drop pipe.
- G. Store gaskets in a cool, dark place, out of direct sunlight, preferably in original cartons.
- H. Damaged pipe, lining, and coatings shall be repaired or replaced at the expense of the Contractor to the Owner's satisfaction.

## 1.05 QUALITY ASSURANCE

- A. Materials and equipment under this Section shall be furnished by manufacturers regularly engaged in the design and manufacture of the materials and equipment for a period of at least 5 years.
- B. Pipe installed under this contract may be inspected for compliance by the Engineer, Owner and/or an independent testing laboratory selected by the Owner.
  - 1. Pipe rejected by the Engineer or Owner shall be immediately removed from the job site.
- C. Acceptance of materials shall be subject to strength and quality testing in addition to inspection of the completed product. Acceptance of installed piping systems shall be based on inspection and leakage tests as specified hereinafter.
- D. Certify welding inspectors per AWS QC1.
- E. Factory Quality Control: The Contractor shall test all products as required herein and by the reference specifications.
- F. Field Quality Control:
  - 1. The Owner will:
    - a. Inspect pipe fabrication and witness any test.
    - b. Inspect field welds and test the welds if it is deemed necessary.
    - c. Perform bacteriological analysis for pipelines to be disinfected.
  - 2. The Contractor shall:
    - a. Perform leakage tests.
    - b. Be responsible for the costs of additional inspection and retesting by the Owner resulting from noncompliance.

## 1.06 SHUTDOWN OF EXISTING UTILITIES, SERVICES, OR OPERATIONS

- A. Refer to Section 01010.

## 1.07 PIPING SYSTEMS

- A. The various piping systems are identified by a multi-letter code on the Drawings. Unless otherwise shown on the Drawings, each system shall be constructed using the materials indicated for that system in the Pipe Schedule. Piping materials are identified by type designation in the schedule unless otherwise noted, and most valves and accessories are identified by a valve and accessory system unless otherwise noted.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Pipe and valve sizes are nominal inside diameter unless otherwise noted.
- B. Construct vents of materials specified for the pipe system for which they serve.
- C. All materials delivered to the job site shall be new, free from defects, and marked to identify the material, class, and other appropriate data such as thickness for piping.

- D. Acceptance of materials shall be subject to strength and quality testing in addition to inspection of the completed product. Acceptance of installed piping systems shall be based on inspection and leakage tests as specified hereinafter.

**2.02 GENERAL MATERIAL REQUIREMENTS**

- A. Gaskets: Gasket materials shall be as noted in the Valve and Accessory System.
- B. Bolts and Tie Rods: Unless specified otherwise herein, flange bolts and nuts, coupling bolts and nuts, tie rods, and other hardware shall be as follows:
  - 1. Buried: Carbon and Alloy Steel Nuts per ASTM A193, Grade B7
  - 2. Concrete encased: Carbon and Alloy Steel Nuts per ASTM A193, Grade B7.
  - 3. Exposed: Carbon and Alloy Steel Nuts per ASTM A193, Grade B7, electroplated zinc.
  - 4. Where bolts and tie rods are installed within a corrosive environment, such bolts and tie rods shall be Type 316 stainless steel per ASTM A193, Grade B8M, Class 2. Apply an anti-galling compound to the threads of stainless steel bolts and tie rods.
- C. Flexible Sealant: Flexible sealant for pipe joints, where shown on the Drawings, shall be a two-component polysulfide, non-sag; Sikaflex 2C, Dualthane, or equal.
- D. Fusion Epoxy Coating: AWWA C213; except application shall be by fluid bed only unless the greatest dimension of the article to be coated exceeds 10 feet, in which case electrostatic spray or flocking application may be used.
- E. All materials in contact with potable water shall comply with the Safe Drinking Water Act and NSF 61 and 378 requirements for use in water systems.

**2.03 PIPING MATERIALS**

- A. Pipe and Fitting Designation: Piping materials are identified by a "Type" designation in these Specifications. The "Type" designation identifies not only the pipe itself but the associated fittings and appurtenances and the installation and test procedures described for that "Type." The designation of a particular type shall indicate a complete installation including fittings, joints, cleaning and testing. The pipe and fitting materials for each type designation shall be as specified herein and summarized in the Pipe Type Schedule.
- B. Pipe Schedule: Piping systems and their corresponding piping and valve systems are listed on the Drawings.
- C. Pipe Type Schedule: Pipe material, joints, and fittings shall be as summarized below. A detailed specification of each pipe type follows. The detailed specification supersedes the schedule in case of any conflicts.

Pipe Type	Pipe Description	Field Joints	Fittings
CU	Copper	Solder or Flare	Wrought Copper or Bronze
PVC-1	PVC, Schedule 80	Threaded or Solvent Weld	PVC, Schedule 80
PVCT	PVCT (Tube)	Compression	PVC Barbed
SSP	Stainless Steel Pipe	Flanged or Weld	Stainless Steel

## 2.04 CU PIPE

- A. Pipe: Copper, ASTM B88:
  - 1. Exposed: Type L (hard drawn).
- B. Joints:
  - 1. Exposed: Soldered.
  - 2. Solder: ASTM B32, Alloy Grade SN 94, SN 95, or SN 96. Solder and flux as all contain less than 0.25 lead.
- C. Fittings:
  - 1. Soldered: Wrought Copper, ASTM B75 for materials and ANSI B16.22 for dimensions; or cast bronze, ASTM B62 for materials and ANSI B16.18 for dimensions.

## 2.05 PVC-1 PIPE

- A. Pipe: Schedule 80 polyvinyl chloride (PVC), gray, normal impact, Type 12454 B, ASTM D1784 and ASTM D1785. Pipe shall bear the National Sanitation Foundation (NSF) label.
- B. Joints: Solvent weld, except flanged or threaded permitted where required at equipment connections and where required on the Drawings. Use Military Specification T 27730A tape for threaded joints.
- C. Fittings: Solvent weld, socket type, of same material as the pipe, Schedule 80, ASTM D2467.
- D. Cement: Solvent weld, ASTM D2564, as recommended by the pipe manufacturer for the schedule and size to be joined, PVC 724 by Weld-On; no equal.
- E. Pipe Cleaner: As recommended by the pipe manufacturer for the schedule and size to be joined.

## 2.06 PVCT PIPE (TUBING)

- A. Tube: Unpigmented reinforced PVC, Nalgene 980; Saint-Grobain Tygon S<sup>3</sup> B-44-4X I.B.; or equal.
- B. Fittings: PVC barbed.
- C. Minimum working pressure 100 psi at 73°F, 25% of burst pressure.

## 2.07 SSP PIPE

- A. Standards: Comply with AWWA C220, AWWA C226, and AWWA C231.
- B. Pipe: Stainless steel, ASTM A312 or A778 except that caustic (sodium hydroxide) pipe shall be A312 only, Type 316L, Schedule 40S.
- C. Joints: Complete joint penetration butt welded except where screwed or flanged joints are required adjacent to valves or equipment.
- D. Fittings: Wrought stainless steel, ASTM A774, TP316L, TP304L, except that caustic system shall have ASTM A403, TP 316L fittings only. Dimensions shall be in accordance with ANSI B16.9.
- E. Flanges: Welding neck or slip-on, ASTM A182 or AWWA C228, TP316L, ANSI B16.5 for dimensions. Class 150, drilling to match adjacent accessories or

valves. Flanges (including bolts and threaded rods) for water service shall be in accordance with AWWA C228.

- F. Gaskets: Full face gasket per ANSI B16.21, See Valve and Accessory System for materials.
- G. Weld testing: 100% visual inspection and 100% ultrasonic or dye penetrant test by Contractor's certified welding inspector.
- H. Descale pipe per ASTM A380 and remove heat tint. Passivate after fabrication per ASTM A380 with final cleaning per Table A.2.1 Part 11 and per ASTM A967. Heat tint discoloration shall not exceed Level 3 as defined by AWS D18.2.

## 2.08 VALVES AND ACCESSORIES

- A. Valve and Accessory System Designation: Most valves and accessories to be furnished and installed are identified by a valve and accessory system designated by a letter symbol in the Pipe Schedule.
- B. General Requirements for Valves:
  - 1. All valves of each type shall be the product of one manufacturer.
  - 2. All exposed valves shall be furnished with operators, handwheels, levers, or other suitable type wrench including handles as specified herein or as shown on the Drawings. Valves 4-inch and larger located more than 7 feet above the floor level shall be furnished with chain operators. Chains shall be galvanized and shall extend to within 3 feet of the floor. Provide hook so that chain may be stored clear of walkways. All buried valves shall be provided with 2-inch-square operating nut and valve boxes.
  - 3. All threaded stem valves shall open by turning the valve stem counter-clockwise.
  - 4. All exposed valves and valve operators shall have a non-bleeding shop coat, unless otherwise specified.
- C. General Requirements for Accessories:
  - 1. Pressure Gauges: Provide pressure gauges. Provide shutoff valves for all pressure gauges.
- D. Valve and Accessory Systems: See Pipe Schedule on Sheet G-4.

## 2.09 VALVE AND ACCESSORY SYSTEM C

- A. Applicable Service Condition: Sample water chlorine solution, hypochlorite, sodium hydroxide (where PVC pipe is used).
- B. Gaskets shall be PTFE unless noted otherwise. Provide Viton gaskets for hypochlorite service.
- C. Ball Valves Through 4-inch Size:
  - 1. Rating: 150 psi at 75°F.
  - 2. Type: Double union.
  - 3. Connections: Socket.
  - 4. Materials: PVC body, Teflon seats and EPDM O-ring seals, except Viton O-ring seals with chlorine/sodium hypochlorite solution.
  - 5. Provide a vented ball in valves used for sodium hypochlorite service.
  - 6. Manufacturers: Spears, R&G Sloane, Asahi/America Pro Block, or equal.

7. Electric Motor Actuator:
  - a. Direct mount
  - b. Motor: 24 VDC motor
  - c. Housing: NEMA 4X
  - d. Auxiliary limit switches: open/closed
  - e. Input signals: 24 VDC
  - f. Dry contacts for open and closed positions
  - g. Visual position indication
  - h. Manual override
  - i. Manufacturer: Spears ELECTRO 50 or equal
  
- D. Check Valves Double Union Type:
  1. Rating: 150 psi at 75°F.
  2. Type: Ball for horizontal or vertical service.
  3. Connections: Union ends for socket weld.
  4. Materials: PVC body, Viton O-ring seals and seats except provide EPDM for caustic service.
  5. Manufacturers: Chemtrol True Union BC, Plastiline No. 8611, or equal.
  
- E. Butterfly Valves:
  1. Rating: 150 psi.
  2. Type: Leak-tight at rated pressure.
  3. Connections: Lugged or flanged, drilled to match existing PVC flanged pipe spools.
  4. Materials: PVC body, PVC disk with EPDM liner and Type 316 stainless steel shaft and bolts. Shaft length to match existing.
  5. Manufacturers: Hayward or equal.
  6. Actuators: Manual with extended shaft and lever handle. Provide local, visual, valve position indicators on all actuators.
  
- F. Strainers:
  1. Rating: 150 psi.
  2. Type: Wye-type basket strainers. Strainer screen size as recommended by feed pump supplier.
  3. Connections: Threaded.
  4. Materials: PVC.
  5. Manufacturers: Chemtrol, GF, or equal.
  6. Installation: Each to be installed with ball valve blowoff and piping to drain.

## 2.10 VALVE AND ACCESSORY SYSTEM E

- A. Applicable Service Conditions: Clean water at pressures to 150 psi and temperatures to 150°F utilizing copper piping.
- B. Gasket materials shall be SBR unless noted otherwise.
- C. Gate Valves through 2-½ inch:
  1. Rating: 200 psi WOG (Water, Oil, Gas).
  2. Type: Rising stem, screw in bonnet, solid wedge disc, handwheel operated.
  3. Connections: Solder ends for copper pipe.
  4. Materials: all bronze.
  5. Manufacturers: Crane No. 428, Nibco 111, or equal.

- D. Globe Valves through 2-½ inch:
  - 1. Rating: 200 psi water.
  - 2. Type: Renewable disc, globe or angle.
  - 3. Connections: Solder ends for copper pipe.
  - 4. Materials: All bronze.
  - 5. Manufacturers: Jenkins; Crane; or equal.
- E. Check Valves through 2-½ inch:
  - 1. Rating: 200 psi water.
  - 2. Type: Regrinding swing check.
  - 3. Connections: Solder ends for copper pipe.
  - 4. Materials: Bronze with bronze or brass disc.
  - 5. Manufacturers: Jenkins; Crane; or equal.
- F. Pressure Relief Valves:
  - 1. Rating: 150 psi for valves 2-inch and smaller.
  - 2. Type: Adjustable spring loaded.
  - 3. Connections: Threaded.
  - 4. Materials: Bronze body.
  - 5. Manufacturers: Consolidated 2478; Farris 1400S; or equal.
- G. Ball Valves:
  - 1. Rating: 400 psi WOG (Water, Oil, Gas).
  - 2. Type: Lever.
  - 3. Connections: Threaded.
  - 4. Materials: Bronze body, chrome-plated ball, Teflon seats.
  - 5. Manufacturers: Apollo 70-100; Watts B-6000; or equal.

## PART 3 - EXECUTION

### 3.01 PIPING INSTALLATION

- A. General Handling and Placing:
  - 1. Carefully inspect each pipe, fitting, valve and accessory before installation to insure there is no defective workmanship or obstructions. Inspect the interior and exterior protective coatings and patch all damaged areas in the field or replace to the satisfaction of the Engineer.
  - 2. Place or erect all piping to accurate line and grade , support, hang, or brace against movement as specified or shown on the Drawings, or as required for proper installation. Remove all dirt and foreign matter from the pipe interior prior to installation and thoroughly clean all joints before joining.
  - 3. Use reducing fittings where any change in pipe size occurs. Do not use bushings unless specifically noted on the Drawings. Use eccentric reducing fittings wherever necessary to provide free drainage of lines.
  - 4. Cover polyvinyl chloride (PVC) pipe stored outside for more than 2 months with canvas or other opaque material. Provide for air circulation under the covering.
  - 5. Prevent damage to the pipe, lining and coating during handling and placement.
  - 6. Remove all dirt and foreign matter from the pipe interior prior to installation and thoroughly clean all joints before joining.

7. Connections between ferrous and non-ferrous piping and accessories shall be made using a dielectric coupling, union, or flange.
- B. General Exposed Piping Installation:
1. Unless shown otherwise, install piping parallel to building lines, plumb and level.
  2. Install piping without springing or forcing the pipe in a manner that would set up stresses in the pipe, valves, or connected equipment.
  3. Set all pipe flanges level, plumb, and aligned. All flanged fittings shall be true and perpendicular to the axis of the pipe. All bolt holes in flanges shall straddle vertical centerline of pipes.
  4. Flexibility and Expansion: Provide flexible couplings, flexible hose, or flexible spools for all piping connections to motor driven equipment and where otherwise shown. The Contractor may install additional flexible couplings at favorably reviewed locations to facilitate piping installation, provided that he submits complete details describing location, pipe supports, and hydraulic thrust protection. Anchor piping subject to expansion or contraction in a manner permitting strains to be evenly distributed. Sleeves for branches through walls from adjacent mains shall be of sufficient size to allow for free side motion of covered pipe in sleeves.
  5. Install unions or flexible connections where shown on the Drawings, and at all non-motor-driven equipment to facilitate removal of the equipment.
  6. Provide valves wherever equipment drain connections are furnished and carry the discharge pipe to the nearest floor drain, drain trench or sump. Where no receptacle for drain exists, install drain piping to 1 inch above the floor. Drain piping and valve materials shall conform to the requirements of the system served.
  7. Where piping conveying liquids passes over motor control centers, electrical panels and other electrical devices, install a protective drainage tray below the piping.
  8. Provide a vent valve at all piping high spots if air release valves or other venting means are not shown.
- C. Pipe Welding:
1. General: Unless specified otherwise, shop and field welding of pipe shall conform to ANSI B31.3 as amended by this paragraph.
  2. All field and shop welding shall be done by the electric arc process unless otherwise specified. All field welding shall be done in passes not thicker than 1/4 inch. Size and type of electrodes, and current and voltages used, shall be subject to the favorable review of the Engineer. Give particular attention to the alignment of edges to be joined, so that complete fusion and penetration will be effected throughout the bottom of the weld. Welds shall contain no valleys or undercuts in the center or edges of the weld. Thoroughly clean each pass, except the final one, of dirt, slag, and flux before the succeeding bead is applied.
  3. Clean completed field welds of pipe joints of dirt, slag and flux, and then visually inspect. Completely chip out all defects in welds discovered during field inspection in a manner that will permit proper and complete repair by welding subject to the favorable review of the Engineer. Under no circumstances will caulking of defective welds be permitted.
  4. All welding shall be done by experienced, skilled operators familiar with the methods and materials to be used. Hand welding will be done only by

welders qualified under the standard qualification procedure of Section IX of the ASME Boiler and Pressure Vessel Code. The Contractor shall conduct tests of his welders, when required by the Engineer, in accordance with that code and in the presence of the Engineer. An independent testing laboratory, favorably reviewed by the Engineer, shall supervise the testing and determine the quality of the test work. Weld specimens in the same positions as those in which the welder is to qualify his work. The Engineer may require test specimens at any time. Any welder whose work is found unsatisfactory shall not remain employed on this Contract, regardless of the quality of his earlier work. Each hand weld specimen shall be plainly marked with the welder's identifying symbol. The Contractor shall furnish all materials required and pay all costs for qualifying welders.

5. Field welds shall follow as closely as possible to the laying operation. All field welds shall be complete before lining or coating of the joints in steel pipe is begun. Where pipe is fusion epoxy lined and/or coated, follow AWWA C213 procedures for field welded joints.
6. A single, continuous, watertight, full fillet weld shall be the minimum required at all field joints. Double welded joints are required on all piping specifically noted to be double welded.
7. See also installation specifics for welding of pipe.

D. Installation Specifics:

1. CUP Pipe:
  - a. Bends shall be made in a manner that does not crimp or flatten pipe.
  - b. Dielectric unions shall be installed at connections with ferrous piping.
  - c. Pipe shall have joints squarely cut clean, soldered joints shall be properly fluxed and heated before solder is placed in the joint. Joints must be driven up tight before solder is added. Compression and flared joints shall be made up in accordance with the fitting manufacturer's installation instructions. Brazing shall be in accordance with ANSI B31.3.
  - d. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
  - e. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.
  - f. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using steel sleeves and mechanical sleeve seals.
  - g. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity.
  - h. Install branch connections to mains using tee fittings in main with take-off out the bottom of the main, except for up-feed risers, which shall have take-off out the top of the main line.
  - i. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, inline pump, and elsewhere as indicated. Install nipple and ball valve in blowdown connection of strainers 2 inches and larger.

2. PVC-1 Pipe:
  - a. Install pipe in accordance with the manufacturer's instructions.
  - b. Place PVC pipe within the installation areas at least 24 hours prior to installation to permit temperature equalization.
  - c. Cut pipe ends squarely, ream and deburr inside and out.
  - d. Clean pipe ends and bells of dirt, grease and other foreign materials prior to making the joint.
  - e. Solvent Weld Joints: Clean pipe ends and sockets and join in strict conformance with the pipe manufacturer's instructions. Make joints in accordance with ASTM D2855. Handle solvent cements and primers in accordance with ASTM F402.
  - f. Containment fittings for chemical and chemical solution lines shall be installed and tested in accordance with manufacturers' instructions. Install containment pipe with position clips at 3-foot centers and at fittings during installation of carrier pipe. Do not make joints until after successful leak tests of carrier pipes.
  - g. PVC-1 Pipe: Threaded connections shall use a short nipple, threaded at one end, socket at the other. Provide thread sealant in accordance with the pipe manufacturer's recommendations. Take care not to overtighten the connection.
  - h. PVC-1 Pipe: No work shall be performed until the pipe manufacturer provides onsite installation training and certifies the installers are trained per ASTM D2855. The Owner's inspector shall be present for the training session.
3. SSP Pipe:
  - a. Install and weld in accordance with AWWA C231 CGA G-4.4 and ASME B31.3. Provide complete joint penetration butt welds. Back purge all welds with cover gas. Seal weld all slip-on flanges.
  - b. Provide anti-seize compound on threaded connections.
  - c. Temporarily plug or cap all points of connection to exclude moisture, dust or other contaminants or impurities prior to being connected.
  - d. Remove all heat tint from welds.
  - e. Descale and passivate per ANSI A380.
  - f. Nondestructive weld testing requirements by the Contractor's certified welding inspector.
    - 1) Provide 100% visual inspection of all welds.
    - 2) Conduct 100% nondestructive testing of welds using ultrasonic or dye penetrant tests.

### 3.02 INSTALLATION OF VALVES AND ACCESSORIES

- A. Wrap buried valve bodies as specified for flexible couplings and flanged coupling adapters.
- B. Install valves and accessories such that all parts are easily accessible for maintenance and operation.
- C. Where valve handwheels are shown on the Drawings, valve orientation shall be as shown. Where valve handwheels are not shown, orient valves to permit easy access to the handwheels or handles and to avoid interferences.

- D. Install pressure gauges and thermometers in a position to permit reading them from a point approximately 5 feet above floor level, except that pump pressure gauges shall be installed close to the pump elevation.
- E. Rigidly support pressure switches and connect them to piping and equipment using a suitable flexible linkage that will not permit transmission of vibrations from the piping or equipment to the pressure switches.
- F. Provide a union adjacent to each screwed end valve and accessory with additional unions as necessary to facilitate removal.
- G. Provide a shutoff valve below each pressure gauge, protective device or air valve unless otherwise specified.
- H. Connections between ferrous and non-ferrous piping, valves, accessories or pipe supports shall be made using a dielectric coupling, union, or flange.
- I. Where valves or other pipeline items require metal full-face connecting flanges, provide transition flanges if the connecting flange is not adequate.
- J. All insulated piping passing through walls or slabs shall be sleeved and insulation shall run continuously through the sleeves and shall allow for 1/8-inch annular clearance between outside of insulation and sleeve wall.
- K. Provide a suitable chrome plated escutcheon on pipes passing through walls, floors, ceilings and partitions in finished areas.
- L. Install link-type seals in cast-in-place metal sleeves or in smooth core drilled holes. Grout both sides flush with non-shrink grout unless otherwise shown on the Drawings.
- M. Install thermometer wells in piping tees in vertical position. Fill with oil. Where wells are in lines 2 inches and smaller, increase line size so that velocity at well section is not increased.
- N. Provide test plugs on all closed water systems and condenser water systems located in inlet and outlet of coils, heat exchangers, cooling towers, and where indicated on Drawings. Locate test plugs where they will be easily accessible, have adequate clearance for insertion and removal of gage needles and thermometer stems, and position to allow unobstructed viewing of gages and thermometers.

### 3.03 PIPE AND VALVE IDENTIFICATION

- A. General: Identify all exposed piping in this project by painting, banding, system name labels, and direction arrows. The color and banding shall be as selected by the Engineer. Identify all exposed valves with tags as specified below.
- B. Exposed Pipe Identification: Before painting, banding and labeling, pipes shall be identified by the Contractor with temporary wired-on cardboard tags showing the proposed marking for review by the Engineer.
- C. Piping: Provide pipe markers.
- D. Valves: Provide each valve with a valve tag identifying the pipeline contents, and its valve number. Contents shall be as designated in the Piping Schedule.

### 3.04 FIELD QUALITY CONTROL

- A. The Owner will:
  - 1. Inspect field welds and test the welds if it is deemed necessary.
  - 2. Perform bacteriological analysis for pipeline to be disinfected.
- B. Factory Quality Control: The Contractor shall test all products as required herein and by the reference specifications.
- C. The Contractor shall:
  - 1. Perform leakage tests.
  - 2. Be responsible for the costs of additional inspection and retesting by the Owner resulting from non-compliance.

### 3.05 CLEANING

- A. Prior to testing, thoroughly clean the inside of each completed piping system of all dirt, loose scale, sand and other foreign material. Cleaning shall be by sweeping, flushing with water or blowing with compressed air or oil-free nitrogen gas, as appropriate for the size and type of pipe. Flushing shall achieve a velocity of at least 3 feet per second. The Contractor shall install temporary strainers, temporarily disconnect equipment, or take other appropriate measures to protect equipment while cleaning piping. Cleaning shall be completed after any pipeline repairs.
- B. Special attention and skill is required to properly clean piping, valves and accessories for chlorine solution piping.
  - 1. Chlorine Solution Piping: After erection, the chlorine solution piping shall be flushed with clear water until there is no evidence of dust, dirt, or debris.

### 3.06 FIELD TESTING

- A. General: Perform leakage tests on all pipe installed in this project. Furnish all equipment, material, personnel and supplies to perform the tests and make all taps and other necessary temporary connections. The test pressure, allowable leakage and test medium shall be as specified and as shown on the Drawings. Test pressure shall be measured at the highest point on the line, except that pressure at lowest point shall not exceed pipe manufacturer's rated test pressure, unless specifically noted otherwise. Leakage tests shall be performed on all piping at a time agreed upon and in the presence of the Engineer. All visible leaks shall be repaired, regardless of the test results. The Contractor may use water for construction, cleaning, testing, and disinfection of the pipelines from the District at a location designated by the District. At any connection to the District water system, the Contractor shall provide an air-gap or reduced pressure backflow valve system to prevent backflow into the water source.
- B. Exposed Piping: All supports, anchors and blocks shall be installed prior to the leakage test. No temporary supports or blocking shall be installed for final test.
- C. Encased Piping: The leakage test for encased piping shall be made after all pipe is installed and encased, and before any structures are constructed above it. However, the Contractor may conduct preliminary tests prior to encasement. If the Contractor elects to conduct preliminary tests, provide any necessary temporary thrust restraint.

- D. Accessories: It shall be the responsibility of the Contractor to block off or remove equipment, valves, gauges, etc., which are not designed to withstand the full test pressure.
- E. Testing Apparatus: Provide pipe taps, nozzles and connections as necessary in piping to permit testing including valves to isolate the new system, addition of test media, and draining lines and disposal of water, as is necessary. These openings shall be plugged in a manner favorably reviewed by the Engineer after use. Provide all required temporary bulkheads.
- F. Pneumatic Testing: Piping tested by air or another gas shall show no reduction of pressure during the test period after corrections have been made for changes in temperature in conformance with the following relationship:

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Where  $T_1$  and  $T_2$  are the absolute temperatures of the gas in the pipe and  $P_1$  and  $P_2$  are the absolute pressures. The subscript "1" denotes the starting conditions and the subscript "2" denotes the final conditions.

- G. Precautions for Pneumatic Testing: Where air or another gas is called for as the test medium, the Contractor shall take special precautions to protect personnel. During the initial pressurization of a pipeline to the specified test pressure, personnel shall be protected by suitable barricades or shall remove themselves to locations where portions of the concrete structure itself are between them and the pipeline under test.
- H. Correction of Defects: If leakage exceeds the allowable, the installation shall be repaired or replaced and leakage tests shall be repeated as necessary until conformance to the leakage test requirements specified herein have been fulfilled. All visible leaks shall be repaired even if the pipeline passes the allowable leakage test.
- I. Reports: The Contractor shall keep records of each piping test, including:
  - 1. Description and identification of piping tested.
  - 2. Test pressure.
  - 3. Date of test.
  - 4. Witnessing by Contractor and Engineer.
  - 5. Test evaluation.
  - 6. Remarks, to include such items as:
    - a. Leaks (type, location).
    - b. Repairs made on leaks.
  - 7. Test reports shall be submitted to the Engineer.
- J. Venting: Where not shown on the Drawings, the Contractor may install valved "tees" at high points on piping to permit venting of air. Valves shall be capped after testing is completed.
- K. Testing Specifics: Piping shall be tested as indicated in the Pipe Schedule shown on the Drawings. Unless specified otherwise, test each system for 4 hours.

**3.07 DISINFECTION OF POTABLE WATER SYSTEMS**

A. See Section 02516.

**END OF SECTION**

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## SECTION 16010

### GENERAL ELECTRICAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

###### A. Work Included:

1. Provide all required labor, project equipment and materials, tools, construction equipment, safety equipment, transportation, and test equipment, and satisfactorily complete all electrical work shown on the Drawings, included in these Specifications, or required for a complete and fully operating facility. In addition, provide wiring for the equipment that will be provided under other Divisions of these Specifications.
2. Provide conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions. Coordinate with the supplier of electrical equipment specified under other Divisions.
3. Provide all 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. This also includes lightning and surge protection equipment wiring at process instrumentation transmitters if required. Contractor shall install vendor furnished cables specified under other Divisions.
4. Provide a complete raceway system for the specialty cable systems. Install the specialty cable systems in accordance with the system manufacturer's installation instructions. Review of the raceway layout, prior to installation, with the system supplier and cable manufacturer to ensure raceway compatibility with the system and materials being furnished. Where redundant cables are furnished, install them in separate raceways.
5. Provide raceway and power wiring for all heating, ventilation and air conditioning equipment furnished under other related Divisions. Refer to HVAC drawings and related specifications for power requirements.
6. Auxiliary Devices: Provide conduit and wire for power and control for all auxiliary devices such as solenoid valves, pressure switches, and instruments that are included as part of a manufacturer's packaged system (i.e., all systems specified in Divisions 11 through 15. Contractor shall be responsible for conduit and wire to these auxiliary devices even if not specifically shown on the Drawings or specified herein.
7. Provide concrete, excavation, backfill and steel reinforcement required for encasement, installation or construction of the Work of the various Sections of Division 16 as a part of the Work under the respective Sections, including duct banks, manholes, handholes, equipment housekeeping pads and light pole bases.

- B. Safety: Conduct operations in accordance with NFPA 70E, Standard for Electrical Safety Requirements for Employee Workspaces.

## 1.02 CODE COMPLIANCE AND REFERENCE STANDARDS

- A. Electric equipment, materials and installation shall comply with the National Electrical Code (NEC) and with the latest edition of the following codes and standards:
  - 1. National Electrical Safety Code (NESC).
  - 2. Occupational Safety and Health Administration (OSHA).
  - 3. National Fire Protection Association (NFPA).
  - 4. National Electrical Manufacturers Association (NEMA).
  - 5. American National Standards Institute (ANSI).
  - 6. Insulated Cable Engineers Association (ICEA).
  - 7. Instrument Society of America (ISA).
  - 8. Underwriters Laboratories (UL).
  - 9. Factory Mutual (FM).
  - 10. Institute of Electrical and Electronics Engineers.
  - 11. ASTM International (ASTM).
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.
- C. All materials and equipment for which a UL standard exists, shall bear a UL label. No such material or equipment shall be brought onsite without a UL label affixed. Other Nationally Recognized Testing Laboratories (NRTLs) acceptable for this project include:
  - 1. FM Approvals (Factory Mutual).
  - 2. ETL (Intertek Electrical Testing Labs).
  - 3. CSA-us (Canadian Standard Association).
- D. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provisions of the Contract Documents will take precedence if they are more stringent or presumptively cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, or between Laws and Regulations, the higher performance requirement shall be binding on the Contractor, unless otherwise directed by the Owner/Engineer.
- E. In accordance with the intent of the Contract Documents, the Contractor accepts the fact that compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, the Contractor's responsibility to comply with all Laws and Regulations at all times.

## 1.03 SUBMITTALS

- A. Shop Drawings shall be custom prepared for this project and submitted as listed in each of the Electrical Specification Sections. Shop drawings shall include the following:
  - 1. Complete materials list stating manufacturer, brand name and catalog number of each item or class of material.
  - 2. For equipment, panels, boxes, control devices, wiring devices, and other uniquely-tagged items as indicated on the Drawings, include the respective tag(s) on each applicable shop drawing and cut sheet.
  - 3. Shop drawings for grounding work not specifically indicated on the drawings but required under the NEC.

4. Front, side and rear elevations along with top views with required dimensional data.
  5. Location of conduit entrances and access plates.
  6. Catalog cuts defining component data.
  7. Connection diagrams, terminal numbers, internal wiring diagrams, conductor size and cable numbers.
  8. Method of anchoring, seismic requirements and weight.
  9. Types of materials and finish.
  10. Nameplates.
  11. Temperature limitations, as applicable.
  12. Voltage requirements, phase and current, as applicable.
  13. Front and rear access requirements.
  14. Test reports.
- B. O&M Manuals and other documentation shall be submitted in accordance with these contract documents. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists, etc. to instruct operating and maintenance personnel unfamiliar with such equipment. All manuals and other documentation shall be submitted as listed in each of the Electrical Specification Sections and include the following:
1. A comprehensive index.
  2. A complete "As-built" set of approved shop drawings.
  3. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.
  4. A table listing of the "as left" settings for all timing relays and alarm and trip set points.
  5. System schematic drawings "As-Built", illustrating all components, piping and electrical connections of the system supplied under this Section.
  6. Detailed service, maintenance and operation instructions for each item supplied.
  7. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
  8. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.
  9. Complete parts list with stock numbers, including spare parts.
- C. Record Drawings shall be promptly furnished when the equipment installation is complete. Payment may be withheld until Record Drawings have been furnished and approved.
- D. At the time of delivery of the equipment, the Contractor shall have an approved shop drawing in his possession for the Owner's Inspector and/or Owner's Engineer for verification.
- E. As-Built Drawings: As the work progresses, legibly record all field changes on a set of Project Contract Drawings, hereinafter called "As-Built Drawings". The As-Built Drawings and specifications shall be kept up to date throughout the project. As-Built Drawings shall accurately show the installed condition of the following items at a minimum:
1. One-line Diagram(s).
  2. Raceways and pull boxes.
  3. Conductor sizes and conduit fills.

4. Panelboard Schedule(s).
5. Control Wiring Diagram(s).
6. Luminaire Schedule(s).
7. Luminaire, receptacle and switch outlet locations.
8. Underground raceway and duct bank routing including manhole/handhole locations.
9. Plan view, sizes and locations of switchgear, switchboards, distribution transformers, motor control centers and panelboards.

#### 1.04 TESTS

- A. The Contractor shall be responsible for factory and field tests indicated in Division 16, as required by the Engineer and as required by other authorities having jurisdiction.
- B. Furnish necessary testing equipment.
- C. Pay the costs of the tests, including replacement parts and labor due to damage resulting from damaged equipment or from testing and correction of a faulty installation.
- D. Reporting:
  1. Where test reporting is indicated, submit proof-of-design test reports for mass-produced equipment with the Shop Drawings.
  2. Submit factory performance test reports for custom-manufactured equipment for approval prior to shipment.
  3. Submit field test reports for review prior to Substantial Completion.
- E. Remove and replace equipment or material that fails a test, or, if the Engineer approves, repair and retest for compliance.
- F. Connections to equipment or materials with a factory warranty shall be as recommended by the manufacturer and shall be performed in a manner that does not void the warranty.

#### 1.05 PERMITS AND INSPECTIONS

- A. Obtain permits and pay all fees required for permits inspections.
- B. Pay inspection, connection and turn-on service charges required by the utility company.
- C. The Engineer may inspect the fabricated equipment at the factory before shipment to job site. Provide the Engineer with sufficient prior notice so that an inspection can be arranged at the factory.
- D. Inspection of the equipment at the factory by the Engineer will be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.
- E. Favorable review of the equipment at the factory only allows the manufacturer to ship the equipment to the project site. The Contractor shall be responsible for the proper installation and satisfactory startup operation of the equipment to the satisfaction of the manufacturer and the Engineer.

#### 1.06 DEMOLITION AND RELATED WORK

- A. General:
  1. Perform electrical demolition work as indicated.

2. The Contractor is cautioned that demolition work may also be indicated on non-electrical Drawings.
  3. Coordinate with all trades regarding electrical de-energization, disconnection and removal, and the overall sequence of construction.
- B. Electrical Requirements for Removed Equipment:
1. Remove dedicated wiring and exposed conduits back to the source.
  2. Where control wiring to be demolished shares a conduit with other wiring to remain, the control wiring shall be abandoned in place. Where power wiring to be demolished shares a conduit with other wiring to remain, the power wiring shall be removed.
  3. Remove power wiring from the power source to the first pull box or manhole remote from the panel and abandon in place the remaining wiring.
  4. Abandon in place wiring routed through encased conduits and cut encased conduits flush to the floor and grout flush with the floor.
  5. Remove remote mounted starters, disconnect switches, circuit breakers, sensors and transmitters.
- C. Where new lighting and receptacles are installed in existing structures, remove old lighting, receptacles, switches, wiring, and conduits.
- D. Junction Boxes:
1. Wiring and conduits indicated to be extended shall be terminated in a new junction box with terminal strips.
  2. Provide a junction box with a NEMA rating in accordance with the area in which it is located and sized as required by the NEC.
  3. Properly identify wires and terminals before disconnection.
- E. Removed materials and equipment not indicated to be returned to the Owner shall, upon removal, become the Contractor's property and shall be disposed of offsite.
- F. Remove and relocate material and equipment indicated to be relocated or reused, and reinstall with care in order to prevent damage.
- G. Place materials indicated to be returned to the Owner in boxes, with the contents clearly marked, and store at a location determined by the Engineer.
- H. Identification:
1. Where switchgear, motor control centers, switchboards or panelboards are indicated to have components, assemblies or circuits removed and/or reconnected, provide the affected equipment compartments with new engraved nameplates matching the existing. Modify panelboard schedule(s) to indicate revised circuits.
  2. Pencil or magic marker markings directly on equipment will not be acceptable.

## 1.07 COORDINATION

- A. Coordinate the electrical work with the other trades, code authorities, utilities, and the Owner.
- B. Where connections must be made to existing installations, properly schedule all the required work with the Owner, including the power shutdown periods. Schedule and carry out shutdowns so as to cause the least disruption to operation of the plant and privately owned facilities.

- C. Submit a written sequencing request indicating the sequence and duration of activities to be performed during the plant shutdown.
- D. Switching, safety tagging and other project related tasks required for shutdown or to isolate existing equipment, shall be performed by the Contractor only when coordinated with the Owner.
- E. In no case shall the Contractor begin any work in, on or adjacent to existing equipment without written authorization from the Engineer.
- F. Modifications:
  - 1. Perform modifications or alterations to existing electrical facilities as required to successfully install and integrate the proposed electrical equipment as indicated.
  - 2. Perform modifications to existing equipment, panels and cabinets in a professional manner. Repair coatings of existing equipment to match existing.
  - 3. The costs for modifications to existing electrical facilities that are required for a complete and operable system shall be included as part of the Work.
- G. Existing Utilities:
  - 1. Exercise extreme caution when digging trenches to not damage existing underground utilities.
  - 2. The cost of repairs of damages caused during construction shall be included as a part of the Work.
- H. Field Verifications:
  - 1. Visit the site before submitting a Bid to become better acquainted with the Work of this Contract.
  - 2. The lack of knowledge will not be accepted as justification for extra compensation to perform the Work.
  - 3. The Contractor shall be responsible for identifying available existing circuit breakers in lighting panel for the intended use as required.
  - 4. The Contractor shall be responsible for field verifying the available space in switchgear, switchboards and/or motor control centers to integrate new overcurrent protective devices meeting the requirements of these Specifications.
  - 5. The cost for the above field verifications shall be included as part of the Work.
- I. Installation of Temporary Power:
  - 1. To facilitate the continuous operation of existing equipment, provide temporary equipment as indicated.
  - 2. Submit installation and connection details for favorable review and acceptance by the Engineer.
  - 3. Costs associated with these temporary installations shall be included as part of the Work.
  - 4. Temporary wiring and equipment shall remain the property of the Contractor unless indicated otherwise.

## 1.08 LOCATIONS

- A. General: Use equipment, materials and wiring methods suitable for the types of locations in which they are located, as defined in paragraph B herein.

- B. Definitions of Types of Locations:
1. Dry Locations: All those indoor areas which do not fall within the definitions below for Wet, Damp, Hazardous, or Corrosive Locations and which are not otherwise designated on the Drawings.
  2. Wet Locations: All locations exposed to the weather, whether under a roof or not, unless otherwise designated on the Drawings.
  3. Damp Locations: All spaces wholly or partially underground, or having a wall or ceiling forming part of a channel or tank, unless otherwise designated on the Drawings.
  4. Hazardous Locations: All areas in which fire or explosion hazards may exist, normally or accidentally, due to flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings. These areas are shown on the Drawings, together with the Class and Division designations as defined in the NEC, determining the enclosure types and wiring methods required.
  5. Corrosive Locations: Areas where chlorine or sulfur dioxide gas under pressure, sulfuric acid, or liquid polymer are stored or processed. These areas are shown on the Drawings.
- C. Unless otherwise specified herein or shown on the Drawings, electrical enclosures and associated installations shall have the following ratings:
1. NEMA 1 gasketed or 12 for dry, non-process indoor above grade locations.
  2. NEMA 3R for outdoor installations identified not to be hazardous or corrosive.
  3. NEMA 4X enclosures of Type 304 or 316 stainless steel in corrosive areas except in chlorine and HFS areas where non-metallic enclosures shall be provided.
  4. NEMA 6 or 6P enclosures for submersible, indoor or outdoor use. Enclosures for temporary submersion shall be rated NEMA 6 and prolonged submersion shall be rated 6P at limited depth.
  5. NEMA 7 enclosures (and listed for use in the area classifications shown) for "Class 1 Div. 1 Group D" and "Class 1 Div. 2 Group D" hazardous locations shown on the Drawings or as defined in NFPA 820 or other codes.
  6. NEMA 9 enclosures (and listed for use in the area classifications shown) for "Class 1 Div. 1 Group E, F and G" and "Class 1 Div. 2 Group E, F and G" hazardous locations shown on the Drawings or as defined in NFPA 820 or other codes.
- D. Equipment, materials and installation in areas designated as hazardous on the Drawings shall comply with NEC Articles 500, 501, 502, and 503.
- E. Equipment and materials installed in areas designated as hazardous on the Drawings shall be UL Listed for the appropriate hazardous area classification.

#### 1.09 PHASE BALANCING

- A. The Drawings do not attempt to balance the electrical loads across the phases. Circuits on motor control centers and panelboards shall be field connected to result in evenly distributed loads across all three phases.
- B. Field balancing of circuits shall not alter the conductor color coding requirements defined in Section 16120.

## 1.10 SIZE OF EQUIPMENT

- A. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.
- B. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure the tilting does not impair the functional integrity of the equipment.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Products that are specified by manufacturer, trade name, or catalog number establish a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are favorably reviewed by the Engineer prior to installation.
- B. It is the intent of these Specifications and Drawings to secure high quality in all materials and equipment in order to facilitate operation and maintenance of the facility. All equipment and materials shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses, which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately stayed, braced, and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details.
- C. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble-free service. Light-duty, fragile, and competitive grade devices of doubtful durability shall not be used.
- D. Where a NEMA enclosure type is indicated in a non-hazardous location, use that type of enclosure despite the fact that certain modifications such as cutouts for control devices may negate the NEMA rating.
- E. Temperature ratings of equipment terminations and lugs shall be rated for use with 75°C conductors. Wire sizes in the Contract Documents are based on NEC ampacity tables using the 75°C ratings.

### 2.02 MOUNTING HARDWARE

- A. Miscellaneous Hardware:
  - 1. Provide nuts, bolts, and washers constructed of stainless steel.
  - 2. Provide threaded rods for trapeze supports constructed from continuous threaded galvanized steel, 3/8 inch diameter minimum.
  - 3. Slotted channel:
    - a. Construct struts for mounting of conduits and equipment of stainless steel.

- b. Where contact with concrete or dissimilar metals may cause galvanic corrosion, use suitable non-metallic insulators in order to prevent such corrosion.
  - c. Slotted channel manufacturer shall be Unistrut, B-Line or approved equal.
- 4. Provide plastic protective end caps for all exposed slotted channel ends. End caps shall be manufactured by Unistrut P2860-33 or approved equal.
  - 5. Provide stainless steel expansion anchors for attaching equipment to concrete walls, floors, and ceilings. Expansion anchors shall be manufactured by Power Fasteners, Inc and be the "Power-Bolt" or "Power-Stud" series or approved equal.

## 2.03 LENS COLOR SCHEME

- A. Indicating light lens colors shall be red for "Run", "Open" or "On"; green for "Stop", "Close" or "Off"; and amber for alarm.

## 2.04 NAMEPLATES

- A. For each piece of electrical equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings, and the model designation.
- B. Identify each piece of equipment and related controls with a rigid laminated engraved phenolic nameplate. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using fasteners constructed of brass, cadmium plated steel, or stainless steel and screwed into inserts or tapped holes as required. Where no inscription is indicated on the Drawings, furnish nameplates with an appropriate inscription furnished by the Engineer upon prior request by the Contractor.
- C. Provide engraved characters of the block style, with no characters smaller than 1/8 inch top to bottom.
- D. Each control device, including pushbuttons, control switches, and indicating lights, shall have an integral legend plate or nameplate indicating the device function. These shall be inscribed as indicated on the Drawings or as favorably reviewed by the Engineer.

## 2.05 PAINTING

- A. Equipment: Refer to each electrical equipment section of these Specifications for painting requirements of equipment enclosures. Repair any final paint finish, which has been damaged or is otherwise unsatisfactory, to the satisfaction of the Engineer.
- B. Wiring System: Paint all exposed conduits, boxes and fittings to match the color of the surface to which they are affixed. Paint finishes shall include proper surface preparation, prime coat, and a final finish coat.

## PART 3 - EXECUTION

### 3.01 REQUIREMENTS

- A. All electrical installations shall conform to the codes and standards outlined in this Section.

### 3.02 WORKMANSHIP

- A. Assign a qualified representative who shall supervise the electrical construction work from beginning to completion and final acceptance.
- B. Perform all labor using qualified craftsmen, who have had experience on similar projects. Provide first-class workmanship for all installations.
- C. Ensure that all equipment and materials fit properly in their installations.
- D. Perform any required work to correct improperly fit installations at no additional expense to the Owner.
- E. Provide materials and incidental required for a complete and operable system, even if not required explicitly by the Contract Documents.
- F. Typical incidentals are terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor-furnished equipment to connect with other equipment indicated in the Contract Documents.

### 3.03 CONCRETE

- A. Where shown on the Drawings or specified, provide the required concrete installations for conduit encasement and equipment foundations.

### 3.04 CONDUCTOR IDENTIFICATION

- A. Identify all wires and cables in conformance with the requirements of Section 16120. This requirement applies to all equipment provided under this Contract, regardless of Division, as well as to all conductors provided or worked on during this Contract.

### 3.05 CONCRETE HOUSEKEEPING PADS

- A. Provide concrete housekeeping pads for indoor floor-standing electrical equipment.
- B. Install all floor-mounted equipment on 4-inch-high reinforced concrete pads. The Contractor, suppliers, and fabricators shall take this requirement into consideration when designing, fabricating, and installing panels, motor control centers, and other enclosures so that height above the floor of the operating handles of electrical devices meets the requirements of these Specifications and applicable codes.
- C. Provide concrete housekeeping curbs 3 inches above the finished floor or grade for conduit stub-ups in indoor locations that are not concealed by equipment enclosures.

### 3.06 CUTTING, DRILLING, AND WELDING

- A. Provide any cutting, drilling, and welding that is required for the electrical construction work.
- B. Structural members shall not be cut or drilled, except when favorably reviewed by the Engineer. Use a core drill wherever it is necessary to drill through concrete or masonry.
- C. Provide the required welding for equipment supports. Conduits and fittings shall not be welded to structural steel.
- D. Perform patch work with the same materials as the surrounding area and finish to match, as required by the structural drawings.

### 3.07 METAL PANELS

- A. Mount all metal panels which are mounted on or abutting concrete walls in damp locations or any outside walls 1/4 inch from the wall, and paint the back sides of the panels with a high build epoxy primer. Film thickness shall be 10 mils minimum.

### 3.08 PROTECTIVE DEVICE COORDINATION

- A. Perform power system studies and provide protective device coordination in accordance with Section 16961.

### 3.09 TESTING

- A. Perform acceptance testing in accordance with Section 16950.
- B. Perform additional testing as indicated within specific equipment sections.

### 3.10 EQUIPMENT STORAGE AND PROTECTION

- A. During construction, provide adequate storage for all equipment and materials that will become part of the completed facility so that it is protected from weather, dust, water, and other environmental impacts, or damage from construction operations.
- B. Store and protect products in accordance with manufacturer's instructions. Seals and labels shall be intact and legible.
- C. Store moisture sensitive products including electrical equipment, instruments and controls in weathertight, humidity and temperature-controlled enclosures to avoid condensation and dust buildup.
- D. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.
- E. Exercise care at all times after installation of equipment, motor control centers, etc., to keep out foreign matter, dust, dirt, debris, or moisture. Use protective sheet-metal covers, canvas, heat lamps, etc., as needed to ensure equipment protection.

### 3.11 CLEANING EQUIPMENT

- A. Before final acceptance, thoroughly clean the electrical Work of cement, plaster, and other materials.
- B. Clean out and vacuum all construction debris from the bottom of all equipment.
- C. Provide and touch-up to original condition any factory painting that has been marred or scratched during shipment or installation, using paint furnished by the equipment manufacturer.
- D. Remove temporary tags, markers, stickers and the like.
- E. Remove all oil and grease spots with a non-flammable cleaning solvent by carefully wiping and scraping cracks and corners.
- F. Clean luminaires inside and out.
- G. Dispose of cleaning debris and refuse off-site.

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## SECTION 16050

### ELECTRIC MOTOR DRIVES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section Includes: Provide motors to drive equipment specified in other sections and Divisions, including, but not limited to, Divisions 11, 13, 15, and 16. Refer to driven equipment sections for additional requirements. Requirements of the driven equipment Specifications shall take precedence over the requirements of this Section, where conflict occurs. This Section applies to all electric motors furnished for this project, unless otherwise noted.

##### 1.02 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association (NEMA) Standard:
  - 1. MG 1 Motors and Generators
- B. Institute of Electrical and Electronics Engineers (IEEE) Standard:
  - 1. 112 Test Procedure for Polyphase Induction Motors and Generators
- C. Underwriters Laboratories (UL) Publication: Recognized Component Directory.

##### 1.03 SUBMITTALS

- A. For each motor, include the following data in the shop drawing submittal for the driven equipment, as part of the driven equipment's Product Review submittals:
  - 1. Machine name and specification number of driven machine
  - 2. Manufacturer's name.
  - 3. Motor model and dimension drawing, including motor weight.
  - 4. Manufacturer's type and frame designation.
  - 5. Nominal Horsepower output.
  - 6. Time rating.
  - 7. Maximum ambient temperature rating.
  - 8. Winding Insulation class and temperature rise class.
  - 9. RPM at full load.
  - 10. Voltage, number of phases, frequency and full load amperes.
  - 11. Code letter for locked rotor kVA.
  - 12. Service factor at 40°C ambient.
  - 13. NEMA design letter.
  - 14. Enclosure type.
  - 15. Bearing data including lubrication requirements, type and frequency.
  - 16. KW input power and power factor at 75% and 100% of rated horsepower output.
  - 17. Guaranteed minimum full load efficiency. Also, nominal efficiencies at 1/2 and 3/4 load.
  - 18. Type of thermal protection or overtemperature protection, if included.
  - 19. Wiring diagram for devices such as motor leak detection, temperature or zero speed switches, as applicable.
  - 20. If utilized with a variable frequency controller, verify motor is inverter duty type. Include minimum speed at which motor may be operated for the driven machinery. Provide shaft grounding information and details.

21. Power factor at 1/2, 3/4, and full load.
  22. Recommended size for power factor correction capacitors to improve power factor to 0.95 percent lagging when operated at full load.
- B. If water cooling is required for motor thrust bearings, the Shop Drawing submittals shall indicate this requirement.

#### 1.04 COORDINATION

- A. General: Coordinate motors with driven equipment requirements. Unless otherwise specified, equipment manufacturers or suppliers shall select and provide motors for their equipment in conformance with these Specifications. Give particular attention to coordination of requirements for:
1. Power.
  2. Starting torque.
  3. Speed.
  4. Bearing load.
  5. Ambient temperature.
  6. Frequency of starting.
  7. Moisture exposure.
  8. Adjustable speed control, where applicable.
- B. Suppliers of motors to be used with adjustable speed systems shall:
1. Provide all relevant motor data to the adjustable speed control manufacturer for analysis. Provide motors in conformance with and compatible with the adjustable speed control manufacturer's equipment and requirements.
  2. Provide all relevant motor data to the pump manufacturer for vibration, reed critical frequency and other required analyses.

#### 1.05 SPECIFIC REQUIREMENTS

- A. The following motor characteristics are specified with the driven equipment in all cases:
1. Speed.
  2. Horsepower or supplier responsibility to determine.
  3. Horizontal or vertical arrangement.
  4. Indoor or outdoor location.
- B. Additional motor characteristics are specified with the driven equipment only where the required motor differs from the typical characteristics described below or where additional properties or characteristics are required that are not specified in this Section.

### PART 2 - PRODUCTS

#### 2.01 GENERAL

- A. Motors shall be designed, built, and installed in the driven equipment, to provide long, trouble-free life in industrial service and shall be rated in conformance with NEMA MG1. Motors rated 100 horsepower or less and rated 600V or less shall be listed in UL Recognized Component Directory or shall be listed and labeled by other organizations acceptable to the authority having code enforcement jurisdiction.

- B. Unless otherwise specified with the driven equipment, provide motors with the following typical characteristics:
1. NEMA Design: Electric motors shall be NEMA Design B unless otherwise indicated. In no case shall starting torque or breakdown torque be less than the value in NEMA MG 1. Motors shall be suitable for the indicated starting method.
  2. Voltage Ratings:
    - a. 1/2 horsepower or less: 115 volts, single phase, 60 Hz, capacitor start. Small fan motors may be split phase or shaded pole type if standard for the equipment. Dual voltage motors rated 115/230 volts, 115/208 volts, or 120-240 volts are acceptable, provided leads are brought out to the conduit box.
    - b. Above 1/2 horsepower: 460 volts, three phase, 60 Hz, squirrel cage induction motors. Dual voltage motors rated 230/460 volts or 208/230/460 volts are acceptable, provided every lead is brought out to the conduit box.
  3. All motors shall have a service factor of 1.15 in an ambient temperature of 40°C.
    - a. Exceptions: Motors, which have special enclosures or winding configurations, may carry a Unity (1.0) Service Factor. Examples are totally enclosed, explosion proof, or submersible motors.
  4. Windings shall be copper.
  5. Horizontal motors 3 HP and larger and every vertical motor shall have split-type cast metal conduit boxes. Motors shall be provided with oversized conduit boxes. Motors other than open drip-proof shall be gasketed.
  6. Provide ground lug inside the terminal box.
  7. Provide lifting eye on each motor weighing more than 50 pounds.
  8. Each motor shall be suitable for six starts per hour (5 minutes on and 5 minutes off, continuously) when powering the specific driven equipment required for this project.
  9. Each motor shall have an overall sound power level at no load not greater than given in NEMA MG1-Part 9.
  10. Inverter duty motors shall be provided with shaft grounding rings. Rings shall be factory installed, and shall be by Aegis, or equal. The motor warranty shall include coverage against VFD-induced bearing damage or failure.
  11. Motors, which have special operating characteristics such as multi-speed, high torque/high slip, short time intermittent ratings shall be nameplated to show how these characteristics differ from standard design.
- C. Motors used with variable frequency drives shall have inverter duty complying with NEMA MG-1, Section IV, Part 31, and shall be clearly identified as "Inverter Duty."
- D. Increased circuit breaker, magnetic starter, and conductor and conduit capacities required for motors larger than the indicated sizes shall be provided as part of the Contractors work.
- E. Two speed motors shall be of the two-winding type.
- F. Exempt Motors: Motors for valve operators, submersible pumps, or motors which are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, or part of domestic or commercial use apparatus may be excepted from these requirements to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

## 2.02 NAMEPLATE

- A. Provide stainless steel nameplate for each motor, attached to the motor by stainless steel screws or drive pins. Nameplates shall indicate clearly the information required by NEMA MG1 Part 10 and Part 12.

## 2.03 ENCLOSURE TYPE BY LOCATION

- A. Unless otherwise specified with the driven equipment, provide motors with the following typical enclosures:
  - 1. Indoors and non-hazardous: Horizontal motors shall be open, drip-proof; vertical motors shall be drip-proof with guard.
  - 2. Outdoors and non-hazardous: Vertical motors shall be weather-protected type I. Horizontal motors shall be totally enclosed, fan cooled. All motors shall have the following features:
    - a. Bearing protection.
    - b. Anti-corrosion treatment of external hardware and internal metal parts.
    - c. Weatherproof terminal box with gaskets between the motor, terminal box, and terminal box cover.
    - d. Guard screens on ventilation openings.
    - e. Moderate moisture resistant insulation, specified hereinafter.
    - f. Interior and exterior corrosion protection coatings.
- B. Special attention to leads into terminal box. When specifically called for in the Specifications for the driven equipment or required by Code, provide the following enclosure types:
  - 1. Hazardous locations: Motors for use in hazardous locations shall have enclosures suitable for the classification indicated. Such motors shall be U.L. listed and be stamped as such.
  - 2. Severe duty: Motors shall have the following features:
    - a. Totally enclosed, fan cooled enclosure.
    - b. Stainless steel nameplate.
    - c. Cast iron housing, bearing brackets, and fan guard.
    - d. Cast iron conduit box with threaded conduit entrance.
    - e. Corrosion resistant fan.
    - f. Corrosion resistant hardware.
    - g. Automatic breather/drain.
    - h. Ground lug.
    - i. Regreasable bearings.
    - j. Provision for excluding water and dust from bearings.
    - k. Class F insulation.
    - l. Service factor of 1.15.
    - m. Epoxy coating on all external surfaces.
  - 3. Submersible: Submersible motors shall comply with the following:
    - a. Air-filled or oil-filled squirrel cage induction type.
    - b. Service factor of 1.15 or better.
    - c. Class F insulation, Class B temperature rise.
    - d. Rated for six starts per hour.
    - e. Listed by either UL or FM for Class 1, Division 1, Groups C and D hazardous locations.
    - f. Suitable for operating in free air continuously (i.e., not submerged in sewage).
    - g. Bearing B10 life 18,000 hours minimum.
    - h. Tungsten carbide seals.

- i. Lower bearings of either the ball or roller type.
- j. If required by the manufacturer to not void the motor warranty, provide a moisture detection system and a motor winding thermostat system. These systems shall be complete, including all necessary interfaces, control panels, conduits, and wires, even though these may not be shown on the Drawings.

## 2.04 INSULATION

- A. Three phase motors shall be provided with Class F insulation, rated to operate at a maximum ambient temperature of 40°C and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in NEMA MG 1-12.44. Single phase motors shall have Class F insulation with temperature rise not to exceed the insulation class. Motors to be operated from adjustable frequency drives shall be provided with insulation systems to withstand 1600 volt spikes, with dV/dT as defined in NEMA MG 1-31. The adjustable frequency drive manufacturer shall coordinate with the motor manufacturer to determine when additional dV/dT protection is required. Where required, it shall be furnished and installed as per the manufacturer's written instructions.
- B. Where called for in the Specifications for the driven equipment, provide the following type of insulation:
  - 1. Moderate Moisture Resistant: Provide extra dip and bake of epoxy or polyester varnish to resist somewhat higher than normal moisture in the atmosphere.

## 2.05 MOTOR HORSEPOWER

- A. The maximum permissible motor loading:
  - 1. Motors with service factor 1.15 or greater: 100% of nameplate horsepower.
  - 2. Motors with service factor less than 1.15: 90% of nameplate horsepower.
- B. Probable motor horsepower ratings have been specified or shown on the Drawings. Changes from the specified horsepower may be accepted, if necessary, to assure that motors do not exceed their maximum permissible loading, as defined above, under normal operation. Motor horsepowers shall not be less than those specified in driven equipment sections. If a larger horsepower rating is required by the driven equipment, provide all changes required to motor starting and control equipment and to the conduit and wiring system without any additional cost to the Owner.

## 2.06 EFFICIENCY

- A. For motors 1 Horsepower and Larger:
  - 1. Provide NEMA premium efficient units. Motors shall be stamped with the efficiency on the nameplate with the caption "NEMA Nominal Efficiency" or "NEMA Nom. Eff." Premium efficiency motors shall have nominal and minimum efficiencies at full load not less than those listed in Table 16050-1. Both efficiencies shall be included in the Shop Drawing submittal.
- B. Efficiencies shall be determined by using the IEEE 112, Test Method B using segregated loss determination.
- C. Single-phase fractional horsepower motors 1/4 HP through 3/4 HP motors shall be high-efficiency split-capacitor types having minimum efficiency ratings of not less than 64% and power factors of not less than 94.5%.

TABLE 16050-1

OPEN DRIP-PROOF (ODP)						
FULL-LOAD EFFICIENCIES OF NEMA PREMIUM EFFICIENCY MOTORS RATED 600 VOLTS OR LESS						
	2 POLE		4 POLE		6 POLE	
HP	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1	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	85.5	82.5	86.5	84.0	87.5	85.5
3	85.5	82.5	89.5	87.5	88.5	86.5
5	86.5	84.0	89.5	87.5	89.5	87.5
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	95.8	95.0	95.8	95.0
450	96.2	95.4	96.2	95.4	96.2	95.4
500	96.2	95.4	96.2	95.4	96.2	95.4

Source: NEMA MG1 - 2011, Table 12-12

TOTALLY ENCLOSED - FAN COOLED (TEFC)						
FULL-LOAD EFFICIENCIES OF NEMA PREMIUM EFFICIENCY MOTORS RATED 600 VOLTS OR LESS						
HP	2 POLE		4 POLE		6 POLE	
	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1	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	85.5	82.5	86.5	84.0	88.5	86.5
3	86.5	84.0	89.5	87.5	89.5	87.5
5	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

Source: NEMA MG1 - 2011, Table 12-12

## 2.07 MOTOR THERMAL PROTECTION

- A. Single Phase Motors: Single phase 120, 208, or 230 volt motors shall have integral thermal overload protection or shall be inherently current limited.
- B. In each motor to be used with adjustable speed drives, in all motors 60 horsepower and larger, or where called for in the Specifications for the driven equipment, provide integral thermostats or other approved devices to protect the motor from overheating. Thermostats shall be snap action, bi-metallic, temperature actuated switch. Thermostats shall be normally closed and the switch point shall be precalibrated by the manufacturer. Thermostats shall be rated 125 Vac, 1 amp.

## 2.08 SPACE HEATERS

- A. On all outdoor motors, where called for in the Specifications for the driven equipment, or where shown on the Drawings provide space heaters or solid-state motor winding heating systems for motors. Heaters shall be 120 or 240 volts,

single-phase, as required by the control circuit voltage. Heater wattage and voltage ratings shall be indicated on motor nameplate.

## 2.09 MOTOR BEARINGS

- A. General: Bearings shall conform to Section 11001, except as indicated herein.
- B. Motors greater than 2 HP shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.
- C. Fractional Horsepower: Motors with fractional horsepower through 2 HP shall be provided with lubricated-for-life ball bearings.
- D. Horizontal Motors Over 2 HP: Motors larger than 2 HP shall be provided with relubricatable ball bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.
- E. Vertical Motors Over 2 HP: Vertical motors larger than 2 HP shall be provided with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.
- F. Water Cooled Motors: If water cooling is required for the thrust bearings, cooling water lines shall be provided complete with shut-off valve, strainer, solenoid valve, flow indicator, thermometer, throttling valve, and, (where subject to freezing), insulation with heat tracing.
- G. Inverter Duty Motors: Provide an insulated bearing to prevent circulating bearing currents.

## 2.10 MANUFACTURERS, OR EQUAL

- A. U.S. Motors
- B. General Electric
- C. WEG

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install motors in driven equipment in conformance with motor manufacturer's recommendations and requirements. Motor nameplate shall be visible when installed on the driven equipment. Where applicable, shaft grounding devices shall be connected to the grounding system in accordance with the manufacturer's recommendations.
- B. Related electrical work involving connections, controls, switches, and disconnects shall be performed in accordance with the applicable sections of Division 16.

### 3.02 FACTORY TESTS

- A. Motors shall be factory tested in conformance with IEEE 112, IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-2. Except where specific testing or witnessed shop tests are required by the specifications for driven equipment, factory test reports may be copies of routine test reports of electrically duplicate motors. Test report shall indicate test

procedure and instrumentation used to measure and record data. Test report shall be certified by the motor manufacturer's test personnel and be submitted to the Engineer.

### 3.03 FIELD TESTING

- A. The Contractor shall perform the following field tests:
1. Inspect each motor installation for any deviation from rated voltage, phase, frequency, and improper installation.
  2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage. Verify shaft grounding devices are properly grounded.
  3. Check winding and bearing temperature detectors and space heaters for functional operation.
  4. Test for proper rotation prior to connection to the driven equipment.
  5. Visually check that motor overload heaters are properly sized and that MCP breaker settings are correct for the motor installed.
  6. Test insulation (megger test) of new and re-used motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

END OF SECTION

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## SECTION 16110

### ELECTRICAL RACEWAY SYSTEMS

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish and install complete raceway systems as shown on the Drawings and as specified herein.
- B. Raceways and conductors that are listed on the conduit and cable schedules are generally not shown on the Drawings, except where they are required to pass through a restricted or designated space and the Contractor would benefit from additional information. Conduit block diagrams indicate exposed conduits as solid lines and shall be run near the ceilings or along walls of the areas through which they pass and shall be routed to avoid interferences with HVAC ducts, cranes and hoists, lighting fixtures, doors and hatches, etc. Conduit block diagrams indicate concealed or buried conduits as dashed lines and shall be run in underground duct banks, center of concrete floor slabs, in partitions, or above hung ceilings as required.
- C. In the event that individual equipment loads provided are larger than indicated in the Contract Documents, revise raceways, conductors, starters, overload elements, and branch circuit protectors as necessary in order to control and protect the increased connected load in conformance to NEC requirements as part of the Work.

##### 1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI) Publications:
  - 1. C80.1 Specification for Zinc Coated Rigid Steel Conduit
  - 2. C80.5 Specifications for Rigid Aluminum Conduit
- B. Federal Specifications (FS):
  - 1. FS W C 1094 W C 1094A Conduit and Conduit Fittings, Plastic, Rigid
  - 2. FS W W C 540 W W C 540A Conduit, Metal, Rigid, (Electrical, Aluminum)
  - 3. W W C 540C Conduit, Metal, Rigid & Coupling, Elbow & Nipple, Electrical Conduit, Aluminum
  - 4. FS W W C 566 W W C 566C Flexible Metal Conduit
- C. National Electrical Manufacturers Association (NEMA) Publications:
  - 1. RN 1 Polyvinyl Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing
  - 2. TC2 Electrical Polyvinyl Chloride (PVC) Conduit
  - 3. TC3 Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
  - 4. TC 6 PVC and ABS Plastic Utilities Duct for Underground Installation
  - 5. TC14 Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
- D. Underwriters Laboratories (UL) Standards:
  - 1. 6 Rigid Metal Electrical Conduit
  - 2. 6A Electrical Rigid Metal Conduit – Aluminum, Red Brass and Stainless Steel
  - 3. 360 Liquid-Tight Flexible Metal Conduit

4. 651 Electrical Rigid Nonmetallic Conduit and Fittings
5. 651A Type EB and A Rigid PVC Conduit and HDPE Conduit
6. 2515 Aboveground Reinforced Thermosetting Resin Conduit

### 1.03 SUBMITTALS

- A. Submit complete catalog cuts of raceways, fittings, boxes, supports, and mounting hardware, marked where applicable to show proposed materials and finishes.
- B. Prepare as-built drawings of encased concealed and exposed raceways, ducts, raceways, junction boxes, pull boxes, and electrical and instrumentation equipment.

### 1.04 LOCATIONS

- A. Refer to Section 16010 for definitions of types of locations.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Pull and junction boxes, fittings and other indicated enclosures that are dedicated to the raceway system shall comply with the requirements of this Section.
- B. Provide exposed conduit of 3/4-inch minimum trade size and encased conduit of 1-inch minimum trade size. Provide 2-inch minimum trade size for conduits containing fiber optic cables.
- C. The use of short sections of 1/2-inch flexible conduit for final termination of field control devices and instrumentation is permitted. They may not be longer than 36 inches in length, and may only transition to the smaller size junction boxes or condulets at the field device.

### 2.02 CONDUIT RACEWAYS

- A. Galvanized Rigid Steel Conduit (GRS) shall be manufactured from mild steel, hot-dip galvanized inside and out, conforming to ANSI C80.1 and UL 6. Couplings shall be threaded type. Manufacturers shall be Allied Tube and Conduit, Wheatland Tube or approved equal.
- B. PVC coated rigid steel conduit (PGRS) shall meet the requirements of GRS above. A PVC coating shall be bonded to the outer surface with a thickness not less than 40 mils. The inside surfaces and threads of the conduit shall be provided with a 2-mil urethane coating. PGRS shall be manufactured in accordance with UL-6, ANSO C80.1, and NEMA RN1. Manufacturers shall be Robroy Industries Perma-Cote or Plasti-Bond series; Thomas & Betts Ocal Blue; or approved equal.
- C. Liquid-Tight Flexible Conduit shall be constructed of a flexible galvanized metal core with a sunlight-resistant thermoplastic outer jacket. Conduit shall be manufactured in accordance with UL 360. Flexible conduit in hazardous areas shall be rated for the Class, Division, and Group in which its installed. Manufacturers shall be Anaconda Sealtite, Electriflex Liquatite or approved equal.
- D. Rigid Nonmetallic Conduit: Rigid nonmetallic conduit shall be PVC Schedule 40 (PVC 40) or PVC Schedule 80 (PVC 80) and sunlight resistant. Conduit shall be approved for underground use and for use with 90°C wires, and shall conform to

NEMA TC-2 and UL 651. Manufacturers shall be Carlon; Cantex; or approved equal.

- E. Fiberglass conduit shall be manufactured using the single circuit filament winding process. The resin shall be epoxy-based, with no fillers. All additives for increasing flame spread and lowering smoke density shall be halogen free. Conduit shall be manufactured in accordance with NEMA TC 14. Manufacturers shall be Champion Fiberglass; United Fiberglass; or approved equal.

## 2.03 CONDUIT SUPPORTS

- A. For indoor, dry locations, supports for individual conduits shall be galvanized malleable iron one-hole type with conduit back spacer. All other locations shall be Type 316 stainless steel.
- B. For indoor, dry locations, supports for multiple conduits shall be hot-dip galvanized Unistrut or Superstrut channels, or equal. All associated hardware shall be hot-dip galvanized. All other locations shall be Type 316 stainless steel.
- C. All channels, strut, threaded rods, nuts and clamps in corrosive areas shall be of epoxy resin reinforced fiberglass material. Provide Robroy; Superstrut; or equal.

## 2.04 FITTINGS

- A. General:
  - 1. For use with metallic conduit, provide cast and malleable iron fittings of the threaded type with 5 full threads.
  - 2. Fittings:
    - a. Provide fittings with neoprene gaskets and non-magnetic stainless steel screws.
    - b. Attach covers by means of holes tapped into the body of the fittings.
    - c. Covers for fittings attached by means of clips or clamps will not be accepted.
  - 3. Terminations:
    - a. In outdoor areas, terminate conduit in rain-tight hubs as manufactured by Myers; O.Z. Gedney; Appleton; or approved equal.
    - b. In other than outdoor areas, provide sealed locknuts and bushings.
- B. Fittings for use with rigid steel shall be hot dipped galvanized steel or galvanized cast ferrous metal; access fittings shall have gasketed cast covers and be Crouse-Hinds Condulets; Appleton Unilets; or equal. Provide threaded-type couplings and connectors; set-screw type and compression-type are not acceptable.
- C. Fittings for use with aluminum shall be cast aluminum with less than 0.40 percent copper content, and suitable for use with aluminum conduit. Manufacturers shall be O.Z. Gedney; Appleton; Crouse-Hinds; or approved equal.
- D. Fittings for use with PVC-coated GRS conduit shall be PVC-coated that are the products of the same manufacturer as the conduit. Both male and female threads and internal surfaces shall contain a 2-mil urethane coating.
- E. Fittings for use with rigid nonmetallic conduit shall be PVC and have solvent-weld-type conduit connections. Boxes shall be manufactured of PVC or fiberglass reinforced polyester (FRP). Manufacturers shall be Carlon; Crouse-Hinds; Hoffman; or approved equal. If such are not available, then the Specification for PVC coated galvanized rigid steel fittings shall apply.

- F. Fittings for flexible conduit shall be Appleton Type ST; O.Z. Gedney Series 4Q; or approved equal.
- G. Fittings for use with fiberglass conduit shall be fiberglass and as recommended by the conduit manufacturer.
- H. Combination expansion-deflection fittings with internal grounding shall be installed where conduit movement is expected in more than one dimension, and where conduits transition out of structures in locations where differential settlement may occur. Combination expansion/deflection fittings shall be manufactured by Crouse-Hinds Type XJGD or approved equal.
- I. Expansion fittings with internal grounding shall be installed wherever exposed raceway cross building expansion joints. Expansion fittings shall be Crouse Hinds Type XLGSA or approved equal.
- J. Union couplings for conduits shall be the Erickson type and shall be Appleton Type EC; O.Z. Gedney 3-piece Series 4; or approved equal. Threadless couplings shall not be used.
- K. Bushings:
  - 1. Bushings shall be the insulated type.
  - 2. Bushings for rigid steel conduit shall be hot dip galvanized insulated grounding type, O.Z. Gedney Type HBLG; Appleton Type GIB, or approved equal.
- L. Conduit seals in hazardous areas shall have zinc electroplate and shall be Crouse-Hinds Type EYS or EZS; Appleton Type EYS, ESU, or EY series; or approved equal.
- M. Conduit seals in areas where chlorine, ammonia, sulfur dioxide and/or hydrofluosilicic areas shall be Link Seal or approved equal.

## 2.05 BOXES

- A. Boxes specified herein are for use with raceway systems only. Boxes used for housing electrical and instrumentation equipment shall be as described elsewhere in these Specifications.
- B. NEMA 1 Areas: NEMA 1 terminal boxes, junction boxes, pull boxes, etc., shall be either sheet or cast malleable iron or aluminum depending on raceway material. Boxes shall be suitable for wall mounting or have feet where self-standing. Boxes shall have continuously welded seams and welds shall be ground smooth. Box bodies 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. All boxes shall have hinged gasketed doors with quarter turn latches or 3-point latch (single operator) system on enclosures larger than 36 inches wide or 32 inches tall. Terminal boxes shall be furnished with terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20A, 600V. Boxes shall be Concept Series as manufactured by Hoffman Engineering Co. or approved equal.
- C. NEMA 4X Areas: NEMA 4X terminal boxes, junction boxes, pull boxes, etc., shall be Type 304 or 316 stainless steel. Boxes shall be suitable for wall mounting or have feet where self-standing. Boxes shall have continuously welded seams and welds shall be ground smooth. Box bodies 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. All boxes shall have hinged gasketed doors

with quarter turn latches or 3-point latch (single operator) system on enclosures larger than 36 inches wide or 32 inches tall. Terminal boxes shall be furnished with terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20A, 600V. Boxes shall be Concept Series as manufactured by Hoffman Engineering Co. or approved equal.

- D. NEMA 7 Areas: Explosion-proof boxes shall be designed for the Class, Division, and Group with which it is to be installed. Boxes shall have O-ring seals to meet NEMA 4 requirements. Boxes shall be aluminum, with stainless steel hinged covers and stainless steel bolts. Boxes shall be as manufactured by Crouse Hinds Type EJB-N4; Appleton Electric; Adalet PLM; or approved equal.
- E. Boxes for use in chemically corrosive areas shall be of rigid PVC. Construction shall be the same as specified for NEMA 4X areas as specified above.

## 2.06 WIREWAYS AND AUXILIARY GUTTERS

- A. General: Wireways shall consist of a prefabricated channel-shaped trough with hinged or removable covers, associated fittings, and supports. Straight sections shall not be longer than 5 feet. Separate power, control, signal and communications cables by grounded metallic dividers in wireways or run in separate wireways. Cross-sectional dimensions shall be as indicated on the Drawings. Fittings shall consist of elbows, tees, crosses, and closing plates as required.
- B. Interior Locations: All components shall be constructed from sheet steel not less than 14 gauge and coated with a corrosion-resistant gray paint. Covers shall be held closed with hinges and clamps.
- C. Exterior Locations: Wireway and associated fittings shall be NEMA rated for the area in which it is to be installed. Wireways shall be supplied with gasketed closing end plates and gasketed hinged covers.
- D. Corrosive Locations: In corrosive locations provide enclosure type boxes for use as wireways. Enclosures and associated fittings shall meet NEMA 4X classifications and shall be manufactured from reinforced injection molded fiberglass or formed and welded stainless steel and shall have gasketed closing plates and hinged and gasketed covers with spring loaded latches.
- E. Ground the steel and aluminum wireway bodies. Provide steel dividers with steel wireways or aluminum dividers with aluminum wireways, and ground by means of an individual grounding conductor.
- F. Terminate conduits in all wet and damp locations with rain-tight hubs as manufactured by O.Z. Gedney; Myers; or approved equal. In finished areas, provide sealed locknuts and bushings.

## 2.07 CONDUIT SEALANTS

- A. Moisture Barrier Types: Sealant shall be a non-toxic, non-shrink, non-hardening, putty type hand applied material providing an effective barrier under submerged conditions.
- B. Fire Retardant Types: Fire stop material shall be a reusable, non-toxic, asbestos-free, expanding, putty type material with a 3-hour rating in accordance with UL 1479. Provide products indicated by the manufacturer to be suitable for the type and size of penetration.

## PART 3 - EXECUTION

### 3.01 CONDUIT, RACEWAY, AND FITTING INSTALLATION

- A. No wire shall be pulled until the raceway 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 raceway system has been completed in every detail.
- B. From pull point to pull point, the sum of the angles of all of the bends and offsets shall not exceed 270 degrees.
- C. Coat threads with a conductive lubricant before assembly.
- D. Provide joints that are tight, thoroughly grounded, secure and free of obstructions by use of a mandrel. Adequately ream the conduit in order to prevent damage to the wires and cables inside. Use strap wrenches and vises to install the conduit in order to prevent wrench marks on the conduit. Any conduit with wrench marks shall be replaced.
- E. The ends of all conduits shall be tightly plugged to exclude dust and moisture during construction. Duxseal, or 3M seal spray shall be used in all applications. Plugging with tape is prohibited, even for short periods of time.
- F. For power, control and signal circuits, provide conduit per Conduit Use Tables below, unless specifically indicated otherwise on the Drawings:
  - 1. Exception: For raceways leaving a building above grade and then going below grade, provide PVC-coated GRS from a point 3 feet above grade to a point 5 feet from the building wall.
- G. Unless boxes have cast, threaded hubs, provide insulated type metallic grounding bushings for metallic conduits at all boxes. Bond together all conduits to provide continuity of the equipment grounding system. Size bonding conductor per NEC.
- H. Provide flexible conduit in lengths of not more than 36 inches at connections to motors, valves, and any equipment subject to vibration or relative movement. All flexible conduits, regardless of length or manufacturer rating, shall have a dedicated ground bonding conductor pulled through, whether it is included in the conduit fill schedules or not.
- I. Conduits embedded in concrete floors on grade shall be installed between grids of reinforcing steel, or shall be encased below the floors, provided the concrete is thickened in a manner satisfactory to the Engineer. Installation of conduit below the bottom of this slab is not acceptable; embedding or encasing is required.
- J. Damage to PVC coating of coated conduits or fittings shall be repaired with factory-approved PVC patching material to the original factory condition.
- K. Install fiberglass conduit in accordance with the manufacturer's instructions. Connections between sections of conduit may be either glued or threaded, at the Contractor's option.
- L. Underground Raceways: Slope all underground raceways to provide drainage; for example, slope conduit from equipment located inside a building to the handhole located outside the building.
- M. Conduit Supports: Properly support all conduits as required by the NEC. Run all conduits exposed except where the Drawings indicate that they are to be embedded in the floor slab, walls, or ceiling, or to be installed underground.

1. Exposed Conduits:
  - a. Support exposed conduits within 1 foot of any outlet and at intervals not exceeding NEC requirements; wherever possible, group conduits together and support on common supports. Support exposed conduits fastened to the surface of the concrete structure by one-hole clamps, or with channels. Use conduit spacers with one-hole clamps. Coordinate conduit locations with piping, equipment, fixtures, and with structural and architectural elements. Conduits attached to walls or columns shall be as unobtrusive as possible and shall avoid windows. Run all exposed conduits parallel to building lines. No diagonal runs will be accepted. Bends in parallel runs shall be concentric and shall be run straight and true.
  - b. Group together exposed conduits in horizontal runs located away from walls and support on trapeze hangers. Arrange such conduits uniformly and neatly. Trapeze hangers shall consist of channels of adequate size, suspended by means of minimum 3/8-inch-diameter rods or other suitable means from the ceiling or from pipe hangers. Install such runs so as not to interfere with the operation of valves or any other equipment, and keep at least 6 inches clear of any pipe which may operate at more than 100°F. Treat cut surfaces or damaged ends with corrosion-resistant coatings such as "Devcon Z", prepared by Subox Coatings; "Galvanox Type I", prepared by Pedley-Knowles; or approved equal. Application shall follow manufacturer's recommendation.
- N. All penetrations through walls into or out of corrosive locations, as defined in Section 16010 shall be made gas-tight. In concrete walls, pour concrete after the conduit is in place, if possible. If not, core drill concrete or CMU walls, install conduit and caulk around it with non-shrink grout. Install conduit seal in each conduit near the penetration.
- O. All conduit penetrations through interior walls and floors shall be sealed with fire retardant type conduit sealant.
- P. Conduit Identification: In each handhole, pull box, cabinet, motor control center or other equipment enclosure, identify each conduit using the conduit number shown on the Drawings by means of a stamped brass tag affixed with stainless steel wire; where affixing a tag is not feasible, identify conduits by affixing a brass tag with epoxy or other approved method of stenciling to the wall or structure adjacent to the conduit terminus.
- Q. Conduit Seals:
  1. Moisture Seals: Provide in accordance with NEC paragraph 300.5(g).
  2. Gas Seals: Provide in accordance with NEC paragraph 501.5.
- R. Aluminum conduit shall not be installed underground or encased in concrete. If necessary to run through concrete, install in a non-metallic conduit sleeve or use PVC coated conduit.
- S. Rigid PVC conduit shall be stored on a flat surface and shielded from the sun.

**CONDUIT USE TABLE 1**

	Inside Buildings						
	Exposed			Concealed			
Circuit Type	Standard	Corrosive	Hazardous	Above Suspended Ceilings	In Stud Walls	Embedded In Concrete	Slab On Grade
Power & 120 Vac Control	GRS or Aluminum**	PVC Coated GRS or Aluminum**	PVC Coated GRS or Aluminum**	PVC-80 or GRS	GRS	PVC-40 or PVC-80	PVC-40 or PVC-80
Signal	GRS or Aluminum**	PVC Coated GRS or Aluminum**	PVC Coated GRS or Aluminum**	GRS	GRS	GRS	GRS
Fiber Optic Cable	GRS or Aluminum**	PVC Coated GRS or Aluminum**	PVC Coated GRS or Aluminum**	PVC-80 or GRS	GRS	PVC-80	PVC-80

**CONDUIT USE TABLE 2**

Circuit Type	Outside Buildings			Transition
	Exposed	Buried In Soil	Duct Bank Encased In Concrete	Within 5 Feet of Building
Power & 120 Vac Control	PVC Coated GRS, Aluminum** or Fiberglass**	PVC Coated GRS	PVC-40	PVC Coated GRS
Signal	PVC Coated GRS, Aluminum** or Fiberglass**	PVC Coated GRS	GRS	PVC Coated GRS
Fiber Optic Cable	PVC Coated GRS, Aluminum** or Fiberglass**	PVC Coated GRS or PVC-80	PVC-40	PVC Coated GRS

\* Provide ground wire sized per NEC requirements for all circuits.

\*\* Aluminum and/or Fiberglass may be used in corrosive locations where environmental conditions warrant its use.

Notes:

1. Generally, the Conduit Use Tables apply.
2. Signal circuits are those subject to RF interference or induced current. MSPs, TSPs, telephone cable, coaxial cable, and manufacturer's cables specially designed for low level signals are all presumed to be part of signal circuits.
3. Provide fiberglass conduit where indicated on the Drawings.

**3.02 WIREWAY INSTALLATION**

- A. Straight sections and fittings shall be solidly bolted together to be mechanically rigid and electrically continuous. Dead ends shall be closed. Unused conduit openings shall be plugged.
- B. Wireways shall be supported every 5 feet.
- C. Wireways and auxiliary gutters shall not contain wiring or control devices and shall not extend over 30 feet in length.

**END OF SECTION**

## SECTION 16120

### LOW VOLTAGE WIRE AND CABLE

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish labor, materials, equipment and incidentals necessary to install field wire and cable specified under this Section. Electrical work shall be in accordance with Section 16010.
- B. Work shall include building wire, cable, wiring connections and terminations and modular wiring systems.

##### 1.02 REFERENCE STANDARDS

- A. ASTM International (ASTM):
  - 1. B3-74 Specification for Soft or Annealed Copper Wire
  - 2. B8-77 Specification for Concentric Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft
  - 3. B173-71 Specification for Rope Lay Stranded Copper Conductors Having Concentric Stranded Members
- B. Insulated Cable Engineers Association (ICEA):
  - 1. S-66-524 Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable
- C. International Electrical Testing Association (NETA):
  - 1. ATS Acceptance Testing Specifications
- D. National Electrical Manufacturers Association:
  - 1. WC-3 Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
  - 2. WC-5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
- E. Underwriters Laboratories (UL) Standards:
  - 1. 62 Flexible Cords and Fixture Wire
  - 2. 510 Insulating Tape
  - 3. 1063 Stranded Conductors for Machine Tool Wire

##### 1.03 SUBMITTALS

- A. Submit the following material or equipment data:
  - 1. Each type of cable and wire to be used.
  - 2. Cable and wire splices.
  - 3. Wire markers.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall protect all cable and wire from being damaged at all times.
- B. Cable ends shall be protected from water entry in accordance with the manufacturer's recommended procedures. Cable ends shall not be left open in manholes or other locations subject to submergence. If the cable ends become

submerged prior to splicing or termination, the cables shall be replaced in their entirety.

- C. Cables shall be pulled into raceways in accordance with the manufacturer's requirements. Under no circumstances shall cable pulling tensions exceed the manufacturer's written instructions.
- D. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.

## PART 2 - PRODUCTS

### 2.01 CONDUCTORS

- A. General: Conductors, include grounding conductors, shall be stranded copper. Aluminum conductor and/or solid conductor wire and cable will not be permitted. Insulation shall bear the UL label, the manufacturer's trademark, and identify the type, voltage, and conductor size. Conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment such as motors, controllers, and industrial control panels shall conform to the requirements of Article 310 of the National Electric Code, latest edition, for current carrying capacity. Flexible cords and cables shall conform to Article 400, and fixture wires shall conform to Article 402. Wiring shall have wire markers at each end.
- B. Power and Control Conductors, 600 volts and Below:
  - 1. Solid copper wires shall be 600 volt Type XHHW-2, sizes #12 and #10 AWG for use with lighting and receptacle circuits only.
  - 2. Stranded copper wire for power circuits shall be 600 volt Type XHHW-2 or RHW-2, Class B stranding, sizes #12 AWG and larger.
  - 3. Stranded copper wire for control circuits shall be 600 volt Type XHHW-2 or RHW-2, Class B stranding, size #14 AWG.
  - 4. Control wires inside panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90°C at dry locations.
  - 5. Fixture wire shall be 600 volt, silicone rubber insulated, 200°C, UL Type SF 2, with stranded copper conductors.
  - 6. Cords shall be 600 volt, 2 conductor plus ground, Type SO, hard service, of adequate length and with grounding type plug attached, rated in amperes as shown on the Drawings.
  - 7. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.
  - 8. Conductors for branch circuits as defined in Article 100 of the NEC shall be sized to prevent voltage drop exceeding 3 percent at the farthest connected load or combinations of such loads and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.
- C. Tray Cable, 600 volts and Below:
  - 1. Multi-conductor tray cable shall be rated 600 volts, listed by UL as Type TC cable per Article 336 of the NEC. Each cable conductor shall be insulated with XHHW-2 type insulation rated at 600 volts. The individual conductors shall be twisted together and jacketed with a PVC outer covering containing

a UL label and necessary identification, including the manufacturer, the number of conductors, size, XHHW-2 insulation, sunlight-resistant and other pertinent information.

2. Conductor sizes shall be the same as for power and control as noted above.
3. Multi-conductor power cables include the following:

Phase Conductor Size (AWG)	Minimum Ground Wire Size (AWG)	No. of Conductors (not incl. Ground)
12	12	2 3
10	10	2 3
8	10	3
6	8	3
4	6	3
2	6	3
1/0	6	3
2/0	4	3
4/0	4	3

4. Multi-conductor control cables include the following:

Conductor Size (AWG)	No. of Conductors (Including 1#14 AWG Ground)
14	3
14	4
14	5
14	7
14	9
14	12
14	19
14	37

**D. VFD Power Cables**

1. VFD power cable shall be three (3) conductor, stranded copper, PVC jacketed, shielded type, tray cable (TC) rated 600 volts with three (3) symmetrical ground conductors. The individual conductors shall be UL listed as Type XHHW-2 or RWH-2 rated for 90°C at wet and dry locations, with XLPE insulation.
2. VFD Cables shall be as manufactured by Belden, Alpha, General Cable, or equal.

## 2.02 SPLICES AND TERMINATIONS OF CONDUCTORS

### A. Splices:

#### 1. Wire and Cable Splicing Materials and Applications:

- a. For Lighting Systems and Power Outlets: Wire nuts shall be twist-on type insulated connectors utilizing an outer insulating cover and a means for connecting and holding the conductors firmly. They shall be UL listed and suitable for connecting two to four solid copper conductors of #14 or #12 AWG size or two or three #10 AWG solid copper conductors.
- b. All Equipment: Crimp type connectors shall be insulated type with nylon jacket, suitable for the size and material of the wires and the number of wires to be spliced and for use with either solid or stranded conductors. They shall be UL listed.
- c. Division 16 Equipment and Power Conductors: Bolted pressure connectors shall be suitable for the size and material of the conductors to be spliced. They shall be UL listed and of the split bolt or bolted split sleeve type in which the bolt or set screw does not bear directly on the conductor.
- d. All Equipment: Epoxy splice kits shall include epoxy resin, hardener, and mold, and shall be suitable for use in wet locations and hazardous locations.

### B. Terminations:

#### 1. Low Voltage Terminations:

- a. Crimp type terminals shall be UL listed, self-insulating sleeve type, with ring or rectangular type tongue, suitable for the size and material of the wire to be terminated, and for use with either solid or stranded conductors.
- b. Terminal lugs shall be UL listed and of the split bolt or bolted split sleeve type in which the bolt or set screw does not bear directly on the conductor. Tongues shall have NEMA standard drilling.
- c. Crimp with manufacturer recommended ratchet-type tool with calibrated dies. Hand crimping tools are not acceptable.

C. Tape used for splices and terminations shall be compatible with the insulation and jacket of the cable and shall be of plastic material. Tape shall conform with UL 510. Varnished cambric, rubber and thermoplastic tape shall be used for all split-bolt terminations.

D. Wire markers shall be heat shrink type (Raychem; T&B; or equal). Wire identification numbers shall be permanently imprinted on the markers. In locations which are not practical for heat shrink type labels, such as conduit bodies and small pull boxes, machine-printed, adhesive backed wire markers shall be used. Markers shall be custom-printed with the full identification string. Individual character markers and clip-on wire markers are not acceptable.

## PART 3 - EXECUTION

### 3.01 CONDUCTOR INSTALLATION

A. The Contractor shall provide, terminate and test all power, control, and instrumentation conductors.

- B. The Contractor shall, as a minimum, provide the number of control wires listed in the conduit schedule or on the Contract Drawings. Excess wires shall be treated as spares for future use.
- C. Conductors shall not be pulled into any raceway until raceway has been cleared of moisture and debris.
- D. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps, and shall be neatly fanned out to terminals.
- E. Single conductor cable in cable trays shall be No. 1/0 or larger and shall be of a type listed and marked for use in cable trays. Tray cable smaller than 1/0 shall be multi-conductor, with outer jacket.
- F. Provide the following types and sizes of conductors for the uses indicated for 600 volts or less:
  1. Solid Copper, Sizes #12 and #10 AWG: As shown on the Drawings for circuits for receptacles, switches and light fixtures with screw-type terminals.
  2. Stranded Copper, Size #14 AWG and Larger, Individual Conductors or CC: As shown on the Drawings for the control of motors or other equipment. Size #14 shall not be used for power supplies to any equipment.
  3. Stranded Copper, Sizes #12 AWG and Larger: As shown on the Drawings for motors and other power circuits.
  4. Stranded Copper, #6 AWG and Larger.
  5. Fixture Wire: For connections to all fixtures in which the temperature may exceed the rating of branch circuit conductors.
- G. Color Coding: All wire shall be coded with specific colors infused in the conductor insulation at the time of manufacture. If a conductor is specified in a gauge not available with integrally colored insulation, it shall be marked by the Contractor at the time of installation using colored electrical coding tape or an approved marking paint. Where tape or paint is used as the conductor identification system, it shall clearly distinguish the conductor over its entire exposed length in all junction boxes, manholes, conduit bodies, or other accessible intermediate locations, and at every termination. Wiring shall conform to the following wiring color code, unless part of a proprietary cable assembly such as a manufacturer-specific cable which uses a special connector:

SYSTEM	CONDUCTOR	COLOR
120/240 volt AC, 1-Phase, 3 Wire	Neutral Line 1 Line 2	White Black Red
120/208 volt AC, 3-Phase, 4 Wire;	Neutral Phase A Phase B Phase C	White Black Red Blue
277/480 volt AC, 3-Phase 4 Wire	Neutral Phase A Phase B Phase C	Grey Brown Orange Yellow
All Systems	Earth, System, or Equipment Ground	Green Insulation, Green w/ Yellow Tracer, or Bare Conductor

SYSTEM	CONDUCTOR	COLOR
120 volt AC Control Power Circuits (In field or in Control Cabinets)	Neutral Line 1 Line 2	White Black Red
120 volt AC UPS-derived Control Power (secondary side)	Neutral Line	White w/ Red Tracer Red w/ White Tracer
24 volt AC Control Power Circuits (In field or in Cabinets)	Neutral  Line	White or Grey, w/ Yellow Tracer Brown
12 or 24 volt DC Control Wiring (PLC Discrete I/O, etc.)	DC Negative DC Positive DC Switched (DI/DO)	Yellow Orange Blue
120 volt AC Control Wiring inside or outside cabinets to/from PLC Discrete I/O	Common or Neutral  120 VAC discrete inputs 120 VAC relay or discrete outputs	White or Grey, w/ Blue Tracer Blue Red
Instrumentation Twisted-shielded Cabling (PLC Analog I/O @ 4-20mA, or 1-5 volt DC, etc.) Process Signals to/from Transmitters, Analyzers, etc.	Negative Polarity Positive Polarity (1st Conductor) Positive Polarity (2nd Conductor) Shield Drain Wire	Black White (or clear)  Red  Bare Conductor, or covered w/ heat-shrink tubing of a unique color
Instrumentation wiring in cabinets (PLC Analog I/O from field terminations of shielded cables).	PLC Analog Input Connections PLC Analog Output Connections	Grey  Brown

- H. Exercise care in pulling wires and cables into conduit or wireways so as to avoid kinking, putting undue stress on the cables or otherwise abrading them. No grease will be permitted in pulling cables. Only soapstone, talc, or UL listed pulling compound will be permitted. The raceway construction shall be complete and protected from the weather before cable is pulled into it. Swab conduits before installing cables and exercise care in pulling, to avoid damage to conductors.
- I. Wrap all cables in manholes with fireproofing tape. Extend tape 1 inch into ducts.
- J. Cable bending radius shall be per applicable code. Install feeder cables in one continuous length unless splices are favorably reviewed.
- K. Provide an equipment grounding conductor, whether or not it is shown on the Drawings, in any flexible conduit or any raceway in which all or any portion of a run consists of non-metallic duct or conduit. For flexible conduit, an external bonding jumper is an acceptable alternative.
- L. In panels, bundle incoming wire and cables, No. 6 AWG and smaller, lace at intervals not greater than 6 inches, neatly spread into trees and connect to their

respective terminals. Allow sufficient slack in cables for alterations in terminal connections. Perform lacing with plastic cable ties or linen lacing twine. Where plastic panel wiring duct is provided for cable runs, lacing is not necessary when the cable is properly installed in the duct.

- M. For cables crossing hinges, utilize extra flexible stranded wire, make up into groups not exceeding 12, and arrange so that they will be protected from chafing and excess flexing when the hinged member is moved.

### 3.02 CONDUCTOR SPLICES AND TERMINATIONS

- A. Splices: Install all conductors without splices unless necessary for installation, as determined by the Engineer. Splices, when permitted, and terminations shall be in accordance with the splice or termination kit manufacturer's instructions. Splice or terminate wire and cable as follows:
  - 1. Watertight Splices: Splices in concrete pull boxes, for any type of cable or wire, shall be watertight and rated for continuous submergence. Make splices in low voltage cables using epoxy resin splicing kits rated for application up to 600 volts.
- B. Terminations:
  - 1. Terminate stranded #14 wire using crimp type terminals where not terminated in a box lug type terminal. Terminals must be coordinated with type of terminal board where provided.
  - 2. Excess control wire shall be long enough to terminate at any terminal block in the enclosure, be properly taped, be identified with origin and be neatly coiled.

### 3.03 CONDUCTOR IDENTIFICATION

- A. Except for interior lighting and receptacle circuits, identify each wire or cable at each termination and in each pull box, junction box, handhole, and manhole using numbered and lettered wire markers. All electrically common conductors shall have the same number. Each electrically different conductor shall be uniquely numbered. Identify panelboard circuits using the panelboard identification and circuit number. Identify motor control circuits using the equipment identification number assigned to the control unit by the motor control center manufacturer and the motor control unit terminal number. Identify other circuits as shown in the circuit schedule or as favorably reviewed by the Engineer.
- B. Conductors between terminals of different numbers shall have both terminal numbers shown at each conductor end. The terminal number closest to the end of the wire shall be the same as the terminal number.

### 3.04 FIELD TESTS

- A. Refer to Section 16950 for all cable testing requirements.

END OF SECTION

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SECTION 16155  
MOTOR STARTERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Work Included: Provide all necessary labor, tools and material to install circuit protective devices as shown on the Drawings and as described in these Specifications.
- C. NEMA Enclosed Combination Starters, with Thermal Overload Relays. Starters may be of the full voltage non-reversing or full voltage reversing type.
- D. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.
- E. Related Work Described Elsewhere:
  - 1. Section 16955: Control Devices

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI) Publication:
  - 1. Z55.1 Gray Finishes for Industrial Apparatus and Equipment
- B. National Electrical Manufacturers Association (NEMA) Publications:
  - 1. ICS 1 Industrial Control & Systems, General Requirements
  - 2. ICS 2 Industrial Control and Systems Controllers
  - 3. ICS 6 Industrial Controls and Systems: Enclosures
  - 4. 250 Enclosures for Electrical Equipment (1,000 Volts Maximum)
- C. Federal Specification (FS):
  - 1. W-C-375 Circuit Breakers, Molded Case, Branch Circuit and Service
- D. Underwriters Laboratories (UL) Standard:
  - 1. 50 Enclosures for Electrical Cabinets
  - 2. 508 Industrial Control Equipment
  - 3. 508A Industrial Control Panels
- E. National Fire Protection Association (NFPA) Publication:
  - 1. 70 National Electrical Code

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with the Product Review category of the General Requirements and the submittal requirements of Section 16010.

1.04 LOCATIONS

- A. Refer to Section 16010 for definitions of types of locations.

## PART 2 - PRODUCTS

### 2.01 COMBINATION MOTOR CONTROL

- A. Each motor starter shall be NEMA rated and consist of a manually operated circuit protective device and a magnetically operated motor starter mounted in a common enclosure, complete with control power transformer and auxiliary devices for control of the circuit as indicated. Starters designed to IEC ratings or with dual IEC/NEMA ratings will not be accepted either as part of a Motor Control Center, as remote starters or as part of an equipment package.
- B. Contactor contacts shall be silver alloy, double break, and shall allow for inspection on NEMA Sizes 1 through 4 without the use of tools. Size 5 and larger shall allow for inspection utilizing standard tools. They shall be replaceable without removing the line, load, or control wiring from the starter, and replaceable without removing the starter from the enclosure.
- C. Contactor coils shall be the encapsulated type and shall be replaceable on NEMA Sizes 1 through 4 without the use of tools. Size 5 and larger shall be replaceable with standard tools. They shall be replaceable without removing the line, load, or control wiring from the starter, and replaceable without removing the starter from the enclosure.
- D. Overload relays shall be an ambient compensated bimetallic-type with interchangeable heaters. Electrically isolated normally open and normally closed contacts shall be provided on the relay. Visual trip indication shall be standard. A test trip feature shall be provided for ease of troubleshooting and shall be conveniently operable without removing components or the motor starter. Overload to have (+/-) 24% adjustability, single-phase sensitivity, isolated alarm contact, and manual or automatic reset.
- E. Operating handle of the circuit protective device shall physically indicate "on", "off" and "tripped" positions. Handle shall accept three padlocks with heavy duty, industrial type shackles. Cover shall be interlocked with the operating handle to prevent opening when in the "on" position. A method shall be provided for releasing the interlock for inspection purposes when the switch is "on."
- F. Motor circuit protectors shall have adjustable magnetic trips by a single dial with a moveable plug stop.
- G. Starters shall be NEMA rated and no smaller than Size 1. Each shall be equipped with an overload element in each phase and auxiliary contacts as indicated on the Drawings, with a minimum of two normally open and two normally closed auxiliary contacts.
- H. Each starter unit shall have its own control power transformer with a grounded secondary. Transformer shall have fused protection (2 primary and one secondary) sized to accommodate the control devices presented on the Contract Drawings, plus 100VA of spare capacity.
- I. Provide push buttons, selector switches, and indicating lights as shown on the Drawings and in compliance with Section 16955 with a lens color scheme identified in Section 16010.
- J. Enclosures shall suit the location per Section 16010.
- K. Nameplates: Provide an engraved plastic nameplate for each combination starter identifying the motorized equipment it controls.

- L. An externally operable manual "reset" button shall be provided. Automatic restart after overload shall not occur.
- M. Unless spare relays are indicated on the drawings, provide one spare control relay and one spare 0-60 second time delay relay, pre-installed on the control board in the starter.
- N. Provide Eaton Type A200 Series; Allen-Bradley Bulletin 513; or equal. If solid state electronic overload is specified, provide Eaton C440 or approved equal.

## 2.02 FULL VOLTAGE NON-REVERSING

- A. NEMA Size as shown on Contract Drawings consisting of contactor with coil voltage as shown on the Contract Drawings or 120 volts at 60 Hz where not shown, overload relay, disconnecting means and short circuit protection shall be provided by thermal magnetic circuit breaker OR magnetic only circuit breaker factory assembled in a NEMA type 1 OR 3R OR 12 OR 4/4X enclosure as shown on Contract Drawings.
- B. Disconnecting means shall be provided with an external operating handle mounted in the flange of the enclosure which has a means to lock the handle in the off position. Mechanism shall prevent enclosure door from opening when handle is in the on position.
- C. Short circuit current rating of the combination starter shall be rated in RMS amperes symmetrical as shown on the Contract Drawings, but in no case less than the values presented from the short circuit study provided under Section 16961.

## 2.03 MANUAL MOTOR STARTERS

- A. Manual motor starters shall be horsepower rated. Provide nameplates and ambient compensated thermal overload protection. Enclosures shall suit the location per Section 16010.
- B. For corrosive locations, provide Crouse-Hinds NFS, or equal. For all other locations, provide Eaton Type MS; Allen-Bradley Bulletin 600; Allen Bradley Bulletin 609; or equal.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install units plumb within 1/8-inch of vertical, and in accordance with manufacturer's instructions. Make sure that fuse ratings are as shown on the Drawings, and that breaker trip settings are per the Construction Manager's instructions.
- B. Contractor shall adjust motor circuit protector devices to the instantaneous trip setting position recommended for the actual horsepower and full load amps of the motor.
- C. Contractor shall verify that overload devices are proper for equipment installed.
- D. Contractor shall make the necessary changes in overload devices as required for any motors having power factor correction capacitors.
- E. Contractor shall touch up any scratches after the equipment has been installed.

3.02 GROUNDING

A. Grounding shall be installed as shown on the Contract Drawings.

3.03 FIELD TESTING

A. As specified in Section 16950.

END OF SECTION

## SECTION 16950

### ELECTRICAL TESTS

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. This Section specifies the work necessary to test, commission, and demonstrate that the electrical system satisfies the requirements of these Specifications and functions as required by the Contract Documents. The work of this Section is applicable to both pre and post energization testing required by the Manufacturer to facilitate sign-off on their respective equipment as well as pre and post energization testing performed by an independent third party entity independent of manufacturers, suppliers and installers of electrical equipment, installations and systems.
- B. The Work shall include furnishing the labor, equipment, and power required to support the testing indicated in other Divisions of these Specifications. Electrical testing indicated herein and functional testing of power and controls not tested under Division 17 – Instrumentation, shall be completed before commencement of the Initial Operation Period as defined in Section 01650, for each phase of construction as indicated on the Drawings. This scope may require the Contractor to activate circuits, shutdown circuits, run equipment, make electrical measurements, replace blown fuses, and install temporary jumpers, etc.
- C. Carry out tests indicated herein for individual items of materials and equipment in other Sections. Testing shall be done in accordance with the manufacturer's instructions, these Specifications, and applicable NETA Acceptance Testing Specifications, NEMA, ANSI, NFPA, and ASTM Standards.
- D. Factory Acceptance Testing and other off-site test requirements are included in other Sections.
- E. Corrections and Replacements
  1. Before final acceptance, each part of the work shall be thoroughly tested, and each test shall be documented and submitted in accordance with the Contract Documents.
  2. Any materials or equipment failing any test shall be corrected or replaced as required to pass the test at no additional cost to the Owner.
  3. Any materials or equipment failing any test shall be re-tested after correction or replacement to verify compliance.
  4. Any failures shall again be corrected or replaced, and then re-tested.
  5. The correction/replacement/re-testing cycle shall continue until the item passes the required test(s).

##### 1.02 REFERENCE STANDARDS

- A. Electric equipment, materials, installation, and testing shall comply with the National Electrical Code (NEC), and shall also conform to the following codes and standards:
  1. American National Standards Institute (ANSI)
  2. InterNational Electrical Testing Association (NETA)
  3. Institute of Electrical and Electronics Engineers (IEEE)
  4. Occupational Health and Safety Administration (OSHA)

5. ASTM International Standard E329
6. IEEE 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems
7. IEEE 576, Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications
8. National Fire Protection Association (NFPA) 70B, NEC for Maintenance
9. Telecommunications Industry Association (TIA) 568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

### 1.03 SUBMITTALS

- A. Submit complete system test procedures and test record forms for review. Test procedures shall include but not be limited to:
  1. Detailed procedures, both pre and post energization testing requirements of the Manufacturer and independent third-party entity, in sufficient detail to verify conformance with these Specifications.
  2. Incorporation of data collection and measurement values as shown in the sample test record forms provided at the end of this Section. Submitted test record forms shall include space for each of the fields listed, at a minimum.
  3. Detailed comprehensive testing schedule including:
    - a. Electrical testing of each major area.
    - b. Each major piece of electrical distribution equipment.
    - c. Each major electrical subsystem.
    - d. Duration of each test.
    - e. Milestone test completion date.
    - f. Date of test results submittals following completion of the tests.
    - g. Names and qualifications of the individual(s) responsible for performing the testing, including a copy of current NETA Technician cards.
    - h. Proof of NETA accreditation for the testing agency.
- B. Following completion of the test submit the completed test results to the Engineer for review. The results shall include a dedicated section with the "as-left" settings of all devices, relays, circuit breakers, etc.
- C. Test results shall be submitted in one submittal.
- D. Test reports shall be based on NETA's latest Acceptance Testing Specifications having a sign-off, pass/fail data filed for each line item covered by NETA's Acceptance Testing Specifications latest edition.

### 1.04 QUALITY ASSURANCE

- A. Testing Firm Qualifications:
  1. Corporately and financially independent organization functioning as an unbiased testing authority.
  2. Professionally independent of manufacturers, suppliers, and installers of electrical equipment and systems being tested.
  3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
  4. Supervising engineer accredited as Certified Electrical Test Technologist by NICET or NETA and having a minimum of 5 years testing experience on similar projects.
  5. Technicians certified by NICET or NETA.

6. Registered Professional Engineer to provide comprehensive project report outlining services performed, results of such services, recommendations, actions taken, and opinions.
  7. In compliance with OSHA CFR 29, Part 1910.7 criteria for accreditation of testing laboratories or a full member company of NETA.
- B. Test equipment shall have an operating accuracy equal to or greater than requirements established by NETA ATS.
- C. Test instrument calibration shall be in accordance with NETA ATS.

#### 1.05 FIELD TESTS

- A. All testing shall be performed in the presence of the Owner.
- B. Any system material or workmanship that is found to be defective on the basis of acceptance tests shall be reported directly to the Owner.

### PART 2 - PRODUCTS

#### 2.01 PRE-ENERGIZATION AND OPERATING TESTS

- A. The complete electrical system for each phase of construction shall be performance tested when first installed on-site. Each protective, switching, and control circuit shall be adjusted in accordance with the recommendations of the Protective Device Coordination Study required by Section 16961 and tested by actual operation using current injection or equivalent methods as necessary to ensure that each and every such circuit operates correctly to the satisfaction of the Owner.
  1. Instrument Transformers. All instrument transformers shall be tested to verify correct polarity and burden.
  2. Protective Relays. Each protective relay shall be demonstrated to operate by injecting current or voltage, or both, at the associated instrument transformer output terminal and observing that the associated switching and signaling functions occur correctly and in proper time and sequence to accomplish the protective function intended.
  3. Switching Circuits. Each switching circuit shall be observed to operate the associated equipment being switched.
  4. Control and Signal Circuits. Each control or signal circuit shall be observed to perform its proper control function or produce a correct signal output.
  5. Metering Circuits. All metering circuits shall be verified to operate correctly from voltage and current sources, similarly to protective relay circuits.
  6. Acceptance Tests. Complete acceptance tests shall be performed, after the station installation is completed, on all assemblies, equipment, conductors, and control and protective systems, as applicable, to verify the integrity of all the systems.
  7. Relays and Metering Utilizing Phase Differences. All relays and metering that use phase differences for operation shall be verified by measuring phase angles at the relay under actual load conditions after operation commences.
- B. Test Report. A test report covering the results of the tests required in the Pre-Energization and Operating Tests shall be delivered to the Engineer prior to energization. Acceptance Testing shall be in accordance with NETA ATS-latest edition, *Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems*, published by the InterNational Electrical Testing

Association. Tests shall be provided by both the manufacturer representative and independent third-party NETA accredited testing agency where required.

## 2.02 FIELD TESTS BY MANUFACTURER'S OR SUPPLIERS

A. All field tests shall be performed by the Manufacturers or Suppliers.

## 2.03 TEST REQUIREMENTS

A. The following test requirements supplement test and acceptance criteria that may be stated elsewhere.

1. Lighting: Switching. Circuitry is in accordance with panel schedules. All interior and exterior lighting shall be checked for proper operation.
2. Activate ground fault tripping by operating test features provided with ground current protective systems and by injecting a known and reasonable current in the ground current sensor circuit. In general, ground fault tripping should occur at a ground current equivalent to 20 percent of phase current. Current injection is not required of circuit 400 amperes or less.

B. Low Voltage Cables-600 volts Maximum:

1. Visual and Mechanical Inspection:
  - a. Compare cable data with Drawings and Specifications.
  - b. Inspect exposed sections of cables for physical damage and correct connection in accordance with single-line diagram.
  - c. Inspect bolted electrical connections for high resistance using one of the following methods:
    - 1) Use of low-resistance ohmmeter
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
    - 3) Perform thermographic survey in accordance with paragraph 2.03L.
  - d. Inspect compression-applied connectors for correct cable match and indentation.
  - e. Inspect for correct identification and arrangements.
  - f. Inspect cable jacket insulation and condition.
2. Electrical Tests:
  - a. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Test duration shall be 1 minute.
    - 1) Motor feeders tested with motors disconnected and controller open.
    - 2) Motor control circuits tested and verified for proper operation with control stations and overcurrent devices connected.
    - 3) Panelboard feeders tested with feeder breaker open and panelboard connected. If a lighting transformer is associated with the panelboard, it shall be connected and the test made for both primary and secondary sides.
    - 4) Conductors of main lighting feeders, including lighting panel with branch circuits open.
    - 5) Prior to performing insulation resistance tests on cables, verify that they are not connected to a solid state device.

- 6) Equipment which may be damaged during this test shall be disconnected.
- 7) The Engineer shall be consulted if minimum insulation values cannot be obtained.
- b. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
- c. Perform continuity test to ensure correct cable connection.
- d. Perform the following industry-standard operational and performance tests on each Category 6 Ethernet cable as detailed in ANSI/EIA-568-C:
  - 1) Wire map (pass/fail)
  - 2) Propagation delay (pass/fail)
  - 3) Delay skew (pass/fail)
  - 4) Cable length
  - 5) Insertion loss (attenuation)
  - 6) Return loss (pass/fail)
  - 7) Near-end crosstalk (NEXT) (pass/fail)
  - 8) Power sum near-end crosstalk (PSNEXT) (pass/fail)
  - 9) Equal level far-end crosstalk (ELFEXT)
  - 10) Power sum equal level far-end crosstalk (PSELFEXT).
- 3. Test Values - Visual and Mechanical:
  - a. Compare bolted connection resistance to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - b. Bolt-torque levels shall be in accordance with NETA ATS Table 100.12 unless otherwise specified by the manufacturer.
  - c. Results of the thermographic survey shall be in accordance with paragraph 2.03L.
- 4. Test Values – Electrical:
  - a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - b. Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations shall be investigated.
  - c. Cable shall exhibit continuity.
  - d. Deviations in resistance between parallel conductors shall be investigated.
  - e. Compare Category 6 Ethernet test values against TIA 568-C for determination of pass/fail status.
- C. Low Voltage Safety Switches:
  - 1. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with drawings and specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, grounding, and required clearances.
    - d. Verify the unit is clean.
    - e. Verify correct blade alignment, blade penetration, travel stops, and mechanical operation.
    - f. Verify that fuse sizes and types are in accordance with drawings, short-circuit studies, and coordination study.
    - g. Verify that each fuse has adequate mechanical support and contact integrity.

- h. Inspect bolted electrical connections for high resistance using one or more of the following methods:
    - 1) Use of a low-resistance ohmmeter.
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12
    - 3) Perform thermographic survey in accordance with paragraph 2.03L.
  - i. Verify operation and sequencing of interlocking systems.
  - j. Verify correct phase barrier installation.
  - k. Verify correct operation of all indicating and control devices.
  - l. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
2. Electrical Tests:
- a. Perform resistance measurements through bolted electrical connections with a low-resistance ohmmeter, if applicable.
  - b. Measure contact resistance across each switchblade and fuse holder.
  - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1
  - d. Measure fuse resistance.
3. Test Values – Visual and Mechanical:
- a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - b. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - c. Results of the thermographic survey shall be in accordance with paragraph 2.03L.
4. Test Values – Electrical:
- a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - b. Microohm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's published data is not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - c. Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated. Dielectric withstand voltage tests shall not proceed until insulation-resistance levels are raised above minimum values.
  - d. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

**D. Molded and Insulated Case Circuit Breakers:**

- 1. Visual and Mechanical Inspection:
  - a. Compare equipment nameplate data with drawings and specifications.

- b. Inspect physical and mechanical condition.
  - c. Inspect anchorage and alignment.
  - d. Verify the unit is clean.
  - e. Operate the circuit breaker to insure smooth operation.
  - f. Inspect bolted electrical connections for high resistance using one or more of the following methods:
    - 1) Use of a low-resistance ohmmeter.
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12
    - 3) Perform thermographic survey in accordance with paragraph 2.03L.
  - g. Inspect operating mechanism, contacts, and arc chutes in unsealed units.
  - h. Perform adjustments for final protective device settings in accordance with the coordination study.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
  - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to ground with the circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1.
  - c. Perform a contact/pole-resistance test.
  - d. Determine long-time pickup and delay by primary current injection.
  - e. Determine short-time pickup and delay by primary current injection.
  - f. Determine ground-fault pickup and time delay by primary current injection.
  - g. Determine instantaneous pickup by primary current injection.
  - h. Test functions of the trip unit by means of secondary injection.
  - i. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data.
  - j. Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti-pump function, and trip unit battery condition. Reset all trip logs and indicators
  - k. Verify operation of charging mechanism.
3. Test Values – Visual and Mechanical:
- a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - b. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - c. Results of the thermographic survey shall be in accordance with paragraph 2.03L.
  - d. Settings shall comply with coordination study recommendations.
4. Test Values – Electrical:
- a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

- b. Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated.
  - c. Microohm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's published data is not available, investigate values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.
  - d. Insulation-resistance values of control wiring shall not be less than two megohms.
  - e. Long-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors. If manufacturer's curves are not available, trip times shall not exceed the value shown in NETA ATS Table 100.7.
  - f. Short-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.
  - g. Ground fault pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.
  - h. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances. In the absence of manufacturer's published data, refer to NETA ATS Table 100.8.
  - i. Pickup values and trip characteristics shall be within manufacturer's published tolerances.
  - j. Minimum pickup voltage of the shunt trip and close coils shall conform to the manufacturer's published data. In the absence of the manufacturer's published data, refer to NETA ATS Table 100.20.
  - k. Breaker open, close, trip, trip-free, anti-pump, and auxiliary features shall function as designed.
  - l. The charging mechanism shall operate in accordance with manufacturer's published data.
- E. Low Voltage Motor Starters:
- 1. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with drawings and specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, and grounding.
    - d. Verify the unit is clean.
    - e. Inspect contactors.
      - 1) Verify mechanical operation.
      - 2) Verify contact gap, wipe, alignment, and pressure are in accordance with manufacturer's published data.
    - f. Inspect bolted electrical connections for high resistance using one or more of the following methods:
      - 1) Use of a low-resistance ohmmeter.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12
      - 3) Perform thermographic survey in accordance with paragraph 2.03L.

- g. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
2. Electrical Tests:
    - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
    - b. Perform insulation-resistance tests on each pole, phase-to-phase and phase-to-ground with starter closed, and across each open pole for one minute. Test voltage shall be in accordance with manufacturer's published data or NETA ATS Table 100.5.
    - c. Perform insulation-resistance tests on all control wiring with respect to ground. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute. For units with solid-state components, follow manufacturer's recommendation.
    - d. Test motor protection devices in accordance with manufacturer's published data.
    - e. Test circuit breakers in accordance with paragraph 2.03D.
    - f. Perform operational tests by initiating control devices.
  3. Test Values – Visual and Mechanical:
    - a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    - b. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
    - c. Results of the thermographic survey shall be in accordance with paragraph 2.03L.
  4. Test Values – Electrical:
    - a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    - b. Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.5. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated.
    - c. Insulation-resistance values of control wiring shall not be less than two megohms.
    - d. Motor protection parameters shall be in accordance with manufacturer's published data.
    - e. Circuit breaker test results shall be in accordance with paragraph 2.03D.
    - f. Control devices shall perform in accordance with system design requirements.
- F. Uninterruptible Power Supplies:
1. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with drawings and specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, and grounding.
    - d. Verify the unit is clean.
    - e. Test all electrical and mechanical interlock systems for correct operation and sequencing.

- f. Inspect bolted electrical connections for high resistance using one or more of the following methods:
  - 1) Use of a low-resistance ohmmeter.
  - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
  - 3) Perform thermographic survey in accordance with paragraph 2.03L.
- g. Verify operation of forced ventilation.
- h. Verify that filters are in place and vents are clear.
- 2. Electrical Tests:
  - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
  - b. Test static transfer from inverter to bypass and back. Use normal load, if possible.
  - c. Set free running frequency of oscillator.
  - d. Test dc undervoltage trip level on inverter input breaker. Set according to manufacturer's published data.
  - e. Test alarm circuits.
  - f. Verify synchronizing indicators for static switch and bypass switches.
  - g. Perform electrical tests for UPS system breakers in accordance with paragraph 2.03D.
- 3. Test Values – Visual and Mechanical:
  - a. Electrical and mechanical interlock systems shall operate in accordance with system design requirements.
  - b. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - c. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - d. Results of the thermographic survey shall be in accordance with paragraph 2.03L.
- 4. Test Values – Electrical:
  - a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - b. Static transfer shall function in accordance with manufacturer's published data.
  - c. Oscillator free running frequency shall be within manufacturer's published tolerances.
  - d. DC undervoltage shall trip inverter input breaker.
  - e. Alarm circuits shall operate in accordance with design requirements.
  - f. Synchronizing indicators shall operate in accordance with design requirements.
  - g. Breaker performance shall be in accordance with paragraph 2.03D.
- G. Test ground fault interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle manufacturer.
- H. A functional test and check of electrical components is required prior to performing subsystem testing and commissioning. Compartments and equipment shall be

cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:

1. Visual and physical check of cables, circuit breakers, transformers, and connections associated with each item of new and modified equipment.
  2. Verification that electrical equipment has been labeled with Arc Flash protection boundary and PPE levels, as required by Section 16961.
  3. Setting of protective relays in conformance with results of the Short Circuit Study required by Section 16961 and testing of relays to assure that relays will trip at the current value and time required by the Study.
  4. Circuit Breakers:
    - a. Circuit breakers that have adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field-adjusted by a representative of the circuit breaker manufacturer.
    - b. Time and pickup setting shall correspond to the recommendations of the Short Circuit Study.
    - c. Setting shall be tabulated and proven for each circuit breaker in its installed position.
    - d. Test results shall be certified by the person performing the tests and shall be submitted to the Engineer.
- I. Subsystem testing for each phase of construction shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the Owner and after process control devices have been adjusted as accurately as possible. Alarm conditions shall be simulated for each alarm point, and alarm indicators shall be checked for proper operation. It is intended that the Contractor will adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.
- J. Subsystems shall be defined as individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, etc.
- K. After initial settings have been completed, each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract Documents. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, proper speed control, etc.
- L. Thermographic Survey:
  1. Visual and Mechanical Inspection:
    - a. Inspect physical, electrical, and mechanical condition.
    - b. Remove all necessary covers prior to thermographic inspection. Utilize appropriate caution, safety devices, and personal protective equipment.
  2. Equipment to be inspected shall include all 120-volt and higher current-carrying devices including all switchgear, switchboards, distribution panels, cable and bus connections, motor control centers and starters, disconnect switches, and other critical equipment. Testing of lighting luminaires, field instrumentation, SCADA and PLCs are not required.
  3. Provide report including the following:
    - a. Description of equipment to be tested.
    - b. Discrepancies.

- c. Temperature difference between the area of concern and the reference area.
  - d. Probable cause of temperature difference.
  - e. Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.
  - f. Identify load conditions at time of inspection.
  - g. Provide photographs and/or thermograms of the deficient area.
  - h. Recommended action.
4. Test Parameters:
- a. Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.
  - b. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
  - c. Thermographic surveys shall be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to NFPA 70B, Section 11-17 (Infrared Inspection).
5. Test Values:
- a. Suggested actions based on temperature rise can be found in Table 100.18 as shown below. The Contractor shall investigate and make repairs as recommended in Table 100.18.
6. Re-Inspection:
- a. All items that are reported deficient in the thermography reports section of the inspection report shall be re-inspected after repairs have been made.
  - b. Original specification will apply to re-inspections.
  - c. Submit re-inspection reports and indicate that repairs have fixed the anomaly or indicate any remaining anomalies.
- M. Voltage Field Test:
- 1. Check and record voltage at point of termination of Local Power Utility supply system after the installation is essentially complete and has been made operational.
  - 2. Check and record voltage amplitude and balance between phases for loaded and unloaded conditions.
  - 3. Unbalance Corrections:
    - a. Notify the Owner if balance (as defined by NEMA) exceeds 1%, or if voltage varies throughout the day and from loaded to unloaded condition more than plus or minus 4% of nominal.
  - 4. Voltage Balance Report:
    - a. Submit Voltage Balance Report for each switchboard, distribution panelboard, load center, motor control center, and transformer.
- N. Equipment Line Current Tests:
- 1. Check and record line current in each phase for each major piece of electrically-operated equipment.
  - 2. Make a line current check after Local Power Utility has made final adjustments to supply voltage magnitude or balance.
  - 3. If any phase current for any piece of equipment is above rated nameplate current, prepare a supplement to the Equipment Line Current Report that identifies any causes of problems and corrective action that was taken.

4. Submit Equipment Line Current Report for each point of connection to motors, transformers, branch circuit distribution connections, and incoming utility service connection.

**2.04 TEST REPORTS**

- A. The test report shall include the following:
  1. Summary of project.
  2. Description of equipment tested.
  3. Description of test.
  4. Test data.
  5. Analysis and recommendations.
  
- B. Test data records shall include the following minimum requirements:
  1. Identification of the testing organization.
  2. Equipment identification.
  3. Humidity, temperature, and other atmospheric conditions that may affect the results of the tests/calibrations.
  4. Date of inspections, tests, maintenance, and/or calibrations.
  5. Identification of the testing technician.
  6. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.
  7. Indication of expected results when calibrations are to be performed.
  8. Indication of "as-found" and "as-left" results.
  9. Sufficient spaces to allow all results and comments to be indicated.
  
- C. The Contractor shall submit the complete report to the Engineer for review.

**TABLE 100.18**

**THERMOGRAPHIC SURVEY  
SUGGESTED ACTIONS BASED ON TEMPERATURE RISE  
(AS PER PARAGRAPH 2.03L)**

<b>Temperature difference (<math>\Delta T</math>) based on comparisons between similar components under similar loading.</b>	<b>Temperature difference (<math>\Delta T</math>) based upon comparisons between component and ambient air temperatures.</b>	<b>Recommended Action</b>
1°C - 3°C	1°C - 10°C	Possible deficiency; warrants investigation
4°C - 15°C	11°C - 20°C	Indicates probable deficiency; repair as time permits
- - - - -	21°C - 40°C	Monitor until corrective measures can be accomplished
>15°C	>40°C	Major discrepancy; repair immediately

**Table 100.18 Notes**

1. Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on

- $\Delta T$ . In the absence of consensus standards for  $\Delta T$ , the values in this table will provide reasonable guidelines.
2. An alternative method of evaluation is the standards-based temperature rating system as discussed in Chapter 8.9.2, Conducting an IR Thermographic Inspection, Electrical Power Systems Maintenance and Testing, by Paul Gill, PE, 1998.
  3. It is a necessary and valid requirement that the person performing the electrical inspection be thoroughly trained and experienced concerning the apparatus and systems being evaluated, as well as knowledgeable of thermographic methodology.

## **PART 3 - EXECUTION**

### **3.01 FIELD TESTS**

- A. The Contractor shall provide 10 working days' notice to the Owner prior to any field testing to permit witnessing of the testing.

## TEST RECORD SHEETS

The test record sheets listed below are provided as an example to demonstrate the minimum requirements to be included on test record sheets for electrical equipment and of the electrical installation as required by these specifications. Sample copies of each sheet are attached.

Sheet No.	Title
1	Insulation Resistance (Power, Control Wire, and Cable) Test Record
2	Insulation Resistance (Instrument Wire and Cable) Test Record
3	Insulation Resistance (Equipment) Test Record
4	Insulation Resistance (Rotating Equipment) Test Record
5	Electric Motor Run-In Test Record
6	Thermographic Inspection Test Record
7	Category 6 Ethernet Cable Assembly Test Record





**INSULATION RESISTANCE (EQUIPMENT)  
TEST RECORD**

TEST EQUIPMENT: \_\_\_\_\_ SUBSTATION: \_\_\_\_\_

AMBIENT TEMPERATURE: \_\_\_\_\_ °C \_\_\_\_\_ °F DATE: \_\_\_\_\_

REFERENCE DRAWING: \_\_\_\_\_ REF. SEC.: \_\_\_\_\_

- NOTES: 1. Use 1,000-V test set for equipment rated 600 volts and below, 2,500/5,000-V test set for equipment rated over 600 volts.
2. For equipment with solid state control circuits, consult manufacturer's literature for maximum test voltages.

Switchgear or MCC  (or other)	INSULATION RESISTANCE (megohms) *						Test Voltage  (kV)	Rated Voltage  (kV)	Initials/Date
	ØA to G	ØB to G	ØC to G	ØA to ØB	ØB to ØC	ØC to ØA			

\*Minimum acceptable values:

EQUIPMENT VOLTAGE CLASS

RESISTANCE (megohms)

TESTER'S INITIALS/DATE \_\_\_\_\_

-----  
DISTRIBUTION:

CONTRACTOR/Date \_\_\_\_\_

**INSULATION RESISTANCE (ROTATING EQUIPMENT)  
TEST RECORD**

TEST EQUIPMENT: \_\_\_\_\_ TEST VOLTAGE: \_\_\_\_\_

AMBIENT TEMPERATURE: \_\_\_\_\_ °C \_\_\_\_\_ °F DATE: \_\_\_\_\_

EQUIP. TEMP., IF KNOWN: \_\_\_\_\_ °C \_\_\_\_\_ °F HOW KNOWN: \_\_\_\_\_

- NOTES: 1. Use 1,000-V test set for equipment 600-volt and below, 2,500/5,000-V test set for equipment rated over 600 volts.
2. Test duration shall be 1 minute, note if otherwise: \_\_\_\_\_.
3. Isolate all motor leads from one another and from frame, test phase separately, wherever practical.
4. Document testing of low voltage and medium voltage equipment on separate sheets.
5. Readings will vary inversely with temperature. When the use of temperature correction factors is specified, attach second sheet with computed values. Indicate on each sheet "measured" or "temperature corrected."

Equip. Tag No.	INSULATION RESISTANCE (megohms) *						Rated Voltage	Equipment Initial/Date
	ØA to G	ØB to G	ØC to G	ØA to ØB	ØB to ØC	ØC to ØA		

\*Minimum acceptable values:

VOLTAGE CLASS

RESISTANCE (megohms)

-----  
DISTRIBUTION:

CONTRACTOR/Date \_\_\_\_\_

**ELECTRIC MOTOR RUN-IN  
TEST RECORD**

TEST EQUIPMENT: \_\_\_\_\_ REFERENCE DRAWING: \_\_\_\_\_

NOTES: 1. Duration of tests to comply with specifications.

TEST	REMARKS	INITIALS/DATE
<b>RESISTANCE:</b> Bonding resistance measured from motor frame to main ground/earth system tap. _____ ohms		
<b>VOLTAGE:</b> Actual voltage measured at Motor Control Center. _____ volts		
<b>ROTATION CHECK:</b> Bump motor to verify rotation. Motor to be uncoupled.		
<b>NO LOAD CURRENT:</b> At beginning of test _____ amps At end of test _____ amps		
<b>TEMPERATURE OF BEARING:</b> Check bearing for high temperature: Before start: 15 minutes after start 30 minutes after start 1 hour after start 2 hours after start 3 hours after start		
<b>VIBRATION:</b> Make visual inspection during run-test. Record any unusual vibration in remarks column.		
<b>NOISE:</b> Record any unusual noise in remarks column.		

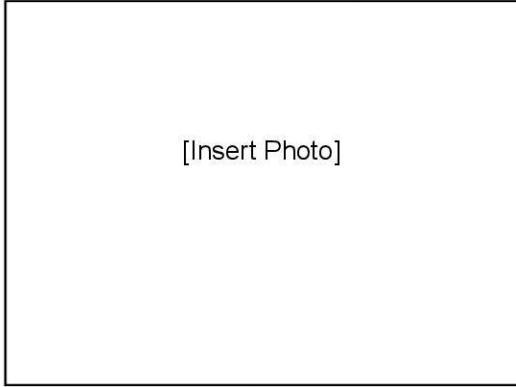
-----  
 DISTRIBUTION:

CONTRACTOR/Date \_\_\_\_\_

**THERMOGRAPHIC INSPECTION TEST RECORD**

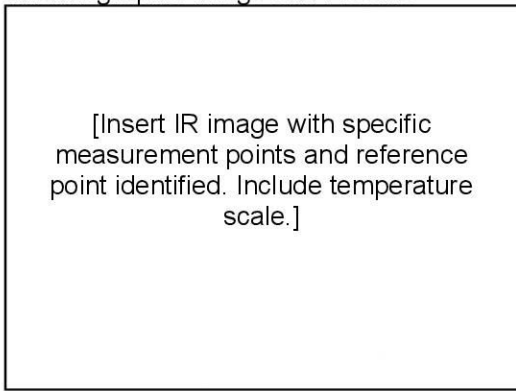
TEST EQUIPMENT: \_\_\_\_\_ CALIBRATION DATE: \_\_\_\_\_  
 AMBIENT TEMPERATURE: \_\_\_\_\_ °C \_\_\_\_\_ °F DATE: \_\_\_\_\_

Photo and Identification



Location	
Equipment ID	
Mfr/Model	
Connected Load	
Actual Load	
Fault (if applicable)	
Recommendation	
Load Factor	

Thermographic Image and Results



Max Temp Point ID: _____	_____ deg C
Ref Temp Point ID: _____	_____ deg C
Ref Temp Point ID: _____	_____ deg C
Ref Temp Point ID: _____	_____ deg C
Temperature Difference	_____ deg C
Load-Corrected Temp Rise	_____ deg C

	Current Rating	Measured Current	Measured Voltage	Voltage Drop Across Connection
Phase A				
Phase B				
Phase C				

Analysis and Recommended Action:

DISTRIBUTION:

CONTRACTOR/Date \_\_\_\_\_

**CATEGORY 6 ETHERNET CABLE ASSEMBLY  
TEST RECORD**

Date/Time: \_\_\_\_\_ Operator: \_\_\_\_\_

Cable Type: \_\_\_\_\_ Test Equipment Model: \_\_\_\_\_

Cable ID: \_\_\_\_\_ Test Equipment Calibration Date: \_\_\_\_\_

<b>Cable Length (ft):</b>																										
Propagation Delay (ns):	[Worst Pair]	Pass/Fail																								
Delay Skew (ns):	[Worst Pair]	Pass/Fail																								
Insertion Loss (dB): Frequency (MHz):	[Worst Pair]	Pass/Fail																								
Return Loss (dB): Frequency (MHz):	[Worst Pair]	Pass/Fail																								
Wire Map	<table border="0"> <tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr> </table>	1	2	3	4	5	6	7	8									1	2	3	4	5	6	7	8	Pass/Fail
1	2	3	4	5	6	7	8																			
1	2	3	4	5	6	7	8																			
Worst Pair NEXT (dB): Frequency (MHz):	[Worst Case Margin] [Worst Case Value]	Pass/Fail																								
Worst Pair PSNEXT (dB): Frequency (MHz):	[Worst Case Margin] [Worst Case Value]	Pass/Fail																								
Worst Pair ELFEXT (dB): Frequency (MHz):	[Worst Case Margin] [Worst Case Value]	Pass/Fail																								
Worst Pair PSELFEXT (dB): Frequency (MHz):	[Worst Case Margin] [Worst Case Value]	Pass/Fail																								

END OF SECTION

## SECTION 16955

### CONTROL DEVICES

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Work Included: Furnish and install all control devices complete, including, as applicable, enclosures, engraved escutcheons or nameplates, gaskets, lenses, lamps, and mounting provisions.

##### 1.02 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association (NEMA) Publications:
  - 1. ICS1 General Standards for Industrial Controls and Systems
  - 2. ICS2 Standards for Industrial Control Devices, Controllers and Assemblies
  - 3. ICS6 Enclosures for Industrial Controls and Systems

##### 1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.

#### PART 2 - PRODUCTS

##### 2.01 GENERAL

- A. All control devices shall conform to applicable provisions of NEMA Standards ICS1 and ICS2.

##### 2.02 CONTROL AND TIMER RELAYS

- A. General: Relays shall be provided as necessary to perform switching functions required of control panels and other control circuits. Relays shall be of the following types (abbreviations in parentheses correspond to labels on the Drawings):
  - 1. Size 0 Magnetic Contactors (MS): Provide Size 0 magnetic contactors for driving Size 4 and Size 5 ac operated motor starters. Provide Size 0 contactors of the same type and manufacture as the motor starter contactors.
  - 2. Relays (CR):
    - a. Provide machine tool relays for the following applications:
      - 1) All relays driving 120 Vac motor starters up to and including Size 3.
      - 2) All relays driving non-motor loads up to 6 amps (or 720 VA).
    - b. Provide machine tool type relays with convertible contacts rated 10 amperes continuous with NEMA Rating Designation A600 for ac applications and N600 for dc applications. Coils shall be designed for continuous duty and shall have the voltage rating indicated on the Drawings.

- c. Relays shall be the magnetically held type unless designated otherwise on the Drawings. For each relay provide one spare Form C contact over and above the number indicated on the Drawings. In addition, for latching relays, provide coil clearing contacts as necessary.
  - d. Manufacturer: Square D, Class 8501, Type X; General Electric CR120B; or equal.
3. General Purpose Control (GR) or (AR) Relays (plug-in):
- a. Provide plug-in style 2-, 3-, or 4-pole enclosed relays with integral neon or LED indicators for the following applications:
    - 1) Relay logic (relays driving other relays, including machine tool relays) operating at voltages up to 120 Vac.
    - 2) Control power switching.
    - 3) All relays driving non-motor loads up to 2 amps (240 VA) at 120 Vac.
  - b. Provide relay sockets rated for 10 amp, 240 Vac with screw-type barriered terminals.
  - c. Manufacturer: Square D, Class 8501, Type R; Allen-Bradley Bulletin 700; or equal.
4. Analog or Digital Signal Switching (SR) Relays: Provide plug-in style indicating type relays with gold plated silver contacts for switching low level currents (less than 100 mA). Provide relay sockets screw-type barriered terminals.
5. Latching Relays (LR):
- a. Latching relay shall be 600 volt machine tool industrial relays, magnetically held, two-coil type. Relay shall have convertible contacts rated 10 amperes with NEMA rating design A600. Latching relay shall be Square D Class 8501; General Electric CR170BL; or equal.
6. Timing Relays (TR) and (TD):
- a. General: Relays designated TR shall be machine tool industrial relays, while those designated as TD shall be general purpose plug-in time delay relays.
  - b. Timing Relay (TR): Timing relay shall be machine tool industrial relay with solid-state timer and external adjustment dial. Range shall be 0 to 120 seconds unless indicated otherwise on the Drawings. Relay shall include an LED indicator and instantaneous and time-delay contacts rated at 10 amps, meeting NEMA A600 designation. Timing relay shall be "on delay" or "off delay" as indicated on the Drawings and shall be Allen Bradley Type RT-RTA; Square D; or equal.
  - c. Time Delay Relays (TD): Relay shall be solid-state with multi-range programmable settings. The relays shall include a calibrated front dial and LED indicator and shall be complete with socket. Relays shall be "on delay" or "off delay" type as indicated on the Drawings. Provide an additional Form C contacts over and above the number indicated on the Drawings. Relay contacts shall be rated 10 amp, 120 Vac. Relays shall be ATC Type 328; Idec Type RTEL; or equal.
7. General Requirements:
- a. Provide relays rated for 1 million operations at 10 amp, 120 Vac, at power factor of 0.2.
  - b. Where timing relays are interfaced to motor starters or adjustable speed motor controllers, provide auxiliary machine-tool relays or Size 0 magnetic contactors. Refer to previous specifications for machine-tool relays and Size 0 magnetic contactors.

- c. Where timing relays or control relays require additional contacts, provide auxiliary control relays, properly sized for the application as described previously in this Section.

## 2.03 ZERO-CROSSING RELAYS

- A. General:
  1. Provide solid state output zero-crossing relays where indicated on the elementary diagrams. Provide zero-crossing relays which actuate for any input control voltage between 10 and 120 Vac. Provide inverse-parallel dual SCR output rated for 10 amps at 120 Vac, suitable for low power factor inductive loads. Provide integral snubber circuit for SCR output to limit dv/dt to protect the triac from damage by highly inductive loads.
  2. Provide 2,500 Vac isolation from input circuit to output circuit.
- B. Installation: Mount zero-crossing relays on the rear panel of the control panel with panhead machine screws, using thermally-conductive heat sink compound. Remove excess compound to prevent accumulation of dirt and debris.
- C. Manufacturer: Provide International Rectifier "Crydom" Model A1210; equivalent model as manufactured by Teledyne; or equal zero-crossing relays.

## 2.04 ROTARY-ACTION SOLENOID DRUM PROGRAMMER (DP)

- A. General:
  1. Provide 12-position solenoid driven rotary-action drum programmer (stepping switch) where shown on the elementary diagrams. Provide step switch which advances one position as the solenoid is de-energized.
  2. Provide a rotary tap switch which provides an input circuit for each step switch position.
  3. Provide easily removable stackable switch assemblies. Provide easily settable switch trip positions. Provide switch contacts rated for 10 amps resistive load at 120 Vac.
- B. Manufacturer: Provide Eagle Signal Model MT12, ATC Series 1800; or equal.

## 2.05 ALTERNATOR RELAYS (ALT)

- A. Alternator relay shall alternate the state of its contacts in response to impulses applied to its coil. Contacts shall be rated 5 amperes minimum at 120 Vac, 60 Hz. Coil shall be rated 120 Vac, 60 Hz. Provide stud terminals for all wiring. Alternator shall be Autocon 7101AA; Struthers Dunn B11AXA; or equal.

## 2.06 INTERVAL TIMERS (IT)

- A. Interval or SS (single shot) timers shall transfer their timed contacts immediately when energized by a control power pulse of 50 milliseconds minimum duration. The contacts shall remain transferred for the preset delay and then reset independently of the control input. A source of continuous operating power is required, if the control pulse is of shorter duration than the delay; interruption of this power shall reset the contacts at any time. Interruption of control power for 50 milliseconds maximum shall be required to initiate a new time cycle. Timer shall be ATC Series 305D; Eagle Signal; or equal.

## 2.07 RESET TIMER (RT)

- A. General: Provide motor-driven reset timer with range of 0 to 99.9 hours. Timer shall reset from zero to the time set on the pointer by means of an external sustained or momentary dry contact closure as required.
- B. Specifications: Provide reset timer with the following specifications:
1. Models: Choice of on delay or off delay operation.
  2. Ranges: 16 standard ranges, from 6 seconds to 60 hours at 60 Hz.
  3. Repeat Accuracy:
    - a. ac Models:  $\pm 0.2\%$  of full scale.
    - b. dc Models:  $\pm 1.75\%$  of full scale at constant ambient temperature and  $\pm 20\%$  voltage variation (48, 125 and 250 volt models);  $\pm 3.5\%$  of full scale at constant voltage and 32 to 120°F ambient temperature
  4. Reset Time: 0.1 second, full scale.
  5. Minimum Setting: 1/60th of range.
  6. Dial Divisions:
    - a. 6 sec, 60 sec, 120 sec, 240 sec, 6 min, 60 min, 120 min, 240 min, 6 hr, and 60 hr with 120 Dial Divisions.
    - b. 15 sec, 30 sec, 15 min, 30 min, 15 hr, and 30 hr with 150 Dial Divisions.
  7. Life Expectancy:
    - a. Mechanical: Over 5,000,000 operations (average.)
    - b. Contacts: 3,000,000 operations under resistive or inductive load of 1 amp.
  8. Timing Motor: Synchronous, permanently lubricated.
  9. Timing Modes: Single cycle interval or delay.
  10. Load Switches:
    - a. Instantaneous: Two, each SPDT; self-cleaning, heavy-duty silver contacts.
    - b. Delayed: Two, each SPDT; precision type, silver contacts.
    - c. Contact Rating (non-inductive):
      - 1) 10 amps: 120 Vac.
      - 2) 5 amps: 240 Vac.
      - 3) 1/4 amp: 115 Vac.
  11. Pilot Light: Wired in parallel with motor, standard with all ac models except explosion-proof.
  12. Terminals: Screw terminals accessible at rear, integral wiring diagram on timer housing.
  13. Housing: Plug-in design; completely gasketed, dust-tight when surface or panel-mounted.
  14. Power Requirements:
    - a. ac Models: 120 or 240 V, 50/60 Hz. (all ranges).
    - b. dc Models: 48, 125 or 250 V with zener regulations; 28 V without zener regulation.
    - c. ac Models:
      - 1) Running Current: 0.128 A (115 Vac).
      - 2) Inrush Current: 0.628 A (115 Vac).
  15. Temperature Rating: 32°F to 120°F (0°C to 50°C).
- C. Manufacturer: Provide reset timer as manufactured by ATC; Eagle Signal; or equal.

## 2.08 ELAPSED TIME METERS (ETM)

- A. Elapsed time meters shall be of the synchronous motor-driven type having a minimum of six (6) decimal digits where the least significant digit shall represent tenths (1/10ths) of hours. Unless specified otherwise, they shall not be equipped with a reset button. They shall be for panel mounting with a square bezel approximately 2-1/2 inches on a side. Meter voltage shall be not more than 120 Vac for meters mounted in instrumentation panels. Elapsed time meters shall be ATC 5702; Yokogawa/General Electric Series 200; Type 240; or equal.

## 2.09 CONTROL PANEL ACCESSORIES

- A. Relays, timers, and other internally mounted equipment shall be of the types specified in other sections of these Specifications.
- B. Panel face mounted equipment shall be of the types specified in other sections of these Specifications.
- C. Standards: All control devices shall conform to applicable provisions of NEMA Standards ICS 1 and ICS 2.
- D. Pushbuttons, Selector Switches and Pilot Lights:
  - 1. Shall be heavy-duty oiltight units; each unit shall have an engraved escutcheon plate unless nameplates are indicated on the Drawings or are necessary because of length of identification. Pushbuttons and selector switches shall have contacts rated 10 amperes continuous, Rating Designation A600 in conformance with NEMA ICS 2.
  - 2. Pushbuttons used as emergency stop devices shall have a padlockable means for maintaining an open circuit. Indicating lights shall be push-to-test transformer type with lenses of the colors shown on the Drawings.
- E. Multiposition control switches shall have rotary action, round knurled handle and the number of positions and stages shown on the Drawings. They shall be suitable for panel mounting. Each position shall have a positive detent. Contacts shall have a continuous current rating of 10 amperes at 300 Vac. Switches shall have integral indicator.
- F. For 4-20 mA<sub>dc</sub> and 1 to 5 V<sub>dc</sub> signal selector switches, provide oiltight selector switches with electronic duty gold contact blocks. Provide sliding contacts for reliable operation without benefit of thermal cleaning action.
- G. Manufacturer: Provide Microswitch heavy-duty oiltight manual controls, Type PT, with electronic duty gold contact blocks; Allen-Bradley Bulletin 800T oiltight selector switch with stackable "Logic-Reed" contact blocks; or equal.
- H. Colors and Descriptions:
  - 1. Indicating Lamps: Unless otherwise noted on the Drawings, the following color code and inscriptions shall be followed for the lenses of all indicating lights.

Indicating Lamp Inscription	Color
ON/START	Red
OFF/STOP	Green
CLOSED	Green
LOW	Amber
FAIL	Red
HIGH	Amber
OPEN	Red
POWER ON	White
RESET	Red
AUTO	Blue

2. Lettering shall be black on white and amber lenses. Lettering shall be white on red and green lenses.
3. Pushbuttons: Follow color coding for indicating lamp above.
4. All unused or noninscribed buttons shall be black. Lettering shall be black on white and yellow buttons. Lettering shall be white on black, red and green buttons.

- I. Panel Lights and Receptacles: Panels shall be internally lighted by fluorescent or LED lamps, provided with guards and a toggle switch located convenient to each access door. One duplex GFI type receptacle shall be provided in each panel section. The lights and receptacles shall be wired to outgoing terminal blocks for 120 volt, 60 Hz, single phase supply.
- J. Nameplates: Unless specified otherwise in the Drawings, nameplates shall be black lamacoid with minimum 3/16-inch-high white letters for major area titles, 5/32-inch for component titles, and 1/8-inch for subtitles, and shall be fastened with a permanent but dissolvable adhesive or by screws.

## 2.10 PROBE RELAYS (PR)

- A. Probe relays shall be solid state liquid level control relays suitable for use with water. The relays shall use an 8 Vac secondary circuit to sense the level of the water by means of electrodes. The relays shall have adjustable potentiometers for setting the sensitivity. Contacts shall be rated 230 volts, 10 amperes, 1/2 horsepower. The relays shall be Warrick Series 2; B&W Series 52; or equal.

## 2.11 PROBES AND HOLDER

- A. Probes shall be 1/4-inch stainless steel rods, PVC insulated. Probe holder shall be case pressure tight, of sufficient size to accommodate all of the probes, threaded to match the probe well, and complete with pressure tight probe plugs. Probes and holder shall be as manufactured by B/W Controller Corporation; Warrick; or equal.

## 2.12 FLASHER

- A. Flasher shall be induction disk motor type. Provide cams for 10 to 30 pulse per minute operation. Flasher contacts shall be 1/2-inch-thick coin silver and shall be rated 15 amperes, 120 volts. Flasher shall be Eagle Signal HT7; Econolite; or equal.

## 2.13 CONTROL STATIONS

- A. Provide control stations complying with NEMA ICS 6 for manual control functions as follows and as shown on the Drawings: start-stop pushbutton, hand-off-auto, forward-reverse-jog-stop, etc. Control stations shall include selector switches, pushbuttons, and indicators as specified in this Section.
- B. Enclosures shall be as follows:
  - 1. Dry Locations: NEMA Type 12.
  - 2. Corrosive Locations: NEMA Type 4X.
  - 3. Hazardous Locations (Gases): NEMA Type 7.
  - 4. Hazardous Locations (Dust): NEMA Type 9.
  - 5. Wet Locations: NEMA Type 4X.
- C. Nameplates: Provide an engraved plastic nameplate for each control station and escutcheons or nameplates for devices mounted thereon.
- D. Provide pushbuttons, selector switches, indicators, etc., as shown on the Drawings and as required. Provide control devices with NEMA ratings matching that of the control station.
- E. Manufacturer: Provide Allen-Bradley; Westinghouse; Crouse-Hinds; or equal.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Identify all control devices with engraved plastic nameplates or escutcheons, as applicable. Install control devices as recommended by the manufacturer.

### 3.02 PROBES AND HOLDER

- A. Adjust potentiometer to suit conductivity of water.

END OF SECTION

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## SECTION 16961

### POWER SYSTEM STUDIES

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

##### 1.02 SCOPE OF WORK

- A. Obtain the services of an independent firm to provide complete Short-Circuit and Protective Device Coordination studies, and Arc Flash Risk Assessment for the electrical system as defined below. The firm performing the work shall have been regularly engaged in short-circuit and protective device coordination services for a period of at least 10 years.
- B. The firm performing the work shall be responsible for the collection of all data required to perform the studies, including the electrical utility company's short-circuit current contribution.
- C. For the purpose of this specification Section, the "Electrical System" shall be defined as the entire power distribution system, including the utility company's main service disconnect down through the main circuit breaker on each electrical bus (Switchgear, Switchboard, Panelboard, disconnect switch, etc.) and all associated downstream feeders and distributed branch circuits. Some equipment not modified as part of this contract is required to be included in the studies defined in this Section. Items within the "Electrical System" are comprised of:
  - 1. All utility transformers.
  - 2. All medium voltage equipment.
  - 3. All medium voltage to low voltage transformers.
  - 4. All 480 VAC generators, transfer switches, switchboards, panelboards, distribution, power conditioning, motor control, and motors.
  - 5. All 480-208 VAC and 480-240 VAC transformers feeding panelboards.
  - 6. All 208 VAC and 240 VAC panelboards.
- D. The Short-Circuit Study shall provide for the calculation of fault currents at each piece of gear in the Electrical System for the entire Site. Fault currents shall be calculated for scenarios of utility and standby power, as outlined in this Section.
- E. The Protective Device Coordination Study shall include trip characteristics for all protective devices in the Site Electrical System, from the utility company's main service disconnect through the main circuit breaker on each 208/120 VAC panelboard of all distributed branch circuits. Trip characteristics shall be analyzed for scenarios of utility and standby power, as outlined in this Section.
- F. The Arc Flash Risk Assessment shall provide for arc flash incident energy calculations at all panels as required by IEEE 1584 (2018 Edition) and NFPA 70E.
- G. Reports:
  - 1. Reports for the Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall be stamped and signed by a Registered Electrical Engineer.

2. Report calculations shall be generated by a software analysis application with proven accuracy and reliability at performing 3-phase fault calculations.

### 1.03 REFERENCE STANDARDS

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE).
- B. American National Standards Institute (ANSI).
- C. The National Fire Protection Association (NFPA).
- D. InterNational Electrical Testing Association (NETA) Standard for Acceptance Testing Specifications (ATS).
- E. NFPA 70E, Standard for Electrical Safety in the Workplace.
- F. IEEE 1584 (2018 Edition), Guide for Performing Arc-Flash Hazard Calculations.
- G. Occupational Safety and Health Administration (OSHA) (29 CFR PART 1910), Occupational Safety and Health Standards for General Industry.

### 1.04 SUBMITTALS

- A. Submit data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.
- B. Submit credentials of firm performing the studies to demonstrate sufficient experience with performing this type of work, as specified herein.
- C. Preliminary: Preliminary Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall be submitted to the Engineer for review prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.
- D. Results of the Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall be summarized in a final report. Submit hardbound copies of the complete final report and one digital copy in PDF on a DVD. Electronic delivery shall contain full searchable text and include any computer models developed for the studies at no additional cost.
- E. Sample arc flash warning labels for each piece of equipment. Submit copies of labels at full size, with all required information as calculated by the Arc Flash Risk Assessment.

### 1.05 DATA COLLECTION

- A. The firm performing the Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall furnish the Contractor with a listing of required data. The Contractor shall collect and furnish all required data. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final acceptance of the equipment shop drawings and/or prior to the release of the equipment for manufacturing.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

### 3.01 GENERAL REQUIREMENTS

- A. The Short-Circuit Study and Protective Device Coordination Study shall be performed as outlined in InterNational Electrical Testing Association (NETA) Standard for Acceptance Testing Specifications, Section 6 with exceptions as included in this Section.
- B. In order to select relays and fuse characteristics as required for optimum coordination, the coordination study shall be performed as soon as the vendors for the new electrical equipment are identified. Relays and fuse selection by the power distribution equipment suppliers shall be based on the results of the favorably reviewed study.
- C. The studies shall be submitted to the Engineer for acceptance before final acceptance of power distribution equipment submittals and before any settings are made on equipment.
- D. The final report for the Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall be bound in a standard 8 1/2-inch by 11 inch sized report. The selection of all protective relay types, current transformers, and fuse types and ratings shall be the responsibility of the manufacturer and shall be based on the preliminary draft of the coordination study, which shall be submitted with the equipment shop drawings (or earlier). The studies shall be accepted by the Engineer before any equipment is shipped. See paragraph 1.04 for submittal requirements.
- E. The report shall include a single line diagram depicting the entire Electrical System included in the analysis. At a minimum, the single line diagram shall be on an 11-inch by 17-inch sheet, and include the following information:
  - 1. Equipment/bus tags which match the contract documents.
  - 2. Equipment/bus ampacity ratings.
  - 3. Motor horsepower.
  - 4. Protective device frame rating, trip setting, and curve options, as applicable.
  - 5. Transformer primary/secondary voltages, kVA rating, and impedance.
  - 6. Conductor materials, insulation types, and lengths.
- F. The studies shall be run on each of the following scenarios:
  - 1. Utility power.
  - 2. Generator power.

### 3.02 SHORT-CIRCUIT STUDY

- A. Provide a complete Short-Circuit Study. The study shall include, but shall not be limited to, the following, as applicable:
  - 1. Full compliance with applicable ANSI and IEEE Standards.
  - 2. Performed on nationally recognized computer software, such as ETAP or SKM Power Tools.
  - 3. Overall system impedance diagram. The diagram shall include the power company's impedance and X/R ratios and circuit element impedances (e.g., transformers, generators, motors, VFDs, feeders, distribution buses as applicable).
  - 4. Available three phase and ground fault asymmetrical and symmetrical short-circuit fault currents at each piece of electrical equipment, bus, transformer, etc.

5. The momentary and interrupting rating of all elements of the distribution system shall be listed. The maximum available short-circuit fault current available at each element shall be calculated.
6. 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, identification of all assumptions made in the preparation of the study, identification of any problem areas, and a definitive statement concerning the adequacy of the distribution system to interrupt and withstand the maximum possible short-circuit fault current.
7. Computer printouts for the three phase, single phase and ground fault studies. Printouts shall indicate the short-circuit fault current available at each major equipment and distribution bus within the medium and low voltage distribution systems.

### 3.03 PROTECTIVE DEVICE COORDINATION STUDY

- A. Provide a complete Protective Device Coordination Study. The Protective Device Coordination Study shall include, but shall not be limited to:
  1. Utility protective devices.
  2. Service entrance and distribution switchgear.
  3. Medium and low voltage power system transformers.
  4. Low voltage switchgear, switchboards, power distribution panels and motor control centers.
  5. Power factor correction and harmonic mitigation equipment.
  6. Motor starters and variable frequency drives.
  7. Standby generators.
  8. A tabulation of all the settings for every over current protective device, timer, power system relays (e.g., ANSI 50, 51), circuit breaker, recommended fuse and current transformer ratings, etc.
  9. Transformer excitation current.
  10. Motor and cable damage curves in accordance with the manufacturer's recommendations.
  11. Select relay types (e.g., inverse, very inverse, extremely inverse, overcurrent with or without voltage restraint, timers), current transformer ratings and types, fuse, residually or zero sequence connected ground faults protection, etc. that will allow the system to be protected within the equipment fault ratings and provide the maximum possible coordination between the protective devices.
  12. Provide recommended settings for protective devices, such as relays and circuit breakers, to achieve the best selectivity to minimize system disturbances during fault clearing.
  13. Provide a complete set of time-current coordination curves on log-log paper for every protective relay, circuit breaker, fuse, timer, etc. serving or located in the electrical equipment furnished for the project, including the utility protective devices. Provide a separate time-current curve for each unique feeder system, without displaying parallel devices powered from a common bus. The time-current curves shall display the coordination from the lowest device in the distribution system up through the utility's protective device. Clearly identify each device curve displayed on the graph, by color coding and text callouts. Include specific settings used for the curve (as applicable) in the text callout. A single line diagram depicting the portion of the

distribution system under study shall appear with each curve. The minimum size log paper to be submitted shall be 11-inch by 17-inch.

14. Time current curves shall include transformer ANSI damage and inrush curves, cable damage curves, circuit breaker and fuse ratings and settings, protective relay settings, and any other information required by ANSI and good design practices. As a minimum, provide curves for:
  - a. Each medium voltage and low voltage feeder down to 480-volt motor control centers and panelboards.
  - b. Each main, tie and feeder circuit breakers located in medium voltage and low voltage switchgear, motor control centers and panelboard. Include the largest feeder circuit breaker in each motor control center and panelboard.
  - c. Each ground fault protective device provided for the medium voltage and low voltage power distribution systems.
- B. The report shall include a reference to any part of the Electrical System where selectivity cannot be achieved, and a brief explanation of the cause. Provide recommendations where applicable for alternate methods that would improve selectivity.

### 3.04 ARC FLASH RISK ASSESSMENT

- A. Provide a detailed Arc Flash Risk Assessment. The analysis shall include, but shall not be limited to:
  1. Determine potential arc flash incident energies, arc flash boundaries, shock hazard boundaries and proper personal protection equipment (PPE) for all energized electrical equipment.
  2. The study shall determine worst-case scenarios for the arc flash energy level calculations, and any suggested changes to the protection scheme or equipment selection that will result in improved system reliability and safety.
  3. The study shall indicate the worst-case values for each of the scenarios listed in paragraph 3.01F. Provide values in tabular format including at a minimum, location of fault, incident energy, arc flash boundary, working distance, acting protective device, protective device activation time, and arcing fault current.
  4. Provide executive summary, including introduction, methodology, information sources, key assumptions, NFPA 70E considerations and calculations.
  5. Develop and install arc flash warning labels based on arc flash study results.

### 3.05 FIELD ADJUSTMENT

- A. All field adjustment and modifications shall be performed in the presence of the Owner, before energizing equipment.
- B. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments shall be completed by the equipment manufacturer.
- C. Make minor modifications to equipment as required to accomplish conformance with Short-Circuit and Protective Device Coordination studies.

### 3.06 MODIFICATIONS

- A. Notify the Owner in writing of any required major equipment modifications. Major modifications to the equipment shall not be allowed unless otherwise approved in writing by the Engineer and the Owner.

### 3.07 ARC FLASH WARNING LABELS

- A. The vendor shall provide a 4 inch by 4 inch thermal transfer type label of high adhesion polyester for each work location analyzed. Labels shall be machine printed, with no field markings.
- B. The label shall have an orange header, compliant with ANSI Z535, with the wording, "WARNING, SHOCK & ARC FLASH HAZARD", and shall include the following information:
  - 1. Location designation (equipment identification tag).
  - 2. Nominal voltage.
  - 3. Arc flash boundary.
  - 4. Incident energy at working distance (in calories/centimeter-squared).
  - 5. Working distance.
  - 6. Shock boundaries.
    - a. Limited approach distance.
    - b. Restricted approach distance.
  - 7. Required personal protective equipment.
  - 8. Engineering report number, revision number, and issue date.
  - 9. Where voltage exceeds 600 VAC or incident energy is greater than 40 cal/cm<sup>2</sup>, label header shall be changed to "DANGER, SHOCK & ARC FLASH HAZARD."
- C. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
  - 1. For each 600, 480 and applicable 240 and 208 VAC panelboards and disconnects, one arc flash label shall be provided.
  - 2. For each industrial control panel, provide one arc flash label.
  - 3. For each transformer, provide one arc flash label at both the front and rear access points, as applicable.
  - 4. For each low voltage motor control center, at least one arc flash label shall be provided. Motor control centers larger than five sections shall bear one arc flash label for each five sections. Back-to-back or turned corner configurations shall be treated as two motor control centers for the purpose of labeling.
  - 5. For each 96-inches of low voltage switchboard, one arc flash label shall be provided.
  - 6. For each standalone VFD or motor starter, one arc flash label shall be provided.
  - 7. For each switchgear, provide one arc flash label for each the front and rear of the incoming compartment and one arc flash label on each compartment that houses a draw-out device.
  - 8. For each medium voltage motor control center, provide one arc flash label each for the front and rear of the incoming compartment, one label for each individual starter or switch operating handle, and one label each for any draw-out power drawers.
  - 9. Where equipment includes a "maintenance mode" bypass setting on a protective device as a temporary arc-flash reduction measure, provide one arc flash label at the applicable protective device which indicates the calculated values when maintenance mode is enabled. This label shall be clearly marked to indicate what it represents.

- D. The Contractor shall affix the labels in accordance with the following:
1. Labels shall be in a clearly visible location on the front panel of the equipment near the incoming service or main protective device. Labels on equipment with bottom-entry incoming service shall be placed a minimum of 60 inches from the bottom of the equipment.
  2. Labels affixed to outdoor equipment which includes an outer door and inner deadfront panel shall be placed on the deadfront panel to avoid fading due to exposure to the elements.
  3. For labels affixed to removable compartment doors or covers, the removable cover shall be clearly marked to identify the specific compartment for which it is intended to be used.

### 3.08 ARC FLASH TRAINING

- A. The equipment manufacturer shall provide arc flash training to the Owner's staff. At a minimum, the training shall include potential arc flash hazards associated with working on energized equipment and maintenance procedures in accordance with the requirements of NFPA 70E, Standard For Electrical Safety Requirements For Employee Workplaces. The training shall be recorded in a video format and provided on a DVD or solid-state media to the Owner.

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## SECTION 17010

### INSTRUMENTATION AND CONTROLS, GENERAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

###### A. Work Included:

1. Provide all tools, equipment, materials, and supplies and be responsible for all labor required to complete the installation, startup, and operational testing of a complete and operable Instrumentation and Control (I&C) System as indicated on the Drawings and as specified herein.
2. Provide all the necessary equipment components and interconnections along with the services of manufacturers' engineering representatives necessary to ensure that the Owner receives a completely integrated and operational I&C system as herein specified.
3. Provide all terminations for wiring at field mounted instruments, equipment enclosures, alarm, and status contacts.
4. Provide all Instrumentation and Control wire required for a fully functioning Instrumentation and Controls System as shown on the Drawings except for wire specifically specified in Division 16. See Section 16010.

###### B. Work Specified in Other Divisions:

1. Process piping, installation of inline instrumentation, gas monitors, chlorinators and sulfonators, air compressors, main air supply headers, and other mechanical work and equipment as specified in Divisions 11, 13, or 15.
2. Instruments and controls which are not directly used for process control, i.e., those provided as part of a package system, such as a boiler, air compressor, etc. as specified in Divisions 11, 13, 15, or 16.
3. Division 16 work, including all instrumentation and controls conduit, and only that wire specified in Division 16. Refer to Division 16 Specifications for specific requirements for wire, conduit, grounding, and other electrical equipment.
4. Final control elements as specified in Section 15050.
5. General mechanical requirements as specified in Section 11001.

##### 1.02 REFERENCE STANDARDS

###### A. American National Standard Institute (ANSI) Publications:

1. ANSI Y14.15a Drafting Practice
2. ANSI C62.1 Surge Arrestors

###### B. Instrumentation Society of America (ISA) Publications:

1. ISA S5.4 Instrument Loop Diagrams
2. ISA S20 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves

##### 1.03 I&C SUBCONTRACTOR QUALIFICATIONS

- ###### A.
- An I&C Subcontractor shall be an electrical contractor who has demonstrated experience in purchasing, calibrating, fabricating, installing, and testing the Instrumentation and Control (I&C) products listed in this Specification Section. Normally, the I&C Subcontractor is a systems house regularly engaged in the

business of panel fabrication, control component procurement, programmable logic controller, and personal computer (PC) application in the process control industry.

- B. The I&C Subcontractor has been regularly engaged for a period greater than 5 years in performing all aspects of the type of work specified in this Section and shown on the Drawings and must prequalify as specified below.
- C. To prequalify, the I&C Subcontractor shall submit 1) proof in the form of names and references of jobs over the past 5 years where this work was accomplished, 2) present samples and an explanation of representative work performed at a meeting with the Engineer prior to bid award, 3) submit the name and qualifications (resumes) of the proposed employees of the firm who would be responsible for the day-to-day work, and 4) an explanation of how the I&C Subcontractor will carry out and implement the responsibilities described in the following section.

#### 1.04 I&C SUBCONTRACTOR SYSTEM RESPONSIBILITIES

- A. General: The I&C equipment as specified in this Division shall be considered an integrated system. Entire system installation including calibration, verification, startup, operation testing, and training shall be performed by qualified personnel, possessing all the necessary skills and equipment, and who have had experience performing similar installations. Instrumentation and control systems drawings are diagrammatic only; it is the responsibility of the Contractor to obtain technical data, determine performance requirements, develop instrumentation detail installation designs, and coordinate the selection of specified equipment with Contractor supplied equipment to meet the design conditions stated.
- B. System Responsibilities:
  - 1. Instrumentation and control system drawings are diagrammatic only. Ensure that all components of the instrumentation system, including primary measuring, indicating, transmitting, receiving, recording, totalizing, controlling, and alarming devices and all appurtenances are completely compatible and shall function as outlined and shall furnish and install such additional equipment, accessories, etc., as are necessary to meet these objectives at no cost to the Owner.
  - 2. Compatibility: See that all components of the instrumentation system, including equipment specified under other Divisions, are completely compatible and function properly as a system. Provide such additional equipment, accessories, etc., as are necessary to meet these objectives at no cost to the Owner.
  - 3. Coordination: For control components, devices, and systems specified in Divisions 11, 13, 15, 16 and 17, or shown on the Drawings.
    - a. Provide technical advice to mechanical and electrical subcontractors as necessary regarding their installation of instruments.
    - b. Verify the correctness of installation of all instruments.
    - c. Verify that the proper type, size, and number of control wires with their conduits are provided.
    - d. Verify that the proper type, size, and number of pneumatic tubes with their conduits are provided.
    - e. Verify that proper electric power circuits provided for all components and systems.
    - f. Resolve all manufacturers' installation discrepancies between requirements and the detail requirements of the Drawings and Specifications.

- g. Supervise final signal connections, both electric and pneumatic, to all process instrumentation and control equipment.
  - h. Adjust, startup, and test all process instrumentation and control equipment.
  - i. Provide specified documentation and training.
4. Performance: While the Drawings provide sufficient information to establish the form and function of the systems and their relationships, the responsibility for system integration and performance rests solely with the Contractor. The Engineer provides technical instruction and guidance where needed.
5. Site and Instrument Inspection: Inspect site for conformance to Drawings, paying special attention to space allocation and dimensions shown or required on Drawings. Inspect completed work and verify that it is ready for installation of instruments and equipment. Inspect each instrument and piece of equipment for damage, defects, completeness, and correct operation before installing.

#### 1.05 SUBMITTALS

- A. Refer to Division 1 for required method of preparation and transmittal, and conform to requirements herein.
- B. Shop Drawings: Submit shop drawings (diagrams) for review in complete bound sets indexed by Specification number, with exterior tabs marked by subject. Submit manufacturer's catalog cuts for each item for which shop drawings are not required. Manufacturer's catalog cuts, specifications, or data sheets shall be clearly marked to delineate the options or styles to be furnished. Show dimensions, physical configurations, methods of connecting instruments together, mounting details, and wiring schematics. Drawings shall be complete with device tag numbers, wire numbers, and terminal board numbers. Submit fabrication details, nameplate legends, and control panel internal wiring and piping schematic drawings. Submit panel graphic drawings where applicable. Include material lists and/or bills of material.
1. Loop/Interconnect Diagrams: Submit a set of analog and discrete wiring diagrams combining the elements of Sketches 17010-1 and 17010-2 that shows the complete details of installation of instruments and control system components. Include on each drawing the conduit number, wire numbers, the conduit run (via pull boxes, handholes, terminal cabinets, etc.) wiring interconnection, and termination points.
- C. Specification Forms:
1. Submit completed Specification Forms per ISA S20, including those instrumentation and control components directly related to process control, but specified in other Divisions of these Specifications.
2. Include on each form the assigned tag numbers, manufacturer's part numbers, and device data. More than one tag numbered item may be included on a sheet.
- D. As-Built Drawings: Submit a revised set of shop drawings that incorporates all change orders and modifications made during performance of the work. In addition to updated loop diagrams, interconnect diagrams and other drawings as necessary to depict the "as-built" condition of equipment. Include all installed field and panel conduit and piping/tubing runs and routing, tray systems, supports, mounting details, interconnection diagrams with cable, wire, tube and termination numbers. Coordinate all drawings with the conductor identification requirements in

Section 16120 and Section 16124. Submit a copy of CAD produced drawings on magnetic media in AutoCAD DWG format.

- E. **Operation and Maintenance Manuals:** Furnish Operation and Maintenance Manuals, including Instruction Manuals and Part Lists, for equipment provided under Division 17 as required by Division 1. Obtain data from manufacturers, and format and bind as specified. Obtain distribution method instructions from the Owner or his representative.
1. **Schedule:** Deliver at least two (2) copies of manuals in 3-ring binders (8-1/2 by 11-inch format) not later than the equipment shipment date.
  2. **Contents:** Include in manuals not less than the following information, as applicable, for each instrument, equipment, subsystem and/or control loop:
    - a. General, introduction and overall description, purpose, functions, simplified theory of operations, etc.
    - b. Specifications (including equipment specification data sheet as described above under Shop Drawings), sufficiently detailed for reordering exact duplicates of the original items.
    - c. Installation instructions, procedures, sequences, tolerances, and precautions.
    - d. Operational procedures.
    - e. Shutdown procedures.
    - f. Maintenance, calibration, and repair instructions.
    - g. Parts list and spare parts recommendations.
    - h. Calibration curves, rating tables, and any other data showing the relationship of the variable inputs and the calibrated output of all measuring devices and controlled equipment.
    - i. Software programs (PLC Ladder Logic, BASIC, or Source Code).
    - j. Computer screens (DWG.PIC).
  3. **Format:**
    - a. Use drawings and pictorials to illustrate the text to the extent necessary to insure a clear, concise presentation. If manuals have been written to cover a family of similar instruments or equipment, strike out inapplicable information in a neat fashion or emphasize applicable portion by heavily weighted arrows, circles or boxes; whichever provides the clearest and neatest presentation.
    - b. Group manuals by system control panels, including field instrumentation connected or associated with the panel. Where identical instruments are used in more than one control loop or subsystem, include only one instruction manual, per panel grouping; however, an index by tag number for all instruments shall identify its location in that manual.
    - c. Provide control loop and/or subsystem operational descriptions to identify the function of each instrument and its relation to the other instruments in the loop.
  4. **Binding:** Bind each manual in a cover which indicates the panel or process area to which it applies, manufacturer's name, local address and telephone number, and year of purchase. Punch and bind manuals in standard three ring binders and include system name and subcontractor's name on binding.
- F. **Accessory and Maintenance Materials:** Submit data for the following items:
1. **Special Tools and Accessories:** Special tools, instruments, and accessories for maintaining instruments and equipment requiring periodic repair and adjustment as specified elsewhere herein. Also, furnish special lifting and handling devices for equipment requiring such devices.

2. Maintenance Materials and Spare Parts: Submit a list of manufacturer recommended spare parts for each item specified. Refer to other sections of these Specifications.
- G. Test Reports: Submit the following test reports as described herein:
1. Instrument Calibration Data Sheets (para. 2.13)
  2. Factory Testing of Control Panels (para. 2.14)
  3. Instrument Verification Report (para. 3.08.B)
  4. Final Operational Testing (para. 3.08.C)
- H. Demonstration and Final Operation Test Plan and Results: Submit a document that outlines all procedures to be used in final operational testing of instrument and control systems. Include a description of each system, the scope of testing, test methods and materials, testing instruments and recorders, a list of functional parameters to be recorded on each item, and Shop Drawings showing temporary bypasses, jumpers, and devices.

#### 1.06 QUALITY ASSURANCE

- A. Standard of Quality: The Contractor shall provide equipment of the types and sizes specified which has been demonstrated to operate successfully. Provide equipment which is new and of recent proven design.

#### 1.07 INSPECTIONS

- A. The Engineer may inspect the fabricated equipment at the factory before shipment to job site. Provide the Engineer with sufficient prior notice so that an inspection can be arranged at the factory.
- B. Inspection of the equipment at the factory by the Engineer will be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.
- C. Favorable review of the equipment at the factory only allows the manufacturer to ship the equipment to the project site. The Contractor shall be responsible for the proper installation and satisfactory startup operation of the equipment to the satisfaction of the manufacturer and the Engineer.

#### 1.08 DRAWINGS

- A. Drawings: The Instrumentation Drawings are diagrammatic; exact locations of instrumentation products shall be determined in the field by the Engineer. Except where special details are used to illustrate the method of installation of a particular piece or type of equipment or material, the requirements or descriptions in this Specification shall take precedence in the event of conflict.
1. Locations of equipment, inserts, anchors, motors, panels, pull boxes, manholes, conduits, stub-ups, fittings, power and convenience outlets, and ground wells are approximate unless dimensioned; verify locations with the Engineer prior to installation. Field verify scaled dimensions on Drawings.
  2. Review the Drawings and Specification Divisions of other trades and perform the instrumentation work that will be required for the installations.
  3. Should there be a need to deviate from the Instrumentation Drawings and Specifications, submit written details and reasons for all changes to the Engineer for favorable review.
  4. Resolution of varying interpretations of the Contract Documents shall conform to Division 0, General and Supplementary Conditions.

5. The Drawings provide details of installation and supersede the manufacturer's recommendation where a conflict exists.

#### 1.09 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Box, crate, or otherwise enclose and protect instruments and equipment during shipment, handling, and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids and gases or any element that could degrade the equipment. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Notify the Engineer in writing in the event that any equipment or material is damaged. Obtain prior favorable review by the Engineer before making repairs to damaged products.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS AND STANDARD SPECIFICATIONS

- A. Provide instruments, equipment and materials suitable for service conditions and meeting standard specifications such as ANSI, ASTM, ISA, and SAMA. The intent of this Specification is to secure instruments and equipment of a uniform quality and manufacture throughout the plant. All instruments in the plant of the same type shall be made by the same manufacturer.

#### 2.02 NAMEPLATES

- A. For each piece of equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings and the model designation.
- B. Identify each piece of equipment and related controls with a rigid laminated engraved phenolic nameplate. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws or, where favorably reviewed by the Engineer, with epoxy cement. Where no inscription is indicated on the Drawings, furnish nameplates with an appropriate inscription furnished by the Engineer upon prior request by the Contractor.
- C. Each control device, including pushbuttons, control switches, and indicating lights, shall have an integral legend plate or nameplate indicating the device function. These shall be inscribed as indicated on the Drawings or as favorably reviewed by the Engineer.
- D. Provide CAUTION or SAFETY nameplates to alert operators of special conditions that may result in faulty equipment operations. Devices containing batteries that must be replaced periodically must be clearly identified. Nameplates are not required if the device senses and displays a low battery warning.

#### 2.03 NAME TAGS

- A. All instrumentation and equipment items or systems shall be identified by name tags. Field equipment shall be tagged with the assigned instrumentation tag number listed in the Instrument Schedule.
- B. Name tags shall be stainless steel with engraved or stamped black characters of 3/16 inch minimum height. Tags shall be attached to equipment with a tag holder and stainless steel band with a worm screw clamping device. Use 20-gauge stainless steel wire where banding is impractical. For field panels or large

equipment cases use stainless steel screws; however, such permanent attachment shall not be on an ordinarily replaceable part.

## 2.04 FIELD-MOUNTED EQUIPMENT

- A. All instrument and control equipment mounted outside of protective structures shall be equipped with suitable surge arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines from lightning discharges or nearby electrical devices. Protective devices used on 120 Vac inputs to field mounted equipment shall be secondary valve surge protectors conforming to the requirements of ANSI C62.1.

## 2.05 EQUIPMENT OPERATING CONDITIONS

- A. All equipment shall be rated for normal operating performance with varying operating conditions over the following minimum ranges:
  - 1. Electrical Power: 120 Vac  $\pm$ 10%, 60 Hz, unregulated, except where specifically stated otherwise on the Drawings or in the Specifications, or when two-wire, loop-powered devices are specified.
  - 2. Field Instruments:
    - a. Outdoor Areas:  
Ambient Temperature: +15°F to +120°F  
Ambient Relative Humidity: 5% to 100%  
Weather: Rain, sleet, snow and ice
    - b. Indoor Unheated Areas:  
Ambient Temperature: +40°F to +120°F  
Ambient Relative Humidity: 5% to 95%, non-condensing
    - c. Indoor Environmentally Controlled Areas:  
Ambient Temperature: +60°F to +104°F  
Ambient Relative Humidity: 10% to 90%, non-condensing

## 2.06 EQUIPMENT LOCATIONS

- A. Provide equipment and materials suitable for the types of locations in which they are located as defined under Division 16. All equipment specified for field mounting shall be weatherproof and splash proof as a minimum. If electrical or electronic components are contained within the equipment, they shall be housed in NEMA 3R gasketed cases, and NEMA 7 in hazardous locations unless noted otherwise on the Drawings.

## 2.07 ANALOG SIGNAL INDICATED UNITS

- A. For all instruments with local or remote indicators, provide indicators scaled in actual engineering units, i.e., gallons per minute, feet, psi, etc., rather than 0 to 100%, unless noted otherwise on the Drawings or Instrument Schedule.

## 2.08 SIGNAL TRANSMISSION

- A. Analog:
  - 1. Signal transmission between electric or electronic instruments shall be 4 20 mA and shall operate at 24 Vdc. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating. Where practical, milliampere signals from the field shall be converted to a voltage signal at the external terminals of each panel, and all instruments within a panel shall be parallel wired.

2. Nonstandard transmission systems such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted in the Instrument Schedule or shown on the Drawings. When transmitters with nonstandard outputs do occur, their output shall be converted to 4 20 mA prior to transmission.
- B. Discrete: All alarm and status signals shall be 24 Vdc unless specified otherwise on the Instrument Schedule. Proprietary data highway or serial bit transmissions such as RS232C shall be allowed to the extent shown on the Drawings.

## 2.09 PANEL/RACK/ENCLOSURE BAY POWER SUPPLIES

- A. Provide each main rack and/or enclosure bay with a separate isolation transformer to prevent ground loops between the instrument and electrical power grounds. These transformers may be nonshielded control power type.
- B. For each two-wire transmitter, provide a 24 Vdc regulated 50 mA power supply with 120 Vac input. Output voltage may be 24 Vdc  $\pm 5\%$  manufacturing tolerance at no load, but shall hold within 1% from no load to full load at 120 Vac  $\pm 10\%$  input. Line to-load regulation shall be within 0.1% from no-load to full load. Ripple shall be less than 15 mV peak-to-peak.
- C. Manufacturer: Provide Model AP9046 instrument loop power supply as manufactured by Action Instruments with plug-in mounting base, equivalent capacity Lambda power supply with terminal blocks for external connections, or equal.

## 2.10 PAINTING

- A. Factory paint all instruments and equipment except where installed in pipelines. Where instrument panels are installed adjacent to electrical control panels provided under Division 16, provide instrument panels of identical color to that of electrical control panels. Paint as required in Division 9 for structural supports, brackets, etc. Repair damaged factory paint to satisfaction of the Engineer. Feathering, priming and painting shall produce a reasonable match to the surrounding paint work.

## 2.11 FASTENERS

- A. Fasteners for securing equipment to walls, floors and the like shall be either hot-dip galvanized after fabrication or stainless steel. Provide stainless steel fasteners in corrosive locations. When fastening to existing walls, floors, and the like, provide capsule anchors, not expansion shields. Size capsule anchors to meet load requirements. Minimum size capsule anchor bolt is 3/8 inch.

## 2.12 INSTRUMENT CALIBRATION

- A. Each field instrument shall be calibrated at 0%, 25%, 50%, 75% and 100% of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 5 times greater than the specified accuracy of the instrument being calibrated. Such test instruments have accuracies traceable to the National Institute of Standards and Technology (NIST).
- B. Submit a written report to the Engineer on each instrument. This report shall include a laboratory calibration sheet or the manufacturer's standards calibration sheet on each instrument and calibration reading as finally adjusted within tolerances.

- C. The Contractor may, at his option, choose to perform calibration on an instrument by acquiring the services of an independent test lab, or by obtaining the required test instruments and performing the calibration.

### 2.13 FACTORY TESTING OF CONTROL PANELS

- A. All fabricated equipment shall be tested before it leaves the factory. At the factory verify wiring continuity and equipment operation by simulating input and output.
- B. Factory testing of control panels/devices/equipment shall be accomplished. Refer to individual Specification sections for tests requiring favorable review.
- C. Upon completion of factory testing, submit a report certifying the control panels/devices/equipment are operable and meet the Specifications.

## PART 3 - EXECUTION

### 3.01 MOUNTINGS

- A. Mount and install equipment as indicated. Mount field instruments on pipe mounts or other similar means in accordance with suppliers' recommendation. Where mounted in control panels, mount according to requirements of that section.
- B. Equipment specified for field mounting shall be suitable for direct pipe mounting or surface mounting, surface-mounted indicators and equipment with calibration adjustments or requiring periodic inspection shall be mounted not lower than 3 feet 6 inches nor higher than 6 feet above walkways, platforms, catwalks, and the like.
- C. Note that applicable specifications require detail drawings showing seismic sway bracing design and anchorage requirements for their equipment. Seismic zone requirements are specified in Division 1.
- D. All devices shall be accessible to operators for servicing, operating, reading, etc. Provide permanent platforms to assure devices are continuously accessible.

### 3.02 PROCESS CONNECTIONS

- A. Provide instrument impulse tubing (see Part 2) to meet the intended process service and ambient environmental condition for corrosion resistance, etc. Install impulse tubing with a continuous slope according to service to promote self-draining or venting back to the process. Terminate connection to process lines or vessels in a service rated roof valve, provided under other Divisions, that will permit closing off the impulse line or removal of the element without requiring shut down of the process. Include blowdown of drip legs and valves for terminations of impulse lines at the instruments.
- B. Process vessels, line penetrations, and root valves shall be furnished and installed under other Divisions of these Specifications. Instrument tubing and valve manifolds are installed as part of this Specification.

### 3.03 FIELD WIRING

- A. Ring out signal wiring prior to termination and perform surge withstand tests where required (see Section 16010 (26 05 00), Part 3 for methods). Verify wire number and terminations are satisfactory as designated on the Loop and Interconnect Diagrams. Verify all terminations are tight and shields are uniformly grounded at one location.

### 3.04 ELECTROMAGNETIC INTERFERENCE (EMI)

- A. Construction shall proceed in a manner which minimizes the introduction of noise (RFI/EMI) into the I&C System.
- B. Cross signal wires and wires carrying ac power or control signals at right angles.
- C. Separate signal wires from wires carrying ac power or switched ac/dc control signals within control panels, terminal cabinets, telemetry equipment, multiplexer cabinets, and data loggers as much as possible. Provide the following minimum separations within such equipment unless indicated otherwise on the Drawings:

Power Wiring Capacity	Separation (Inches)
120 volts ac or 10 amps	12
240 volts ac or 50 amps	18
480 volts ac or 200 amps	24
4,160 volts ac or 800 amps	48

### 3.05 SIGNAL GROUNDING

- A. A single-point grounding system for instrument signals is required for all instrument panels. This instrument single point grounding system does not use building steel or conduit systems for its ground path.
  - 1. Ground all signal shields, signal grounds, and power supplies at an isolated signal bus within each instrument panel, rack, or enclosure. See Section 17510 for isolated bus requirements. The shields at the far ends of these signal cables must be disconnected (floated) from any ground to prevent ground loops.
  - 2. Do not connect the rack or enclosure frames to the signal grounding buses.
  - 3. Connect each isolated signal ground bus within each panel using a stranded, insulated copper wire of size 6 AWG or larger directly to a system ground rod installed per the Drawings.

### 3.06 PREPARATION

- A. Ensure that installation areas are clean and that concrete or masonry operations are completed prior to installing instruments and equipment. Maintain the areas in a broom-clean condition during installation operations.
- B. Panels shall be protected during construction to prevent damage to front panel devices and prevent dust accumulation in the intervals. Other protective measures (lamp, strip heaters, etc.) shall be included as weather conditions dictate.

### 3.07 FIELD TESTING

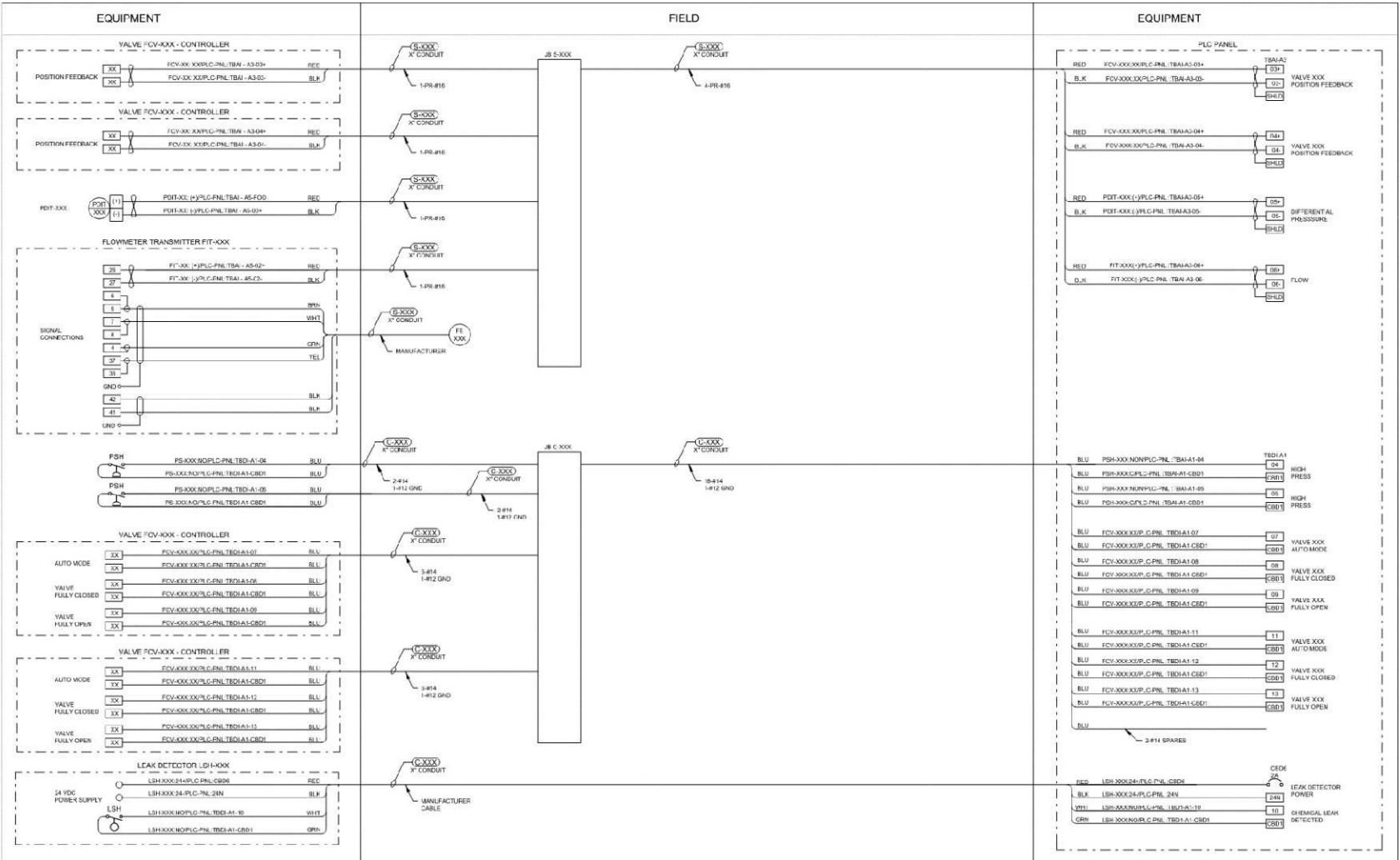
- A. General: The purpose of the field testing is to verify instruments are calibrated and operationally performing their intended function. Provide the services of factory trained and experienced engineers to perform verification and operational testing as prescribed below. Since the initial calibration of instruments may not satisfy the final operation of system, perform recalibration or adjust setpoints as required to satisfy the performance requirements of the system. Notify the Engineer and Owner in writing a minimum of 48 hours prior to the proposed date for commencing final operational testing and acceptance.

- B. **System Verification Testing:** Verify that each instrument shown on the Instrument Schedule is operating and calibrated as specified in the Instrument Schedule by simulating inputs at the primary element in each system loop and verify performance at loop output devices (i.e., recorder, indicator, alarm, etc., except controllers). Simulate inputs at 0%, 25%, 50%, 75%, and 100% of span or with on-off inputs, as applicable. During system verification:
1. Make initial or provisional settings on levels, alarms, etc. listed in the Instrument Schedule.
  2. Verify controllers by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point.
  3. Cause malfunctions to sound alarms or switch to standby to check system operation.
  4. Check all loop instruments thoroughly for correct operation.
  5. Immediately correct all defects and malfunctions disclosed by tests.
  6. Submit a report certifying completion of verification of each instrument system. This report shall include a data sheet on each instrument tested that indicates instrument tolerances, instrument calibration verification, data and initial settings made to devices.
- C. **Final Operational Testing:** Upon completion of instrument verification, test all systems under process conditions in the presence of the Owner or designated representative. System testing shall be accomplished in accordance with the approved Test Plan (paragraph 1.07I) The test for each portion thereof shall be witnessed, documented and signed off upon completion by the Engineer. The intent of this test is to demonstrate and certify the operational interrelationship of plant instrumentation and control systems. This testing shall include, but not be limited to:
1. Making final adjustments to levels, alarms, etc.
  2. Optimum tuning of controllers.
  3. Checking all alarms, failure interlocks, and operational interlocks.
  4. Verifying all computer input and outputs and CRT displays are fully functional.
  5. Verifying automatic computer-generated reports are performing satisfactorily.
  6. Immediately correcting all defects and malfunctions and retesting.
  7. Submit the witnessed test results and a transmittal letter indicating that all required systems have been tested satisfactorily and the systems meet all the functional requirements of their applicable specifications.

### 3.08 INSTRUCTION OF OWNER'S PERSONNEL

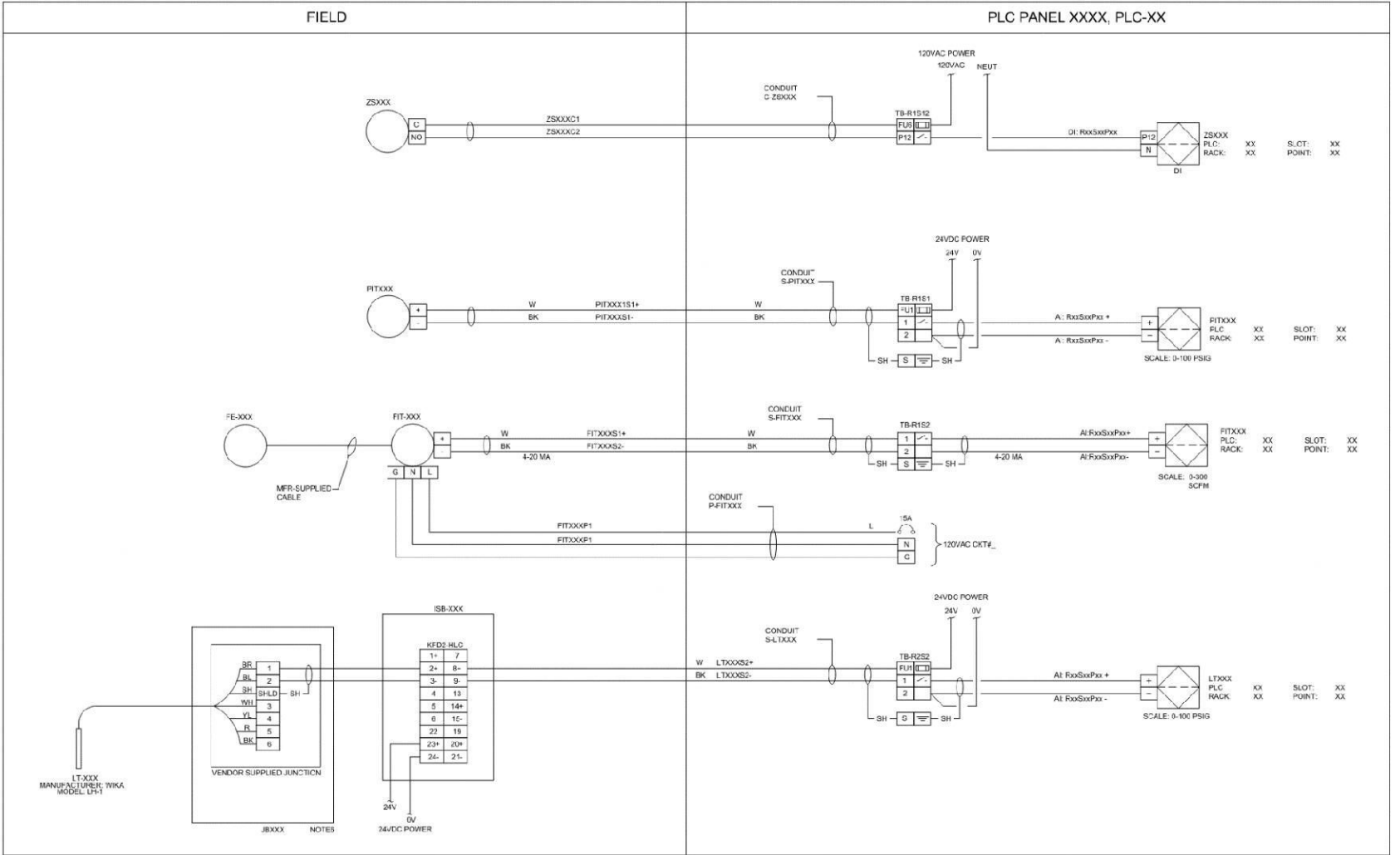
- A. Provide the services of a factory trained and field experienced instrumentation engineer to conduct group training of up to five of the Owner's designated personnel in the operation of each instrument system. This training shall be for the time period of five working days and shall be performed during the operational testing period. Include instruction covering basic system theory, operating principles and adjustments, routine maintenance and repair, and "hands on" operation. The text for this training shall be the Operation and Maintenance Manuals furnished under these Specifications.

SKETCH 17010-1



Sketch 17010-2

END OF SECTION



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## SECTION 17110

### GAS DETECTION DEVICES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. General: The Contractor shall furnish and install all gas detection devices, complete and operable, in accordance with the Contract Documents.

##### 1.02 REFERENCES

- A. As specified in of Section 17010.

##### 1.03 CONTRACTOR SUBMITTALS

- A. General: The Shop Drawings and Technical Manual shall be submitted in conformance with Section 01300.

##### 1.04 QUALITY ASSURANCE

- A. General: The accuracy of each instrumentation system or loop shall include the following.
  1. Verify proper power and signal wire terminations.
  2. Ensure proper power voltage is applied to the device.
  3. Check for correct output signal.

##### 1.05 MANUFACTURER'S REPRESENTATIVE SERVICES

- A. General: None required for this section.

##### 1.06 PRODUCT HANDLING

- A. General: Product shall be properly crated/protected to prevent damage and moisture intrusion during shipping and handling.

#### PART 2 - PRODUCTS

##### 2.01 GENERAL

- A. All devices specified herein shall conform to the requirements of the Contract Documents.

##### 2.02 HYDROGEN GAS DETECTOR

- A. Electrochemical Gas Detection Cell Specific for Hydrogen Gas Detection.
- B. Hot swappable, replaceable gas sensor.
- C. Temperature and humidity compensated gas sensor.
- D. Automatic sensor detection.
- E. 3 Wire, 24VDC, powered gas monitor.

- F. Isolated 4-20 mA output.
- G. Three alarm contacts, configurable.
- H. Integrated backlit LCD graphic display with process value, engineering units.
- I. -40°C to 60°C rated electronics.
- J. Polycarbonate corrosion resistant housing, IP66.
- K. Remote mount sensor and mounting module.
- L. Manufacturer:
  - 1. MSA Ultima XA Series
  - 2. Or Engineer-approved equal.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Installation, wiring, testing, calibration, validation, startup, and instructions shall be in accordance with Section 17010 and shall be per manufacturer's requirements.

END OF SECTION

## SECTION 17140

### LEVEL MEASUREMENT

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- A. Provisions: Requirements of Division 1 and Section 17010 form a part of this Section.
- B. Work Included: Level measurement devices for process instrumentation, auxiliary equipment, and supplies directly related to the installation of and operation of these level measurement devices, to perform the required functions in conjunction with information and equipment specified in other sections of Division 17. Refer to the Instrument List for a listing of required devices.

##### 1.02 SUBMITTALS

- A. Shop Drawings:
  - 1. Shop drawings to be submitted in this Section shall be made in one package under Product Review category of shop drawings.
  - 2. In addition to the requirements of Section 17010, shop drawings shall include for each type of instrument: physical dimensions, supply voltage and frequency, electrical load, accuracy, description of operation, operating instructions, and calibration procedure.
  - 3. All shop drawings, catalog pages, and cut sheets shall be clearly marked with the unique tag for the instrument(s) to which they apply.
  - 4. Shop drawings shall include a completed ISA S20 form for each device.
  - 5. Installation Method: The proposed method of mounting sensors and instruments shall accompany all shop drawings.
- B. Manuals:
  - 1. Submit manuals in accordance with the requirements of Section 17010.
  - 2. ISA S20 forms: Include a completed final S20 form for each device with the manuals. S20 forms shall be updated to include final values or notes from testing, startup, and commissioning.
  - 3. Parts List: Include a parts list showing current net prices and a list of recommended spares with the manuals.

##### 1.03 QUALITY ASSURANCE

- A. Manufacturer: In addition to the requirements of General Requirements, level measurement devices furnished shall be manufactured by firms regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of current design.
- B. Maintainability: All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.
- C. Materials and Installation: Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the

minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Instrument List.

## PART 2 - PRODUCTS

### 2.01 LEVEL TRANSMITTER – RADAR TYPE

#### A. Pulsed Time-of-Flight (PTOF) Radar:

##### 1. General:

a. This type of level sensor shall use the following principle. A burst of microwave energy in the form of a “chirp” of a specific frequency profile is directed toward a target surface of interface. The interface may be air-liquid, air-solid, liquid-solid, and liquid-liquid if the densities of the two liquids are sufficiently different and provide a clearly definable interface. The return time and frequency profile of the reflected radiation is measured and converted into an electrical signal proportional to the distance from the sensor to the interface, or alternatively the distance from another reference level, such as the tank bottom, when the sensor is top mounted. As such, these are radio emitters regulated by FCC Part 15, and all applications must be approved by the vendor as conforming.

##### 2. Specific Requirements:

- a. Specific applications shall be as shown on the Drawings.
- b. Sensor shall be certified by the vendor as complying with FCC Part 15 for the specific application and mounting geometry in the design.
- c. Level ranges, output signals, and setpoints are specified in the Instrument List.
- d. Frequency Band: 26 GHz.
- e. The sensor beam angle shall be 10 degrees maximum.
- f. Accuracy: +/- 2 mm.

##### 3. Construction:

- a. The unit shall consist of a sensing probe with integral or remote mounted electronic transmitter as indicated in the Instrument List or on the Drawings. In a remote mount application, the interconnecting cable between sensing probe and electronic transmitter shall be provided by the manufacturer with the instrument.
- b. A level indicator shall be provided on the transmitter where indicated in the Instrument List or on the Drawings. The indicator shall be of the type and in the units specified in the Instrument List.
- c. The housing for the probe and transmitter shall be rated NEMA 4X.
- d. All instruments and sensors to be installed in hazardous locations shall be rated for the class, division, and group indicated on the Drawings.

4. Mounting: The probe shall be flange mounted, and the transmitter shall be surface mounted as indicated on the Drawings. Probe installation shall be per manufacturer's instructions.

5. Signal/Output: 4 to 20 milliamperes into 0 to 600 ohms.

##### 6. Power:

- a. The system shall operate from 24 Vdc (4-wire) 120 Vac, 60 Hertz power.

- b. Variations of  $\pm 10\%$  in voltage or frequency shall not affect the accuracy in excess of 0.5%.
- 7. Accessories: Provide a sunscreen of stainless steel construction for all transmitters mounted outdoors. The sunscreen shall provide adequate ventilation, out of direct sunlight, and improve readability of digital indicators.
- 8. Manufacturer (PTOF Type): Endress+Hauser Micropilot FMR/NMR series, Vega VegaPuls series, Emerson/Rosemount 5400 series, or equal.

## 2.02 LEVEL SWITCH – CABLE-MOUNTED FLOAT TYPE, SUMP DUTY

- A. General:
  - 1. Level switch shall use the movement of a float, the weight of whose moving parts is less than that of the displaced process liquid, to actuate switches as the level changes.
  - 2. The switch shall be integrally mounted within the float and connected to a terminal box by a waterproof electric cable.
- B. Specific Requirements:
  - 1. The switch shall be reversible such that the switching action operates on rising or falling level.
  - 2. The switch actuating points shall be as listed in the Instrument List or on the Drawings.
  - 3. All instruments and sensors to be installed in hazardous locations shall be rated for the class, division, and group indicated on the Drawings.
- C. Construction:
  - 1. The switch covering shall be made of indestructible polypropylene material.
  - 2. The cable jacket shall be PVC coated.
  - 3. Pressure rating: 40 psi minimum.
  - 4. Temperature rating: 140°F minimum.
  - 5. The float shall not be greater than 7 inches in diameter.
  - 6. The switch shall be hermetically sealed.
  - 7. Cable shall be 18 AWG minimum.
  - 8. Provide sufficient cable length to reach from the bottom of the tank or wet well to the terminal box without splicing.
- D. Mounting: The float shall be clamped securely at a fixed operating elevation as indicated on the Drawings or Instrument List. The operating level shall be easily adjusted by suspended cable or altering the height of the cable fixing point.
- E. Signal/Output: Dry contact rated for 5 amperes minimum at 250 Vac or Vdc.
- F. Accessories:
  - 1. Provide a stainless steel clamp for mounting each float switch. Plastic is not allowed.
  - 2. Provide intrinsically-safe relays (ISR) for switches used in hazardous locations where shown on the Drawings.
- G. Manufacturer: Xylem/Flygt ENM-10; Endress+Hauser Liquifloat; or equal.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Installation, testing, calibration, validation, startup, and instruction shall be in accordance with Section 17010.

- B. Top-Mounted Non-Contact Instruments: Level instruments which rely upon ultrasonic, radar, or laser type sensing shall be mounted such that the emitted beam can measure the full range of the medium without interference or obstruction.
- C. Suspended Cables and Instruments:
  - 1. Unless shown otherwise on the Drawings, provide a stainless steel anchor/hook and strain relief device for each cable or instrument. Strain relief device shall be as manufactured by Hubbell/Kellems or equal.
  - 2. Excess cable shall be neatly coiled and suspended from anchor/hook. Plastic ties are not allowed.
- D. Where instrument cables exit the open end of a conduit into a tank or wet well, provide a removable bushing around the cable at the conduit opening. The bushing shall support the cable to prevent chafing and seal the opening to reduce moisture accumulation in the conduit. Bushings shall be Emerson/OZ Gedney Type CSBI or equal.

END OF SECTION