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**NEW YORK WELL PHASE 2 CONSTRUCTION  
SPECIFICATIONS, NEW YORK WELL EQUIPPING AND  
SITE IMPROVEMENTS**

**Project No. C25WTNYWDE**

**BID SET**

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PREPARED FOR

**FAIR OAKS WATER DISTRICT**



PREPARED BY

**KASL CONSULTING ENGINEERS, INC.  
FRISCH ENGINEERING INC.  
VE SOLUTIONS INC.**

JUNE 2025

FAIR OAKS WATER DISTRICT  
10326 FAIR OAKS BLVD  
FAIR OAKS, CA 95628

**SPECIFICATIONS FOR  
NEW YORK WELL PHASE 2 CONSTRUCTION  
NEW YORK WELL EQUIPPING AND SITE IMPROVEMENTS**

**Project No. C25WTNYWDE**

Certifications and Seals

These specifications contained herein have been prepared by or under the direction of the following California registered professionals:



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**INVITATION TO BID**  
**NEW YORK WELL PHASE 2 CONSTRUCTION**  
**NEW YORK WELL EQUIPPING AND SITE IMPROVEMENTS**

Sealed Bids for furnishing all plant, labor, equipment, materials and performing all work to equip water supply well and to complete site improvements will be received and opened at the office of the **Fair Oaks Water District, 10326 Fair Oaks Boulevard, Fair Oaks, CA. 95628, Attn: Blake Chetcuti** (hereinafter called **District**), on September 3, 2025 at 2:00 p.m., local time. Immediately following the bid due date and time, Bids will be publicly opened and read. Bidder's representatives may use the following login information for teleconferencing the bid opening, Phone (916) 844-3159, Conference ID: 208640.

The work includes installation of District supplied line shaft driven well pump and District supplied 350 horsepower vertical turbine pump capable of delivering not less than 2000 gpm of well water at a total design head of 450 feet. The scope of work includes construction of concrete well pedestal and well pad, above ground and below ground piping, valves and fittings, sodium hypochlorite feed system for chlorination and sodium bisulfite feed system for dechlorination, CMU block wall building, site grading, drainage, fencing, gate, walkways, retaining walls, asphalt and aggregate base surfacing, hydroseeding and erosion control improvements. The New York Well improvements have been designed as an ASR (Aquifer Storage and Recovery) Well and will include improvements and controls for the return of dechlorinated, potable water to the groundwater aquifer. The work includes installation of the District supplied ASR control valve. The New York Well improvements include new pump control panels and motor control panels, well building lighting, power and control improvements, well water supply and ASR system instrumentation and controls, electrical and control system wiring, conduits and incidentals.

The work will be monitored by District Staff and by the District's Representative, KASL Consulting Engineers, Inc. together with their electrical Subconsultant, Frisch Engineering, Inc.

**A mandatory pre-bid site walk will be held on August 14, 2025 at 2:00 PM. Interested parties are encouraged to attend and shall first meet at the District's Office in Fair Oaks before proceeding to the New York Well site.**

A set of Contract Documents may be viewed at FOWD website; <https://www.fowd.com/projects-and-bids> and purchased at <http://www.crispplanroom.com>. Under Public Jobs search "NEW YORK WELL PHASE 2 CONSTRUCTION, NEW YORK WELL EQUIPPING AND SITE IMPROVEMENTS". For additional information, contact the Planroom at Crisp Imaging, Sacramento (916) 344-6742. Only Complete sets of Contract Documents may be purchased. The Bidder's attention is directed to the Instruction to Bidders for complete instructions regarding submission of bid.

Board of Directors approval to award the bid is scheduled for September 15, 2025. Anticipating one month for completion of contractual documents, insurance, and other contractor submittals, the commencement of construction would likely be on or around Mid- October 2025. The Work must be completed within **450** calendar days after the commencement date stated in the Notice to Proceed.

The **CONTRACTOR** shall have completed at least three projects within the last five years similar to the subject project and shall provide references to the **DISTRICT**.

**DISTRICT** reserves its rights to waive any informality or deficiency in any Bid, to accept any Bid, to negotiate modifications of any Bid with any Bidder and accept any modified Bid, to reject any Bid, to reject all Bids, and to rebid the Project, all at the **DISTRICT's** sole discretion

**BID PROPOSAL**

FROM: FAIR OAKS WATER DISTRICT

**PROJECT NAME:** NEW YORK WELL PHASE 2 CONSTRUCTION,  
NEW YORK WELL EQUIPPING AND SITE IMPROVEMENTS      **PROJECT NO:** C25WTNYWDE

1. Bids shall be completed on the attached Bid Schedule. All numbered bid items must be completed. Numbers shall be stated in figures and the form signed. Any corrections to entries made on bid forms shall be initialed by the person (s) signing the bid. Before submitting a bid, bidders shall carefully examine the project documents and inspect the site of the work, fully inform themselves as to all existing governmental agency conditions and limitations and shall include a total cost figure on the bid proposal form.
2. The undersigned, having familiarized himself/herself with the local conditions affecting the cost of the work, and with the Contract Documents, for the above named project, do hereby propose to perform everything required to be performed, and to provide and furnish all labor, materials, tools, expendable equipment, and all utility and transportation services necessary to complete work in the above named project, all in accordance with the prepared drawings, bidding documents and specifications.
3. The undersigned agrees, if awarded the contract, to start work within 20 calendar days after issuance of Notice to Proceed, and to complete same, ready for substantial and unobstructed use by DISTRICT within 450 calendar days of issuance of Notice to Proceed.
4. In submitting this bid, it is understood that the right is reserved by the DISTRICT to reject any and all bids or any portion thereof. It is agreed that this bid may not be withdrawn for a period of forty-five (45) days from the opening thereof. The work advertised shall be awarded to the lowest responsible, responsive bidder.
5. This Bid submittal includes a Bid Bond in the amount of 10% of the total Bid Proposal.
6. The undersigned firm/individual holds California State Construction License Number \_\_\_\_\_ and Worker's Compensation Policy Number \_\_\_\_\_ issued by \_\_\_\_\_
7. The undersigned has completed and included the Designation of Subcontractors and the Qualifying Experience Statement as Bid Proposal attachments.
8. The undersigned acknowledges receipt of the contract documents for the project consisting of the New York Well Phase 2 Construction, New York Well Equipping and Site Improvements Specifications dated June 2025, together with all attached documents. The undersigned acknowledges that addenda numbers \_\_\_\_\_ through \_\_\_\_\_ have been received and examined as part of the Contract Documents.
9. The undersigned understands that if awarded bid, invoices and payments shall be for actual quantities of material installed at lump sum or cost bid for each bid item.

FIRM NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

CITY & STATE: \_\_\_\_\_

TELEPHONE NO.: \_\_\_\_\_

BY: \_\_\_\_\_ TITLE: \_\_\_\_\_  
TYPE OR PRINT NAME OF PERSON SIGNING BID PROPOSAL

BY: \_\_\_\_\_ DATE: \_\_\_\_\_ 2025  
SIGNATURE

BIDS ARE TO BE RETURNED NO LATER THAN 2 :00 PM, SEPTEMBER 3,2025 AT FAIR OAKS WATER DISTRICT OFFICE. MARK THE PROJECT NAME ON THE BIDDING ENVELOPE SUBMIT BID TO BLAKE CHETCUTI, ASSOCIATE ENGINEER.

RETURN TO: FAIR OAKS WATER DISTRICT  
10326 FAIR OAKS BOULEVARD  
FAIR OAKS, CA 95628

Bid Proposal (1 of 2)

## **BID PROPOSAL**

Project No.: C25WTNYWDE

District: Fair Oaks Water District

Project Name: NEW YORK WELL PHASE 2 CONSTRUCTION, NEW YORK WELL EQUIPPING AND SITE IMPROVEMENTS

Owner Name: Fair Oaks Water District

THIS PROJECT BIDS ON: September 3, 2025 at 2:00 p.m.

Item	Description	Unit	Qty.	Unit Price, \$	Total Price, \$
1	Mobilization and Demobilization	LS	1		
2	Site Improvements	LS	1		
3	Well Head Pedestal and Well Pad	LS	1		
4	Install District Furnished Well Pump and Motor	LS	1		
5	Well Discharge, Valves and Piping Appurtenances	LS	1		
6	Install District Furnished ASR Valve and Appurtenances	LS	1		
7	Chemical Equipment and Piping	LS	1		
8	Plumbing Drain and Water Service	LS	1		
9	Well Building	LS	1		
10	Electrical and Instrumentation	LS	1		

**Total Bid Proposal (Items 1- 10)** \_\_\_\_\_  
 Figures

**Total Bid Proposal** \_\_\_\_\_

(Written)

Bid Proposal (2 of 2)



**QUALIFYING EXPERIENCE STATEMENT**

	<b>Project Name</b>	<b>Owner</b>	<b>Date of Substantial Completion</b>	<b>Construction Cost</b>	<b>Owner's Representative &amp; Phone No.</b>
1.					
2.					
3.					
4.					
5.					

With the submittal of this Bid Proposal, Bidder certifies that they have been engaged in the contracting business under the present business name for a minimum of 5 years. Bidders must list a minimum of three (3) projects successfully completed as the prime contractor, within the last five (5) years of similar nature, construction cost and complexity as the New York Well Phase 2 Project. District will consider the qualifying experience submitted in selecting the lowest responsive, responsible bidder for this Project.

**QUALIFYING EXPERIENCE STATEMENT**

Bid Proposal Attachment

## **FAIR OAKS WATER DISTRICT CONSTRUCTION AGREEMENT**

This CONSTRUCTION AGREEMENT (Agreement) is made at Fair Oaks, California, between the FAIR OAKS WATER DISTRICT ("DISTRICT") and \_\_\_\_\_ ("CONTRACTOR"), who agree as follows:

**GENERAL TERMS & CONDITIONS** - The General Terms & Conditions set forth in Exhibit "A" are part of this Agreement. In the event of any inconsistency between said General Terms & Conditions and any other terms or conditions of this Agreement, the General Terms & Conditions shall prevail.

**SCOPE OF WORK** - Subject to the terms and conditions set forth in this Agreement, CONTRACTOR shall provide construction services to the DISTRICT in accordance with the General Terms & Conditions (EXHIBIT "A"), Invitation to Bid and Bid Proposal (EXHIBIT "B") at rates provided in submitted bid, a total cost of \$\_\_\_\_\_, Technical Specifications (EXHIBIT "C"), and Improvement Plans (EXHIBIT "D").

CONTRACTOR shall complete all work as specified or indicated in the Agreement. The work includes but it is not limited to:

- Obtain all necessary permits
- Move on and off site
- Construct site clearing, earthwork, grading, surfacing, pavement and erosion control improvements
- Construct perimeter concrete retaining walls
- Furnish and install ornamental iron fence, gate and gate operating equipment
- Furnish and install cast-in- place structural concrete
- Furnish and install pre-cast concrete vaults, valve boxes and covers
- Furnish and install Project piping, pipe valves and pipe appurtenances
- Construct concrete block masonry Well Building together with building roofing, doors, skylight, hardware, wallboards, coatings and building appurtenances
- Install District furnished shaft driven well pump and vertical turbine motor
- Install District furnished Aquifer Storage and Recovery (ASR) Valve and ASR Valve appurtenances
- Furnish and install chemical feed, storage and piping improvements
- Furnish and install building plumbing improvements
- Furnish and install building ventilation and air conditioning equipment
- Furnish and install Project electrical, control and instrumentation improvements

**ENTIRE AGREEMENT** - This Agreement, all exhibits (Exhibits "A-D") attached hereto, all other terms or provisions incorporated herein by reference, constitute the entire agreement and understanding between the DISTRICT and the CONTRACTOR as to the subject matter contained herein.

**CONTRACT COMMITMENT** - This Agreement shall be in effect starting the date of signing until complete satisfaction of FOWD. Maintenance bond and guarantee letter shall be provided prior to final acceptance of project at completion.

**CONTRACT TIME AND LIQUIDATED DAMAGES** - The work will be completed and ready for final payment within 450 calendar days from the commencement stated in the Notice to Proceed. The work will be considered completed upon completion of the aquifer testing.

The DISTRICT and the CONTRACTOR agree that as liquidated damages for delay (but not as a penalty), the CONTRACTOR shall pay the DISTRICT \$250 for each day that expires after the time specified above.

### **CONTRACTOR'S REPRESENTATIONS**

CONTRACTOR makes the following representations:

- a. CONTRACTOR has familiarized itself with the nature and extent of the Contract Documents, Contract Times, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or finishing of the Work.
- b. CONTRACTOR familiarized itself with available lands, subsurface and physical conditions and associated responsibilities as described in the General Conditions.
- c. CONTRACTOR has given DISTRICT written notice of all conflicts, errors or discrepancies that they have discovered in the Contract Documents and the written resolution thereof by DISTRICT is acceptable to CONTRACTOR.

DISTRICT and CONTRACTOR each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect of all covenants, agreements, and obligations contained in the Contract Documents.

### **Drug-Free Workplace Certification of Compliance:**

By signing this Agreement, Contractor or its sub-contractors hereby certify, under penalty of perjury under the laws of the State of California, compliance with the requirements of the Drug-Free Workplace Act of 1990 (Government Code 8350 *et seq.*), that they have received and read a copy of the District's Drug-Free Awareness Program, as required by Government Code Section 8355(b) and have or will provide a drug-free workplace by notifying employees and sub-contractors that unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance is prohibited and specifying actions to be taken against employees or sub-contractors for violations, as required by Government Code Section 8355(a).

**INSTRUCTIONS**

Sign and return one original with a copy of requested insurance certificates, payment and performance bonds. Upon acceptance by DISTRICT, contracted work can be scheduled.

**DISTRICT:**

**FAIR OAKS WATER DISTRICT**

10326 Fair Oaks Blvd.  
Fair Oaks, CA 95628  
Attn: Tom R. Gray  
Title: General Manager

(916) 967-5723

**CONTRACTOR:**

**COMPANY NAME**

Address  
City, State Zip Code  
Attn: \_\_\_\_\_  
Title:

(xxx) xxx-xxxx

\_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Signature)

Tom R. Gray

Print Name \_\_\_\_\_

General Manager

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

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

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

Other authorized representative(s):

Other authorized representative(s):

Shawn Huckaby, Operations Manager

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**License No.:** \_\_\_\_\_

**EXHIBIT "A"**  
**GENERAL TERMS & CONDITIONS**

**CONTRACT FORMATION**

Contractor's quotation or proposal is deemed a firm offer and the final signing of this contract by all parties constitutes invocation of all items within the contract and is legally binding.

**Section 1 – RESPONSIBLE PARTIES/DEFINITIONS**

**District:** Whenever the word "District" or alternatively, "FOWD" is used in these General Conditions, it shall be understood to mean the Fair Oaks Water District and acting by and through its Authorized FOWD Representative.

Contractor shall not accept direction or orders from any person other than the General Manager or the person(s) whose name(s) is (are) inserted on the CONTRACT as "other authorized representative(s)."

**Contractor:** The word "Contractor" shall be understood to mean a Contractor (the contracting company) who has a current California State Contractor's License of appropriate class to do the work for which it is contracted to do as defined in the *California Contractor's License Law and Reference Book*; has, when applicable, a current business licenses to perform the work from the local jurisdiction where the work is to be performed; has been approved by the District; and is employed through the District's General Contract documents to complete the scope of work contained therein in accordance with the District's "STANDARD SPECIFICATIONS & STANDARD DRAWINGS" and "EQUIVALENT MATERIALS LIST" for construction work, the Contractor shall have a Class A or C34 California Contractor's License.

**County:** Whenever the word "County" is used in these General Conditions, it shall be understood to mean the County of Sacramento.

**Section 2 - CONTRACT DOCUMENTS**

**Contract Defined:** Wherever used herein, the term "Contract" shall mean the Fair Oaks Water District "General Contract", these General Conditions, the appropriate form of bid document, and any other documents incorporated into the Contract by reference. All of the forgoing documents shall together form the agreement between Contractor and the District, and a reference to any of them shall be deemed to include the entire Contract which shall be read as a whole.

The Contract, which may be supplemented from time to time with additional accepted bids and/or revised contract documents, represents the entire and integrated agreement of the parties and supersedes all prior negotiations, agreements and understandings.

Work called for in any one Contract Document and not mentioned in another is to be performed and executed as if mentioned in all Contract Documents. The titles and headings contained herein and in said documents are solely to facilitate reference to various provisions of the Contract Documents and in no way affect or limit the interpretations of the provisions to which they refer.

**Conflicts:** In the event of a conflict between the terms and conditions as set forth in this Contract and the terms and conditions set forth in other Contract Documents, the terms and conditions set forth in this Contract shall prevail.

**Plans and General Conditions:** Where conflicts exist between the District Contract and the Plan, then the information in the Contract shall take precedence.

**Change Orders:** Any supplements or changes to the Contract Agreements or Construction issued plans, Individual Work Scope Agreements, Term Contracts or General Category Work Agreements and these General Conditions shall be in writing and presented in the form of a Change Order.

**Addendum:** Any supplements or changes to individual Task Orders or Contract shall be in writing and presented in the form of an addendum.

**Consummation of Change Orders and Addenda:** Such Change Orders and Addenda executed as described above shall be effective when thereafter signed by the Contractor's Authorized Representative and authorized representative of FOWD.

### **Section 3 – SEVERABILITY**

The Contractor and the District agree that any provision of this contract that is found to be illegal or unenforceable, such term or provision shall be deemed stricken and the remainder of the contract shall remain in full force and effect. Either party having knowledge of such term or provision shall promptly inform the other of the presumed non-applicability of such provision.

### **Section 4 – RESPONSIBILITY FOR WORK**

Until the completion and final acceptance by the District, of all the work under and implied by this Contract, the work shall be under the Contractor's responsible care and charge. The Contractor shall rebuild, repair, restore and make good all injuries, damages, re-erections, and repairs occasioned or rendered necessary by causes of any nature whatsoever.

### **Section 5 – EXTRA WORK**

The Contractor shall do no extra work except on the written authorization of the District. If the District does authorize extra work, the costs thereof will be added to the monthly invoice upon the completion of the extra work.

### **Section 6 – CONTRACT AMOUNT**

The District agrees to pay, and the Contractor agrees to accept, in full payment for the above work, the sum computed in accordance with the actual amount of each item of work performed or material furnished and incorporated in the work, at the unit price which the Contractor bid for each such item in the Contractor's bid, said unit price to be determined as provided in the proposal.

### **Section 7 – PROGRESS AND FINAL PAYMENTS**

1. On a monthly basis, or as presented in project request for proposal, the Contractor shall present to the District a statement showing the amount of labor and materials incorporated in the work during the preceding month, along with certified payroll documentation. The District personnel shall verify the statement. If accuracy of invoice is satisfactory, a payment will be made in an amount equal to ninety-five percent (95%) of the value to date, based on the contract price, less

any previous payments for all work performed and materials actually used by the Contractor during said period. The remaining five percent (5%) of the value of the work completed under this contract, if unencumbered, shall be paid after final completion and acceptance of work by the District. Acceptance by the Contractor of said final payment shall constitute a waiver of all claims against the District arising under the Contract Document. The Contractor shall not be paid for any defective, unfinished, disputed, or improper work.

2. Undisputed invoices processing:
  - a. For invoices less than \$25,000, the FOWD will pay the contractor 30 days from the date of invoice.
  - b. For invoices \$25,000 and greater depending on when the invoices are submitted and the timing of the FOWD's Board meeting, the check processing for expenses \$25,000 and greater can take up to 60 days.
3. Pursuant to Part 5, Section 22300 of the Public Contract Code, the Contractor will be permitted to substitute securities for any money withheld by the District to ensure performance under this contract. At the request and expense of the Contractor, securities equivalent to the amount withheld shall be deposited with the District, or with a State or Federally chartered bank in California as the escrow agent, who shall pay such monies to the Contractor upon satisfactory completion of the Contract. At the direction of the District, the securities shall be returned to the Contractor.
4. Alternately, the Contractor may request that the owner shall make payment of retentions earned directly to the escrow agent at the expense of the Contractor. At the expense of the Contractor, Contractor may direct the investment of the payments into the investments upon the same terms provided for in this section for securities deposited by the Contractor. Upon satisfactory completion of the contract, Contractor shall receive from the escrow agent all securities, interest, and payments received by the escrow agent from the owner, pursuant to the terms of this section. The Contractor shall pay to each sub-contractor, not later than twenty (20) days following receipt of the payment, the respective amount of interest earned, net of costs attributed to retention withheld from each sub-contractor, on the amount of retention withheld to insure the performance of the Contractor.
5. Securities eligible for investment under this section shall include those listed in Section 16430 of the Government Code, or bank or savings and loan certificates of deposit.
6. The Contractor shall be the beneficial owner of any securities substituted for monies withheld and shall receive any interest thereon.
7. Any escrow agreement entered into pursuant to this provision shall be substantially in the form set forth in Section 22300 (e) of the California Public Contract Code.

**Section 8 – RETENTION OF SUMS CHARGED AGAINST CONTRACTOR**

When, under the provisions of this contract, the District shall charge any sum of money against the Contractor, the District shall deduct and retain the amount of such charge from the amount of the next succeeding progress estimate, or from any other monies due or that may become due the Contractor from the District. If, on completion or termination of the Contract, sums due the Contractor are insufficient to pay the District's charges against the Contractor, the District shall have the right to recover the balance from the Contractor.

**Right of the District to Withhold Payments:** In accepting work with the District, the Contractor agrees the District may withhold or cancel the whole or any part of any partial payment or final payment

to such an extent as may be reasonably necessary to protect the District from loss due to, but not limited to, any one of the following items or a combination of the items:

1. **Defective Work:** Defective work not remedied, regardless of when any such work may be found to be defective.
2. **Claims or Liens:** Claims or liens filed or reasonable evidence indicating probable filing of claims or liens.
3. **Failure of Contractor to Pay for Goods or Services:** Failure of the Contractor to make payments promptly for labor, material, equipment or other facilities, or to sub-contractors.
4. **Ability of Contractor to Complete for Unearned Balance:** A reasonable that work can be completed for the balance unearned.
5. **Damage to Other Work or Property:** Damage to other work or property which is caused either directly or indirectly by the Contractor.
6. **Pending Notice of Completion:** The District may have a "Notice of Completion" published and withhold final payment pending the outcome of the discovery period and subject to all other applicable provisions of these General Conditions.
7. **Settlement of Back Charges:** Settlement of back charges resulting from bonafide claims on totally unrelated work awarded to the Contractor using otherwise unencumbered funds available from current contracted work.
8. **Provision of Listing of Sub-contractors and Suppliers:** Payment may be withheld until Contractor has provided a list of all sub-contractors, suppliers or others, who have provided goods and services for work performed, including reasonable time for District to verify Contractor's payment to same.

Whenever the District shall, in accordance herewith, withhold any monies otherwise due to the Contractor, written notice of the amount withheld and the reasons thereof shall be given the Contractor. Once the Contractor has removed the grounds for such withholding, the District will promptly pay to the Contractor any amounts owed to Contractor from the amount withheld.

#### **Section 9 – NOTICES AND INVOICES**

All notices, invoices, and payments shall be made in writing and may be given by personal delivery, via email in pdf format, or by mail. Notices, invoices, and payments sent by United States mail shall be addressed to the designated FOWD and Contractor Authorized Representatives, as applicable, as indicated on the Construction Agreement. When so addressed, all such notices, invoices and payments shall be deemed given upon two days following deposit in the United States mail, all postage prepaid. In all other instances, notices, invoices, and payments shall be deemed given at the time of actual receipt. Any invoices emailed to FOWD must include FOWD project manager and ap@fowd.com.

#### **Section 10 – NO WAIVER BY PAYMENT**

Payment to the Contractor or occupation of the project by the District shall not relieve the Contractor of liability for defective materials or quality of the work used in the completion of the project or for

failure to construct the project according to specifications. Acceptance by the Contractor of any payment provided for in this contract shall be a representation by the Contractor to the District that all work performed before the payment became due has been completed by Contractor in accordance with the terms of the contract and according to the specifications.

### **Section 11 – WAGE RATES**

The Contractor acknowledges that the Contractor has examined the California State Prevailing Wage Determination made by the Director of the California Department of Industrial Relations (DIR) and agrees to pay workers not less than the stipulated wage rates. Contractor shall provide the District with current DIR registration number and copies of the prevailing wage payroll with each payment request.

### **Section 12 – EIGHT HOUR DAY LIMITATION**

Contractor agrees that 8 hours labor shall constitute a day's work, and no worker, in the employ of the Contractor, or any sub-contractor, doing or contracting to do any part of the Work under this Contract, shall be required or permitted to work more than 8 hours in any one calendar day and 40 hours in any one calendar week; provided that subject to California Labor Code section 1815, a worker may perform work in excess of 8 hours per day or 40 hours per week at not less than one and one-half times the basic rate of pay.

### **Section 13 – INDEMNIFICATION**

To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless and defend the District, its directors, officers, employees, consultants or authorized volunteers, and each of them from and against:

1. Any and all claims, demands, causes of action, damages, costs, expenses, losses or liabilities, in law or in equity, of every kind and nature whatsoever for, but not limited to, injury to or death of any person including the District and/or the Contractor, or any directors, officers, employees, or authorized volunteers of the District or the Contractor, and damages to or destruction of property of any person, including but not limited to, the District and/or the Contractor or their directors, officers, employees, or authorized volunteers, arising out of or in any manner directly or indirectly connected with the work to be performed under this agreement, however caused, regardless of any negligence of the District or its directors, officers, employees, or authorized volunteers, except the sole negligence or willful misconduct or gross negligence of the District or its directors, officers, employees, or authorized volunteers;
2. Any and all actions, proceedings, damages, costs, expenses, penalties or liabilities, in law or equity, of every kind or nature whatsoever, arising out of, resulting from, or on account of the violation of any governmental law or regulation, compliance with which is the responsibility of Contractor;
3. Any and all losses, expenses, damages (including damages to the work itself), attorneys' fees, and other costs, including all costs of defense, which any of them may incur with respect to the failure, neglect, or refusal of Contractor to faithfully perform the work and all of the Contractor's obligations under the contract. Such costs, expenses, and damages shall include

all costs, including attorneys' fees, incurred by the indemnified parties in any lawsuit to which they are a party.

4. The Contractor shall defend, at Contractor's own cost, expense and risk, any and all such aforesaid suits, actions or other legal proceedings of every kind that may be brought or instituted against the District or District's directors, officers, employees, or authorized volunteers arising out of or in any manner directly or indirectly connected with the work to be performed under this agreement.
5. The Contractor shall pay and satisfy any judgment, award or decree that may be rendered against the District or its directors, officers, employees, or authorized volunteers, in any such suit, action or other legal proceeding.
6. The Contractor shall reimburse the District or its directors, officers, employees, or authorized volunteers, for any and all legal expenses and costs incurred by each of them in connection therewith or in enforcing the indemnity herein provided.
7. The Contractor agrees to carry insurance for this purpose as set out in the specifications. Contractor's obligation to indemnify shall not be restricted to insurance proceeds, if any, received by the District, or its directors, officers, employees or authorized volunteers.

#### **Section 14 – SAFETY**

The Contractor shall execute and maintain the Contractor's work to avoid injury or damage to any person or property. The Contractor shall comply with the requirements of the specifications relating to safety measures applicable in particular operations or kinds of work.

1. In the performance of this contract the contractor shall comply with all applicable federal, state, and local statutory and regulatory requirements including, but not limited to California Department of Industrial Relations (Cal/OSHA) regulations; and the U.S. Department of Transportation Omnibus Transportation Employee Testing Act related to their scope of work and operations. In case of conflict in regulations, the most stringent shall apply. The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract. Safety precautions shall include but shall not be limited to: adequate life protection and lifesaving equipment; adequate illumination; instructions in accident prevention for all employees, such as the use of machinery guards, safe walkways, scaffolds, ladders, bridges, gang planks, confined space procedures, trenching and shoring, fall protection, and other safety devices; equipment and wearing apparel as are necessary or lawfully required to prevent accidents, injuries, or illnesses; and adequate facilities for the proper inspection and maintenance of all safety measures.
2. Contractor must obtain all applicable Division of Occupational Safety and Health (CAL-OSHA) permit(s) and others required by California Labor Code and California Government Code, prior to the initiation of any practices, work, method, operation, or process related to the work covered in the contract. Permits required by governmental authorities will be obtained and maintained at Contractor's expense.

3. It is a condition of this contract, and shall be made a condition of each sub-contract which the contractor enters into pursuant to this contract, that the contractor and any sub-contractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to the employees' health or safety, as determined under Cal/OSHA safety and health standards.
4. The Contractor shall be responsible for the safeguarding of all utilities. At least three working days before beginning work, the Contractor shall contact for an Underground Service Alert (USA) in order to determine the location of sub-structures. The Contractor shall immediately notify FOWD and the utility owner if they disturb, disconnect, or damage any utility.
5. In accordance with Section 6705 of the California Labor Code, the Contractor shall submit to Fair Oaks Water District specific plans to show details of provisions for worker protection from caving ground during excavations of trenches of five feet or more in depth. The excavation/trench safety plan shall be submitted to and accepted by Fair Oaks Water District prior to starting excavation. The trench safety plan shall have details showing the design of shoring, bracing, sloping or other provisions to be made for worker protection from the hazard of caving ground. If such a plan varies from the shoring system standards established by the Construction Safety Orders of the California Department of Industrial Relations (Cal/OSHA), the plan shall be prepared by a California registered civil or structural engineer. As part of the plan, a note shall be included stating that the registered civil or structural engineer certifies that the plan complies with the Cal/OSHA Construction Safety Orders, or that the registered civil or structural engineer certifies that the plan is not less effective than the shoring, bracing, sloping or other provisions of the Safety Orders. In no event shall the Contractor use a shoring, sloping, or protective system less effective than that required by said Construction Safety Orders. Submission of this plan in no way relieves the Contractor of the requirement to maintain safety in all areas. If excavations or trench work requiring a Cal/OSHA permit are to be undertaken, the Contractor shall submit his/her permit with the excavation/trench work safety plan to FOWD before work begins.
6. In the event of damage to any property or bodily injury to any person, the Contractor's Representative will provide immediate verbal notification (to be followed by a detailed written report) within forty-eight (48) hours to the District Inspector, or alternatively, to the Authorized District Representative named in the Contract Agreement, or alternatively, Task Order.
7. **Asbestos Pipe Work, Removal, Transportation, and Disposal Compliance** -The Contractor shall comply with all applicable state, and federal regulations, including those set forth by the Occupational Safety and Health Administration (OSHA), regarding the handling, removal, transportation, and disposal of asbestos-containing materials (ACM). This includes, but is not limited to, adherence to the regulations governing asbestos management, removal, containment, air monitoring, and waste disposal practices. The Contractor shall implement Best Management Practices (BMP) to prevent asbestos contamination and ensure the safety of all workers, the public, the environment in accordance with the requirements of the State of California, OSHA standards including 29 CFR 1926.1101, and all other applicable laws. The Contractor shall ensure that all asbestos-related work is performed by trained and certified personnel and that proper permits, notifications, and reporting requirements are met. The Contractor shall be

responsible for the safe transportation, disposal, and final disposition of asbestos-containing materials in accordance with applicable regulations and guidelines.

## **Section 15 – INSURANCE**

**Minimum Insurance Requirements** – Contractor shall procure and maintain for the duration of the contract, *and for 5 years thereafter*, insurance against claims for injuries or death to persons or damages to property which may arise from or in connection with the performance of the work hereunder and the results of that work by the contractor, their agents, representatives, employees, or sub-contractor.

Contractor will file with District, before beginning services, certificates of insurance (Acord Form 25 or equivalent) satisfactory to District evidencing:

- a) **Coverage** – Coverage for commercial general liability and automobile liability insurance shall be at least as broad as the following:
  - i. Insurance Services Office (ISO) Commercial General Liability Coverage (Occurrence Form CG 00 01)
  - ii. Insurance Services Office (ISO) Business Auto Coverage (Form CA 00 01), covering Symbol 1 (any auto)
  
- b) **Limit – The Contractor shall maintain limits no less than the following:**
  - i. General liability - coverage of not less than two million (\$2,000,000) per occurrence or the full per occurrence limits of the policies available, whichever is greater for bodily injury, personal injury, and property damage; (\$4,000,000 general and products-completed operations aggregate (if used)).
  - ii. Auto liability - One million dollars (\$1,000,000) for bodily injury and property damage each accident limit;
  - iii. As required by the State of California, Contractor shall provide workers' compensation (statutory limits) and employer's liability of no less than (\$1,000,000) per accident for bodily injury or disease. Waiver of Subrogation (also known as Transfer of Rights of Recovery Against Others to Us): The insurer(s) named above agree to waive all rights of subrogation against the Fair Oaks Water District, its elected or appointed officers, officials, agents, authorized volunteers and employees for losses paid under the terms of this policy which arise from work performed by the Named Insured for the Fair Oaks Water District; but this provision applies regardless of whether or not the Fair Oaks Water District has received a waiver of subrogation from the insurer.
  - iv. Builder's Risk – (Course of Construction) - insurance utilizing an "All Risk" (Special Perils) coverage form with limits equal to the completed value of the project and no coinsurance penalty provision.

c) **Required Provisions**

- i. **Additional Insured Status:** The commercial general liability coverage shall give Fair Oaks Water District, its directors, officers, employees (collectively the District), and authorized volunteers insured status (via ISO endorsement at least as broad as CG 20 10 11 85 or **both** CG 20 10 10 01 and GC 20 37 10 01) specifically naming the Fair Oaks Water District, its directors, officers, employees, or authorized volunteers; or using the language that states "as required by written contract" with respect to liability arising out of activities performed by or on behalf of the Contractor including materials, parts, or equipment furnished in connection with such work or operations; premises owned, occupied or used by the Contractor, or automobiles owned, leased, hired or borrowed by the Contractor.
- ii. **Primary Coverage:** For any claims related to this project, the Contractor's insurance coverage shall be primary. The general liability coverage is to state or be endorsed (with as broad as ISO endorsement CG 20 01 04 13) to state "such insurance shall be primary and any insurance, self-insurance or other coverage maintained by District, its directors, officers, employees, or authorized volunteers shall not contribute to it."
- iii. Any failure to comply with reporting or other provisions of the policies including breaches of warranties shall not affect coverage provided to the District, its directors, officers, employees, or authorized volunteers.
- iv. Contractor's insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.
- v. Each insurance policy required by this clause shall state or be endorsed to state that coverage shall not be canceled by either party, except after thirty (30) days (10 days for non-payment of premium) prior written notice by U.S. mail has been given to the District.
- vi. Such liability insurance shall indemnify the Contractor and the sub-contractors against loss from liability imposed by law upon, or assumed under contract by, the Contractor or sub-contractors for damages on account of such bodily injury (including death), property damage, personal injury and completed operations and products liability.
- vii. The general liability policy shall cover bodily injury and property damage liability, owned and non-owned equipment, blanket contractual liability, completed operations liability, explosion, collapse, underground excavation and removal of lateral support.
- viii. The automobile liability policy shall cover all owned, non-owned, and hired automobiles.
- ix. Deductibles and Self-Insured Retentions: Insurance deductibles or self-insured retentions must be declared by the Contractor, and approved by the District. At the election of District the Contractor shall either cause the insurer to reduce or

eliminate such self-insured retentions as respects the District, its directors, officers, employees, and authorized volunteers or the Contractor shall provide a financial guarantee satisfactory to the District guaranteeing payment of losses and related investigations, claim administration, and defense expenses. The policy language shall provide, or be endorsed to provide, that the self-insured retention may be satisfied by either the named insured or the District.

- x. Coverage is to be placed with a carrier with an A.M. Best rating of no less than A :VII, or equivalent, or as otherwise approved by District.
  - xi. The coverage shall contain no special limitations on the scope of protection afforded to District, its directors, officers, employees, or authorized volunteers.
  - xii. In the event that the Contractor employs other Contractors (sub-contractors) as part of the work covered by this Agreement, it shall be the Contractor's responsibility to require and confirm that each sub-contractor meets the minimum insurance requirements specified above (via as broad as ISO CG 20 38 04 13). The Contractor shall, upon demand of District, deliver to District copies of such policy or policies of insurance and the receipts for payment of premiums thereon.
- d) If the Contractor maintains broader coverage and/or higher limits than the minimums shown above, the District requires and shall be entitled to the broader coverage and/or higher limits maintained by the Contractor. Any available insurance proceeds in excess of the specified minimum limits of insurance and coverage shall be available to the District.
  - e) If any of the required coverages expire during the term of this Agreement, the Contractor shall deliver the renewal certificate(s) including the general liability additional insured endorsement to District at least ten (10) days prior to the expiration date.
  - f) The Contractor shall provide and maintain builder's risk (course of construction) or an installation floater (for materials and equipment) covering all risks of direct physical loss, damage or destruction to the work in the amount specified in the General Conditions, to insure against such losses until final acceptance of the work by the District. Such insurance shall insure at least against the perils of fire and extended coverage, theft, vandalism and malicious mischief, and collapse. The Policy shall be endorsed with District, its directors, officers, employees, and authorized volunteers named as loss payee, as their interest may appear. The making of progress payments to the Contractor shall not be construed as creating an insurable interest by or for District or be construed as relieving the Contractor or his/her subcontractors of responsibility for loss from any direct physical loss, damage or destruction occurring prior to final acceptance of the work by the District.

**Verification of Coverage – Evidence of Insurance**

Contractor shall furnish the District with copies of certificates and amendatory endorsements effecting coverage required by this contract. All certificates and endorsements are to be received and approved by the District before work commences. However, failure to obtain the required documents prior to the work beginning shall not waive the Contractor's obligation to provide them. The District reserves the right to require complete, certified copies of all required insurance policies, including policy Declaration pages and Endorsement pages, required by these

specifications, at any time. Failure to continually satisfy the Insurance requirements is a material breach of contract.

### **Continuation of Coverage**

The Contractor shall, upon demand of Fair Oaks Water District, deliver evidence of coverage showing continuation of coverage for at least (5) years after completion of the project. Contractor further waives all rights of subrogation under this agreement when any of the required coverages expire during the term of this agreement, the Contractor shall deliver the renewal certificate(s) including the general liability additional insured endorsement and evidence of waiver of rights of subrogation against Fair Oaks Water District (if builder's risk insurance is applicable) to Fair Oaks Water District at least ten (10) days prior to the expiration date.

### **Section 16 – BONDS**

**Performance Bond:** The Contractor shall obtain at its sole cost and expense and provide to District a performance bond in the amount equal to 100% of this Contract for the faithful performance of the work to be done under the terms of this contract, with sureties as may be agreeable to the District.

**Payment Bond:** The Contractor shall obtain at its sole cost and expense and provide to District a payment bond in the amount equal to 100% of this Contract for the faithful performance of the work to be done under the terms of this contract, as provided for in Section 3247 of the California Civil Code with sureties as may be agreeable to the District.

**Maintenance Bond:** Prior to the District Preliminary Acceptance Letter issuance for the new water facilities constructed by the Contractor per project documents, the Contractor shall furnish an overall maintenance bond or corporate surety bond, payable to the District. This bond, which shall be executed by a duly licensed surety company authorized to do business in the State of California, shall protect the District against the results of any failure attributable to any cause, including, but not limited to, faulty material, poor workmanship, and defective equipment or damage of the work occurring within the Guarantee period under the provisions of the Guarantee.

The bond shall guarantee the Contractor's responsibility as outlined above for a period of one (1) year or shall remain in effect for as long as the Guarantee remains in effect. The bond shall be provided on forms to be approved by the District and shall be in the sum of not less than one hundred percent (100%) of the awarded amount including any change orders issued during the project construction.

The bonds must comply with California Civil Code sections 3247 and 3248 and applicable provisions of the California Bond and Undertaking Law (Cal. Code of Civil Procedure § 995.010 et seq.).

### **Section 17 – SUB-CONTRACTORS**

None of this work may be delegated or sub-contracted without written consent of the District prior to work started. The successful bidder shall not assign its work or any of its rights hereunder to another contractor. The District may require written documentation of qualifications and references for any sub-contractor being considered for District approval to perform any part of any work under this Contract.

The General Contract shall bind Contractor's sub-contractors, successors and assigns, and that Contractor shall cause its employee, agents, and sub-contractors to comply with all requirements of the General Contract and these General Conditions.

If, at any time during the performance of this Contract, Contractor fails to maintain any item of the required insurance in full force and effect, Contractor shall immediately discontinue all work under the Contract and District will withhold all Contract payments due or that become due until notice is received by District that such insurance has been restored in full force and effect and that the premiums therefore have been paid for a period satisfactory to the District.

### **Section 18 – GUARANTEE**

Excepting only items of routine maintenance, ordinary wear and tear and unusual abuse or neglect, Contractor guarantees all work executed by the Contractor and all supplies, materials and devices of whatsoever nature incorporated in, or attached to the work, or otherwise delivered to the District as a part of the work pursuant to the Contract, to be absolutely free of all defects in the quality of work and materials for a period of **one (1) year** after final acceptance by the District of work performed. The Contractor shall repair or replace any or all such work or material, together with all or any other work or material which may be displaced or damaged in so doing, that may prove defective in the quality of work or material within said one year guarantee period without expense or charge of any nature whatsoever to the District.

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

### **Section 19 – LAWS, REGULATIONS AND PERMITS**

The Contractor shall give all notices required by law and comply with all laws, ordinances, rules and regulations pertaining to the conduct of the work. The Contractor shall be liable for all violations of the law in connection with work furnished by the Contractor. If the Contractor observes that the drawings or specifications are at variance with any law or ordinance, rule or regulation, the Contractor shall promptly notify the District in writing and any necessary changes shall be made by written instruction or change order. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules or regulations and without giving notice to the District appointed engineer, the Contractor shall bear all costs arising there from.

All necessary permits or similar authorizations required for this construction as per the "Construction Issued" Plans for such work will be obtained by the District unless otherwise stated. Copies of all permits will be furnished to the Contractor. Bonds that may be required to obtain the permits shall be furnished by the Contractor. Contractor shall maintain a copy of such permits with the Crew installing the work.

**Section 20 – AUTHORIZED PERSONNEL**

Contractor shall not accept direction or orders from any person other than the FOWD General Manager or the person(s) whose name(s) is listed as "other authorized representative(s)."

**Section 21 – UNLAWFUL HARASSMENT**

The District is committed to providing a work environment free of unlawful harassment. The Contractor and sub-contractors shall adhere to the District's policy prohibiting sexual harassment, and harassment based on pregnancy, childbirth, or related medical conditions, race, religious creed, color, national origin or ancestry, physical or mental disability, medical condition, marital status, age, sexual orientation or any other basis protected by federal, state or local law or ordinance or regulations. All such harassment is unlawful. District's anti-harassment policy applies to all persons, including but not limited to contractors and sub-contractors involved in the operation of the District and prohibits unlawful harassment by any employee of the District, including supervisors, coworkers, contractors and sub-contractors.

**Section 22 – SCOPE OF WORK**

The Contractor shall furnish all labor, materials, equipment, tools, facilities and transportation necessary to perform the work submitted in the bid proposal. Work must be performed and completed in accordance with District Standard and/or Project Specifications to the satisfaction of the District, and in the manner designated in, and in strict conformity with the Contract Documents.

Any change in the scope of the professional services to be done, method of performance, nature of materials or price thereof, or to any other matter materially affecting the performance or nature of the professional services will not be paid for or accepted unless such change, addition or deletion be approved in advance, in writing by a supplemental agreement by the Fair Oaks Water District. Contractor's "authorized representative(s)" has (have) the authority to execute such written change for Contractor.

**Section 23 – DISTRICT'S RIGHT TO TERMINATE / RIGHT TO PROCEED**

If the Contractor refuses or fails to prosecute the work, or any separable part thereof, with such diligence as will insure its completion within the time specified in Contract, or any extension thereof, or fails to complete said work within such time, the District General Manager may, by written notice to the Contractor, terminate their right to proceed with the work or such part of the work as to which there has been delay. In such event, the District may take over the work and prosecute the same to completion, by contract or otherwise, and the Contractor shall be liable to the District for any excess cost occasioned the District thereby, until such reasonable time as may be required for the final completion of the work.

**Section 24 – ASSIGNMENT BY CONTRACTOR**

This contract is for the services of the Contractor in construction of the Project and the Contractor may not assign this contract, or delegate Contractor's duties under this contract to any other person or entity without the prior written consent of District.

1. **Proof of Financial Responsibility:** All suppliers and/or carriers hired or used by Contractor or District (including, without limitation, suppliers and/or carriers of hazardous materials) shall provide District with proof of financial responsibility in accordance with all applicable law, including, without limitation, the Federal Motor Carrier Act of 1980 (driver's insurance), as

amended, the rules and regulations of the Federal Interstate Commerce Commission and applicable state law.

2. **Shutdowns and Shutdown Fees:** For all shutdowns, a forty-eight (48) hour minimum advance notice must be given by the Contractor to the District at the address indicated on the bid sheet. All shutdowns must be made by District personnel. The District will charge the Contractor a shutdown fee when the Contractor works overtime or on weekends for its own convenience. The District shutdown fee will be \$100 per day or actual time and material cost incurred by the District, whichever is greater. The Contractor must have prior approval for such shutdowns from the District's designee so named in writing.
3. **Traffic Control and Safety Regulations:** Contractor assumes the responsibility to observe all applicable federal, state and local laws, regulations and guidelines in the performance of its work, including without limitation the regulations established by O.S.H.A. and the Work Area Traffic Control Handbook, current edition (Los Angeles: Building News, Inc.) and to perform all work in a safe and prudent manner. Without in any way limiting that responsibility or assuming responsibility for safety, the District is particularly concerned that the following rules are strictly observed:

A supervisor shall be present at all times to ensure that all personnel at the job site perform in accordance with all applicable safety requirements; and

A Traffic Control Plan has been submitted and approved by the Sacramento County DOT; and

All personnel at the job site shall be properly equipped and attired, including an approved hard hat, protective eye wear, high visibility safety vest, appropriate breathing apparatus as may be required for protection from paint fumes and other Personal Protective Equipment (PPE) as necessary; and

Safety/Warning Signs shall be placed around the perimeter of the work area. Work performed in streets shall have safety devices in place in accordance with the Work Area Traffic Control Handbook and other applicable governmental rules and regulations.

4. **Damage to Property:** The Contractor shall assume the risk of all loss of or damage to property or materials during the progress of said work. The Contractor shall not disturb the facilities of other utilities or other underground structures, and it shall be liable for damages caused by its operations. Where such information is available, some effort has been made to designate the approximate location and kind of known substructures as shown on the plans, but this shall not relieve the Contractor of its responsibility to protect any and all utility lines, shown or not shown on the plan, during the performance of its work under this Contract. The Contractor shall provide a minimum of forty-eight (48) hours' notice of intent to start work to those agencies having substructures in or jurisdiction over the construction area including but not necessarily limited to Underground Service Alert.
5. **Coordination of Work:** The Contractor shall be responsible to plan and coordinate its work with other contractors working in the same project area. Loss or damage resulting from a failure to plan or coordinate shall be the Contractor's sole responsibility.

6. **Pre-Inspection of Site:** It shall be the Contractor's responsibility to ascertain the existence of any conditions affecting the work which would have been disclosed by reasonable examination of the site. The Contractor shall, upon discovering any conditions not indicated on the plans, immediately bring them to the attention of the District's assigned representative.
7. **Location of Connections:** The Contractor shall, unless instructed to the contrary by the District, excavate and expose existing District facilities at all locations where a connection (tie-in) is to be made, as shown on the plans, and shall verify that such conditions are as indicated on the plan **prior** to requesting a shutdown of existing mains.

The Contractor shall field locate points of connection or tie-in when not designated on the plan. Forty-eight (48) hours advance notification is required. Conditions differing from those indicated on the plan and requiring additional material, or material with different dimensions, shall be brought to the attention of the District's assigned representative immediately.

Any additional expenses incurred by the Contractor as a result of failure to verify existing conditions or utilities shall be considered its sole expense and will not be reimbursed by the District.

8. **Performance of Work:** Where conflicts or omissions arise involving performance of work by the Contractor under the District's Specifications, then the following priority shall be observed:
  - a. Fair Oaks Water District Construction documents.
  - b. Standards of the American Water Works Association.
  - c. Sacramento County Specifications.
  - d. Standard Specifications for Public Works Construction.
  - e. Requirements of federal, state, county and local law.
9. **Storm Drainage Discharge Best Management Practices Compliance** -The Contractor shall comply with all applicable local, county, and state laws, regulations, ordinances, and standards pertaining to storm drainage discharge and Best Management Practices (BMP) during the execution of the work. The Contractor is responsible for implementing and maintaining all necessary BMPs to minimize the impact of stormwater runoff and ensure compliance with applicable environmental laws and regulations. The Contractor shall promptly address and correct any violations or non-compliance issues as identified by the governing authorities.

#### **Section 25 – NOTICE TO START WORK**

1. **Pre-Construction Meeting:** When the cost of the jobs exceeds \$10,000, or otherwise when directed in writing by the District, the Contractor shall arrange for a pre-construction meeting to be held at the job site or other suitable location. It shall be the Contractor's responsibility to notify all utilities and agencies maintaining facilities or having jurisdiction within the area of work as well as the District's Inspector when assigned, or alternative, the assigned Authorized FOWD Representative.
2. **Scheduling of Work:** Prior to the start of any work, the Contractor shall upon request submit its proposed construction schedule in the form of a tabulation, chart, graph or as otherwise reasonably requested in sufficient detail to show the chronological relationship of all activities of the project, including the estimated number of working days for each phase when more than one phase is involved.

3. **Scheduled Start Date:** The Contractor, in accepting individual contracts, agrees to start the work within ten (10) working days after receipt of contract and written request from the Authorized FOWD Representative to start the work, or alternatively, on the date as indicated by the District as a condition of award in its original bid request and further included in its General Contract. Failure of Contractor to start the work in accordance with the provisions of this Article shall be grounds for termination.
4. **Change to Previously Scheduled Start Dates:** The District reserves the right to determine the sequence by which jobs are to be performed when the Contractor has been awarded more than one job with the District. In the event of scheduling conflicts where more than one District entity is involved, the District's Project Manager Support shall determine the priority. The District further reserves the right to adjust the order of priority for its convenience at no additional cost to the District where the Contractor has not yet commenced mobilization of a previously scheduled job.
5. **Supervision of Work:** The Contractor shall provide the Authorized FOWD Representative named in the District's Construction Agreement with the name and contact information of the supervisor responsible for the work. Such notification shall be provided a minimum of two (2) working days in advance of the scheduled start date. The Contractor shall assure that all work performed for the District is at all times supervised and staffed by qualified personnel thoroughly equipped and trained in the skills required to fulfill the work, and that such employees and agents will, at all times, comply with all applicable laws, ordinances and regulations (including, without limitation, all safety regulations, applicable to persons at a project site) that may in any manner apply to the performance of its work. The Contractor assumes all liability for loss, damage or injury to the person or property of itself and its owners, officers, agents, and employees.
6. **Protection of Work and Clean up:** Until the final completion of the work and acceptance thereof by the District, the Contractor shall care for and maintain all areas affected by its construction. The Contractor shall properly remove all debris, rubbish, and spoils from the site of the work after its completion and prior to acceptance thereof by the District.

The Contractor shall immediately remove any item posing a safety hazard and at the end of each working day remove or otherwise move from view all items presenting an untidy appearance.

All landscaping must be restored to its original condition and to the satisfaction of the District. Potentially sensitive situations should be videotaped by Contractor prior to commencement of the work.

Dust control shall be maintained as specified in Section 78 of the "*Standard Specifications for Public Works Construction*", current edition.

7. **Inspection Fees:** The District will charge the Contractor an inspection fee only when the Contractor, for its own convenience, elects to work outside of the defined workday.

Inspection request for weekends and holidays must be received in writing by Authorized FOWD Representative named in the Contract Agreement, or alternatively Task Order.

8. The foregoing in no way limits the obligation of the Contractor to assume full responsibility for the observance of all applicable safety and occupational health rules and regulations.

#### **Section 26 – TERMINATION OF CONTRACT AGREEMENTS**

**Termination Resulting from Delays by Contractor:** If the District determines that the Contractor is not diligently pursuing the work, the District will so notify the Contractor in writing, specifying what steps need to be taken to correct the situation. The additional cost to the Contractor in rectifying the situation, if any, shall be its sole cost and responsibility. Failure by the Contractor to take the necessary steps to commence the work within fifteen (15) calendar days of notice to proceed or to diligently complete the work may result in cancellation of the remaining work. Any additional cost to the District due to such cancellation of work shall be the Contractor's responsibility, and no further payment if any will be made by the District until all cost are determined. Contractor will be given written notice of termination.

**Termination Resulting From Default by Contractor:** When, in the opinion of the District, the Contractor is not performing its obligations in accordance with the Contract, or has become insolvent, or has sub-contracted work without the written approval of the District, the Contract may be canceled. In the event of cancellation, the Contractor shall be paid for the actual amount of work completed less any damages or expense incurred by the District as a result of such cancellation. If the District's damages or expenses so incurred exceed amounts due to Contractor, Contractor shall pay the District the difference upon demand. Payment for actual work completed will be based on bid prices or fractions thereof and field evaluation of work completed. The District will not be held liable for damages to the Contractor resulting from cancellation for the reasons set forth above. The Contractor shall be notified in writing specifying the reasons for cancellation, and notice shall be served upon the Surety when appropriate. Contractor will be given written notice of termination.

#### **Section 27 – ENTIRE AGREEMENT**

**Entire Understanding:** These General Conditions and the provisions and specifications contained in the General Contract form; FOWD Construction Requisition; Individual Work Scope Agreements; Term Contracts, and General Category Work Agreements, including awarded Task Orders thereto, and including attachments incorporated in such agreements by reference; represent the entire understanding for such Contract Agreements between the District and Contractor and any negotiations, proposals or oral agreements are intended to be integrated in such agreements and to be superseded by such Contract Agreements. By executing the General Contract form, Contractor waives all provisions of any printed form of agreement supplied or prepared by it that might otherwise be incorporated into a Contract Agreement, to the extent any such document is inconsistent with these General Conditions, excepting as noted below.

#### **Section 28 – ATTORNEYS' FEES**

Should any litigation be commenced between the parties to this agreement concerning the project, any provisions of this contract, or the rights and obligations of either in relation thereto, the party prevailing in the litigation shall be entitled to a reasonable sum as and for the party's attorneys' fees in the litigation.

**Section 29 – ARBITRATION**

**Basis for Settling Disputes and Disagreements:** Any dispute or disagreement arising between Contractor and District in connection with a breach or alleged breach of the Contract Agreements, including Task Orders and/or these General Conditions governing such Contract Agreements, that is not resolved to the mutual satisfaction of the parties within thirty (30) days (or such longer period as may be mutually agreed upon) from the date that either party informs the other in writing that such dispute or disagreement exists, shall be solely and finally settled by a single arbitrator in accordance with the Commercial Arbitration Rules (the "Arbitration Rules") of the American Arbitration Association (the "AAA"), in effect on the date that such notice is given, with the following exception: The party that demands arbitration of the unresolved dispute or disagreement shall in writing specify the matter to be submitted to arbitration and at the same time choose and nominate a competent person to act as the arbitrator. Within fourteen (14) days after receipt of such written notice, the other party shall indicate in writing its concurrence or nonconcurrence in the arbitrator nominated by the other party. If the parties concur in the proposed arbitrator, that arbitrator shall promptly resolve the question in dispute or disagreement in accordance with the Arbitration Rules. If the parties fail to concur in the proposed arbitrator, then upon application by either party, the dispute or disagreement shall be referred for resolution by a single arbitrator appointed in accordance with the Arbitration Rules by the AAA.

1. **Performance of Work During Arbitration:** Notwithstanding this Section 25, during the pendency of any arbitration proceedings, unless otherwise requested by FOWD, Contractor shall proceed diligently with performance of the Contract Agreements and Contractor and FOWD shall continue to be bound thereby.
2. **Location for Arbitration Proceedings:** Any arbitration proceedings hereunder shall be conducted in Sacramento County, California.
3. **Arbitration Award:** The arbitration award shall be made final and binding upon the Contractor and District and judgment may be entered thereon, upon the application of either party, by any court having jurisdiction.
4. **Cost of Arbitration:** Each party shall bear the cost of preparing and presenting its case; but the cost of arbitration, including the fees and expenses of the arbitrator(s), will be paid solely by the losing party.
5. **Survival of Arbitration Rights Beyond Termination of Contract Agreements:** This Section 25 shall survive termination of any Contract Agreement, including any applicable Task Order and these General Conditions governing such agreements with respect to all claims pending at the time of termination.

By signing below, the parties have read and agreed to the General Terms & Conditions (Exhibit

**A).DISTRICT:**

**CONTRACTOR:**

\_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Signature)

Print: \_\_\_\_\_

Print: \_\_\_\_\_

Title: General Manager\_\_\_\_\_

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

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## SECTION 01000

### SUMMARY AND GENERAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

Unless otherwise noted in these Specifications, the Contractor is to furnish all labor, equipment, tools, materials, transportation, services, permits and supplies to:

- Provide demolition, clearing, grading, pavement, concrete, gate and fence removal as needed to construct the New York Well Phase 2, New York Well Equipping and Site Improvements.
- Install a District furnished line shaft well pump with enclosed impeller and stainless steel cone strainer in the existing 18 inch diameter New York Well. The bottom of the well pump shall be set 294 feet below existing ground surface.
- Install District furnished 350 hp vertical turbine motor.
- Furnish and install well discharge piping, ASR piping, pump to waste drain pipe, piping for connection for future groundwater treatment, sample piping and water service piping.
- Furnish and install pipe trench, bedding and backfill, thrust blocks, pipe supports, valves, fittings, connections and appurtenances.
- Furnish and install manual, self activated and motor operated control valves, valve fittings, valve appurtenances, valve supports.
- Install District furnished ASR valve and ASR valve appurtenances.
- Furnish and install bidirectional flow meter and meter vault.
- Furnish and install drain box, drop inlet and storm drain pipe.
- Furnish and install concrete well head pedestal and well pad.
- Furnish and install well head appurtenances including modifications to existing sounding tube and gravel fill pipe and new air vent.
- Construct site grading, drainage and retaining wall improvements.
- Construct asphalt paving improvements and aggregate surfacing.
- Furnish and install sodium hypochlorite and sodium bisulfite feed pumps, piping, controllers, flowcells, chlorination and dechlorination injection facilities.
- Construct CMU Well Building, well building pad, access doors, rollupdoor, skylight
- Furnish and install room exhaust fans and air conditioning unit in MCC Room.
- Furnish and install miscellaneous site improvements including hose bibs, emergency shower and eye / face wash, plumbing appurtenances.
- Furnish and install site fencing, gate and gate control equipment.
- Furnish and install motor control center.

- 
- Furnish and install electrical and control wiring, conduit and appurtenances to furnish line power or standby power to the well pump motor and to New York Well Building improvements as shown on the improvement plans.
  - Furnish and install field instrumentation, Process Automation Controllers (PAC), SCADA hardware, Human Machine Interface (HMI), Operator Interface Terminal (OIT), telemetry and network equipment hardware and software, configured, programmed, tested, commissioned and documented for a fully functioning process control system, as specified in these Technical Specifications and shown on the Plans.
  - Furnish and install environmental protection and erosion control measures.
  - Furnish and install all other FOWD required demolition, clearing, piping, grading, surface restoration, pavement, well supply pump and motor and ASR facilities not otherwise furnished by the District and all other environmental compliance improvements as shown on the Plans, as specified in these Specifications and as directed by FOWD.

### 1.02 **CONTRACTOR'S OFFICE, PLANT AND EQUIPMENT**

The Contractor shall at all times be responsible for the security of his material and equipment. The Fair Oaks Water District (FOWD or District) will not take responsibility for missing or damaged equipment, tools, or personal belongings. During the performance of the contract, the Contractor may elect to furnish and temporarily install a suitable office (or offices) at the site of the work.

### 1.03 – **WORKSHOP, STORAGE FACILITIES AND STAGING AREAS**

The Contractor shall provide storage building(s) or secured storage areas for the protection of their equipment, material, supplies and tools. Workshop(s), storage building(s) and storage areas shall be located in the general area of the Work and as designated by the District.

Temporary acquisition and use of staging areas and compliance with all pertinent local ordinances and permitting procedures shall be the sole responsibility of the Contractor.

### 1.04 - **SURVEY DATA, CONSTRUCTION STAKING**

Topographic survey of the District improvements was conducted in 2020 and updated in 2024. Spot elevations and topography shown on the improvement plans represent conditions which existed at the time of these surveys.

Unless otherwise specified, the District will provide the following construction staking;

- Horizontal and vertical survey control points
- Construction staking for perimeter retaining walls. Contractor shall coordinate staking protocol with the District's Representative. Construction staking will be provided for wall alignment, angle points, top of wall elevation (or top of wall footing elevation), changes to wall height.

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The cost for restaking shall be borne by the Contractor. From the above information the Contractor shall be responsible for the horizontal and vertical alignment of site piping improvements, grading, paving and drainage improvements and all other New York Well Phase 2 Construction Well Equipping and Site Improvements shown on the Plans.

#### **1.05 - EXISTING UTILITIES**

In general, the locations of existing major utilities, whether aboveground or underground, are indicated on the Plans. The District does not guarantee the accuracy or completeness of this information and it is to be understood that other aboveground or underground facilities not shown on the Plans may be encountered during the course of the work.

Existing above ground utilities, including but not limited to power transmission, telephone and internet systems, whether shown on the Plans or not, shall be maintained, relocated, rerouted, removed, and restored as may be necessary by the Contractor in a manner satisfactory to owners and operators of the utilities and the District. The Contractor shall review the location of Project area underground water, drainage, sewer, power and communication conduit within the limits of work. All existing underground utilities shall be located and identified with the assistance of USA underground services prior to start of construction.

Existing underground utilities and appurtenant structures, which are to remain, whether shown on the Plans or not, shall be maintained, relocated, rerouted, removed, and restored by the Contractor so as not to conflict with the Work of this contract.

For purposes of this section, an existing underground utility shall be considered to be in conflict with the proposed work if it crosses or projects into proposed work at an elevation between the top and bottom of the proposed pipeline or structure.

#### **1.06 - REMOVAL OF EXISTING FACILITIES**

Where existing structures, piping, sensors, equipment, conduit, wiring, vegetation, fencing and other appurtenances are specified to be removed or are required to be removed in order to satisfactorily complete the Work, such items shall be removed in an acceptable manner. Generally, when such items are removed, the areas and surfaces from which items were removed shall be left with a finished and neat appearance compatible with the surrounding areas and surfaces. The Contractor shall do all grading, resurfacing, and other work as necessary to comply with the above requirements.

#### **1.07 - SAFETY AND HEALTH**

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

1. Construction means and methods.

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2. Safety of employees engaged in the Work while on and off the site.
  3. Safety of the District's employees, the District's Inspector(s) and the District's Representative(s), and other authorized District personnel who may visit or be affected by the Work.
  4. Safety of the Work itself including material and equipment to be incorporated therein.
  5. Safety of property at the site or adjacent thereto.
  6. Safety programs, equipment and protective devices required to assure the safety of persons and property for whom/which the Contractor is responsible.
- B. The duties of the District's Engineer(s), District's Inspector(s) or District's Representative(s) conducting review of the Contractor's performance are 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.
- C. The Contractor is hereby informed that work on this project could be hazardous. The Contractor shall carefully instruct all personnel working in potentially hazardous work areas as to potential dangers and shall provide such necessary safety equipment and instructions as required to prevent injury to personnel and damage to property, and to comply with all applicable laws and regulations including CALOSHA, Federal OSHA, and other regulations referenced in these Contract Documents.
- D. The Contractor shall, at all times, maintain the Project site in a condition that is safe for the District, District staff, the District's Engineer(s), District's Representative(s) and the District's Inspectors to make site visits and to conduct construction review. If the District cannot allow personnel to visit the site because it is not safe, the Contractor is not providing required safe access to the Work as required by the General Conditions.
- E. The Contractor shall prepare a Safety Plan that meets the requirements of applicable regulations. At a minimum, the Contractor's Safety Plan shall set forth definite procedures for informing the Contractor's 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.

## 1.08 - DRAINAGE

Existing drainage conduits shall be maintained throughout the contract time to provide the flow capacities available before commencing work. The Contractor shall provide measures necessary to prevent siltation of drainage facilities due to his operation. Drainage conduits which are broken, removed or otherwise interfered with shall be replaced.

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## 1.09 - PROTECTION OF MATERIALS AND EQUIPMENT

### A. General

Materials and equipment shall be shipped, handled, stored, and installed in ways that will prevent damage to the items. Damaged items will not be permitted as part of the Work except in cases of minor damage that have been satisfactorily repaired and are acceptable to the District.

### B. Pipe

Pipe and appurtenances shall be handled, stored, and installed as recommended by the manufacturer. Pipes with soft coatings such as coal tar epoxy, enamel, paint, or like coatings shall be stored to protect the coating from physical damage or other deterioration and shall only be handled in such manner that there will be no damage to exterior coating. Pipes shipped with interior bracing shall have the bracing removed only when recommended by the pipe manufacturer. PVC pipes shall be covered while temporarily stored in staging areas to prevent UV damage.

### C. Equipment

1. **Definition:** For the purpose of this article, "equipment" means any mechanical, electrical, or instrumentation device and other items with one or more moving parts.
2. **Packing and Marking:** All equipment shall be adequately and effectively protected against damage from moisture, dust, handling, or other cause during transport from manufacturer's premises to site.
3. **Identification and Storage of Equipment:** Each item of equipment and valve shall have firmly and permanently affixed to it non-corrosive metallic label or tag with its equipment number or other similar discrete identifying mark.
4. **Protection of Equipment After Installation:** After installation, all equipment shall be protected from damage, including but not limited to dust, abrasive particles, debris, and dirt generated by the placement, chipping, sandblasting, cutting, finishing, and grinding of new or existing concrete, terrazzo and metal, and the fumes, particulate matter, and splatter from welding, brazing, and painting of new or existing piping and equipment; and the Contractor is advised that as a minimum, vacuum cleaning, blowers with filters, protective shieldings, and other dust suppression methods will be required at all times to adequately protect all equipment. During concreting operations, including finishing, all equipment that may be affected by cement dust must be completely covered.
5. **Delivery of Equipment:** District's personnel will not accept materials or equipment deliveries for the Contractor.

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## 1.10 - CLEANUP

The Contractor shall not allow the Project Site to become littered with trash and waste but shall maintain the site in a neat orderly condition throughout the construction period. On or before the completion of the Work, the Contractor shall carefully clean out all pits, drain lines, and drains, chambers or conduits and shall tear down and remove all temporary structures built by them and shall remove rubbish of all kinds from any of the grounds which they have occupied and leave them in a condition satisfactory to the District.

## 1.11 – CONTRACTOR’S UTILITIES

### A. Power

The Contractor shall provide power as required for the Work.

### B. Water

The Contractor shall obtain and pay the current fees and rates for the water they may need for operation, potable or washdown purposes. Water for construction and testing purposes may be obtained from the District through the application and payment of current fees and rates of a District supplied hydrant meter. The Contractor shall make all arrangements and shall supply all pumps, hoses, fittings, backflow prevention devices, or other related items for drawing water at no cost to the District. Water not incorporated into the final Work shall be safely disposed of by the Contractor, in compliance with all permits, as part of the Work. Contractor may arrange and pay all current fees and rates for temporary water service through the District. Approval of hydrants for such use shall be at the sole discretion of the District. There is an existing District hydrant on the New York Avenue frontage of the New York Well Site that may be used for the construction water requirements per FOWD Agreement.

### C. Telephone / Internet / Wifi

The Contractor shall arrange telephone, wifi and internet service at their construction site office(s) as needed.

### D. Sanitary Facilities

The Contractor shall provide their own toilet and wash-up facilities. Such facilities shall be subject to the acceptance of the District as to location and type. The Contractor shall maintain sanitary facilities in acceptable condition from the beginning of the Work until completion and shall then remove the facilities and disinfect the premises.

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## 1.12 – PRECONSTRUCTION MEETING

Prior to beginning the Work, the Contractor and its key personnel and Subcontractors including the Contractor's Superintendent, Project Manager, and Field Engineer(s) shall attend a meeting with the District, the District's Design Engineer and the District's Representatives to discuss the following:

1. Name, authority, and responsibilities of parties involved
2. Project Procedures:
  - a. Progress Meetings
  - b. Correspondence
  - c. Notification
  - d. Submittal of Product Data, Shop Drawing Samples, and Proposed Equivalents
  - e. Requests for Information
  - f. Response to Requests for Information
  - g. Requests for Quotation
  - h. Work Directive Change
  - i. Change Orders
  - j. Engineer's "Items of Concern List"
3. Short Term (3 week) Schedules and Contractor's Construction Schedule
4. Temporary Facilities and Control
5. Testing During Construction
6. Contractor's Coordination
7. Mechanical/Electrical Coordination
8. Maintenance of Record Drawings
9. District Provided Items or Work and District Furnished Contractor Installed Items, if any
10. Early Beneficial or Partial Occupancy by District
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

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### 1.13 – SCHEDULE

A work schedule and hours of operation shall be required prior to starting the work. Noise abatement issues will require approval from the District.

Normal work days and times shall be weekdays, between 7:00 a.m. and 4:00 p.m., Monday – Friday. The Contractor shall be responsible for any additional costs incurred by the District for weekend or holiday work requested by the Contractor. These additional costs include, but are not limited to, overtime pay and additional District overhead costs.

### 1.14 – DISTRICT STANDARD SPECIFICATIONS

These Technical Specifications modify and supplement Fair Oaks Water District Standard Specifications which are included as part of the Project Contract Documents by reference.

### 1.15 - SECURITY

Provide security and facilities to protect the Work, existing facilities, and District's operations from unauthorized entry, vandalism, or theft. Contractor shall provide security, fencing and night watchman, as necessary, to provide adequate security.

### 1.16 – STATE AND FEDERAL LABOR STANDARDS

Employees of the Contractor and all subcontractors engaged in this project shall be compensated at or above the current prevailing wage rate determination issued by the Director of Industrial Relations. Copies of the applicable, current, State and Federal prevailing wage rates are on file with the District. The Contractor shall pay the higher wage rate in each craft, classification or worker type. A copy of the applicable current prevailing wage rates shall be posted the Project site. The Contractor and all subcontractors are subject to the application of Section 1720 et seq. of the California Labor Code which details the regulations and procedures governing the payment of State prevailing wages.

### 1.17 - PUBLIC LIABILITY AND AUTOMOBILE LIABILITY INSURANCE:

The Contractor shall furnish the District a policy or certificate of public liability insurance, including automobile liability insurance, in accordance with the requirements of these General Requirements, except as may be herein provided.

### 1.18 - EMPLOYMENT OF APPRENTICES:

- A. The Contractor shall comply with the requirements of Sections 1777.5 and 1777.6 of the Labor Code in the employment of apprentices. The responsibility for compliance with the provisions of said Section 1777.5 for all apprentice able occupations shall

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rest with the Contractor. No apprentice may be placed on the job without prior submission of apprenticeship registration, allowable pay rates and approval of the District. Failure to obtain prior approval will require payment of journeyman wages until approval is received.

- B. Information relative to apprenticeship standards, wage schedules and other requirements may be obtained from the Division of Apprenticeship Standards, 455 Golden Gate Avenue, San Francisco, California, or from its branch offices.

**1.19 - EIGHT-HOUR DAY:**

- A. The time of service of any laborer, workman or mechanic employed upon any of the work herein specified is limited and restricted to eight (8) hours during any one (1) calendar day, and forty (40) hours during any one (1) calendar week, except that work performed by employees of Contractor in excess of eight (8) hours per day, and forty (40) hours during any one week, shall be permitted for public work upon compensation for all hours worked in excess of eight (8) hours per day and not less than one and one-half (1-1/2) times the basic rate of pay.

**PART 2 – PRODUCTS – Not used**

**PART 3 – EXECUTION – Not used**

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

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SECTION 01006

**PROJECT LOCATION AND SITE ACCESS**

**PART 1 – GENERAL**

**1.01 PROJECT LOCATION**

The New York Well site is located at 4301 New York Avenue between Winding Way and Lemon Street, Fair Oaks, Sacramento County, California 95628.

**1.02 SITE ACCESS**

The Contractor, subcontractors, equipment suppliers, and any other person or agency performing work on the project shall access the site from New York Avenue at the existing New York Avenue driveway. All persons working at the site shall park either onsite or in the area designated by the District on the west side of New York Avenue taking care not to block traffic on New York Avenue Drive. The Contractor shall keep not less than 2 travel lanes on New York clear and open at all times.

**PART 2 – PRODUCTS – Not used**

**PART 3 – EXECUTION – Not used**

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

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SECTION 01025

**MEASUREMENT AND PAYMENT**

**PART 1 – GENERAL**

**1.01 SUMMARY**

This section includes: Description of bid items, measurement, and payment.

**1.02 MEASUREMENT AND PAYMENT**

All measurements will be based on completed work performed in strict accordance with the specifications. Payment will be made for bid items only. Bid items include, but are not limited to mobilization and demobilization, site work, construction of well head pedestal and pad, line shaft well pump and vertical turbine motor, piping, valves and other piping appurtenances, chemical equipment and piping, plumbing, drain and water supply improvements, construction of new well building and electrical and instrumentation improvements including all equipment, labor and materials necessary to complete the Work.

**1.03 BID ITEM DESCRIPTION**

**Bid Item No. 1 – Mobilization and Demobilization**

Description: This item includes, but is not necessarily limited to, all work associated with the site preparation improvements and permitting. This work also includes planning for and adhering to Storm Water and Non-Storm Water Best Management Practices (BMPs) to meet requirements of the Districts' NPDES Permit.

Measurement: Shall be lump sum (LS) for the completed work described above, and shall not exceed 5% of the Total Base Bid.

Payment: Based upon the LS bid for this item, 50% after Notice to Proceed, 50% upon final cleanup, demobilization and completion less retention.

**Bid Item No. 2 – Site Improvements**

Description: This item includes, but is not necessarily limited to, all work to complete demolition, grading, drainage, storm drainage piping, erosion control improvements, retaining walls, asphalt concrete pavement and aggregate base surfacing, fencing, gates, gate control equipment and yard piping improvements as shown on the Project Plans and specified in these Technical Specifications.

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Measurement: Shall be LS for the completed work described above.

Payment: Based upon the LS amount bid less retention.

**Bid Item No. 3 – Well Head Pedestal And Well Pad**

Description: This item includes, but is not necessarily limited to, all work and material associated with constructing the concrete well head pedestal and concrete well pad modifications to the existing sounding tube and gravel fill pipe and construction of new air vent pipe as shown on the Project Plans.

Measurement: Shall be LS for the completed work described above.

Payment: Based upon the LS amount bid less retention.

**Bid Item No. 4 – Install District Furnished Well Pump and Motor**

Description: This item includes, but is not necessarily limited to, all work and material associated with installing the District furnished line shaft well pump and vertical turbine motor, pump column, check valve, cone strainer and fabricated discharge head assembly shown on the Project Plans and as specified in Section 11200 - Water Well Pump and Motor, of these Technical Specifications.

Measurement: Shall be based on completion of installation and testing of the well pump and motor and pump column assembly.

Payment: Based upon the LS amount bid less retention.

**Bid Item No. 5 – Well Discharge Piping, Valves and Piping Appurtenances**

Description: This item includes, but is not necessarily limited to, all work and material associated with furnishing and installing all well discharge piping, pump to waste piping, fittings, valves, taps, equipment mounting, and supports and for furnishing and installing all the well discharge and pump to waste piping as shown on the Project Plans and as specified in Section 03400-Precast Concrete Vaults and Valve Boxes, Section 15040 - Piping, Section 15100 - Manual, Self Activated and Automatically Controlled Valves and in other related sections of these Technical Specifications.

Measurement: Shall be LS for the completed work described above.

Payment: Based upon the LS amount bid less retention.

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**Bid Item No. 6 – Install District Furnished ASR Valve, Piping and Appurtenances**

Description: This item includes, but is not necessarily limited to all work and material associated and installing all District furnished ASR valve, ASR piping, ASR pipe fittings, control valves, taps, hydraulic fluid lines, ASR control panel and ASR control panel equipment and the furnishing and installation of ASR fluid support straps and equipment mounting as shown on the Project Plans and as specified in Section 15200 – Aquifer Storage and Recovery Valves, of these Technical Specifications.

Measurement: Shall be LS for the completed work described above.

Payment: Based upon the LS amount bid less retention

**Bid Item No. 7 - Chemical Equipment and Piping**

Description: This item includes, but is not necessarily limited to, all work and material associated with furnishing and installing the sodium hypochlorite and sodium bisulfite (chemical) feed pumps, chemical piping, chemical controllers and flowcells, chemical equipment mounting, chemical injection and diffuser assemblies, chlorination and dechlorination facilities as specified in Section 11250 - Chemical Feed and Control Systems and in other related sections of these Technical Specifications.

Measurement: Shall be LS for the completed work described above.

Payment: Based upon the LS amount bid less retention.

**Bid Item No. 8 – Plumbing, Drain and Water Service**

Description: This item includes, but is not limited to, all work and materials associated with furnishing and installing water service piping, water service valves, hose bibs, emergency shower and eye / face wash, floor drains, mud valves and drain pipe shown on the Project Plans and as specified in Section 15400 – Plumbing and Plumbing Appurtenances and related sections of these Technical Specifications.

Measurement: Shall be LS for the completed work described above.

Payment: Based upon the LS amount bid less retention.

**Bid Item No. 9 - Well Building**

Description: This item includes, but is not limited to all work consistent with furnishing and installing well building foundations, pad, structure, ceilings, roof, access doors, rollup door and equipment, skylight, ventilation and air conditioning equipment as specified in Sections

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03100 – Concrete Formwork, Section 03200 – Reinforcing Steel, Section 03300 – Cast in Place Structural Concrete, Section 03315 – Grout, Section 04232 – Reinforced Concrete Block Masonry, Section 05100 – Structural and Miscellaneous Metals, Section 06190 – Prefabricated Wood Trusses, Section 06200 – Finish Carpentry, Section 07410 – Standing Seam Metal Roof Panels, Section 07600 - Flashing and Sheet Metal, Section 07920 – Joint Sealants, Section 08110 - Metal Doors and Frames, Section 08322 – Overhead Coiling Door, Section 08620 – Skylight, Section 08710 – Door Hardware, Section 08910 – Metal Wall Louvers, Section 09290 – Gypsum Wallboard, Section 09900- Coating Systems and Section 15800 – Air Ventilation and Conditioning Equipment.

Measurement: Shall be LS for the completed work described above.

Payment: Based upon the LS amount bid less retention.

### **Bid Item No. 10 – Electrical/Instrumentation**

Description: This item includes, but is not necessarily limited to, all labor, materials, tools, equipment, and incidentals required to construct and/or install all electrical equipment, control panels, lighting, gate operators, power supply equipment, fixtures, and instrumentation equipment, including sensors, gages, switches, alarms, and hardware, as shown on the plans and specified in Division 16 - Electrical, of the Technical Specifications, complete and in place.

Measurement: Shall be LS for the completed work described above.

Payment: Based upon the LS amount less retention.

**PART 2 – PRODUCTS – Not used**

**PART 3 – EXECUTION – Not used**

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

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SECTION 01300

**SHOP DRAWINGS, PRODUCT DATA AND SAMPLES**

**PART 1 – GENERAL**

**1.01 DESCRIPTION**

A. Scope

Submit Shop Drawings and Product Data as required by the Contract Documents for equipment and materials to be furnished under this Contract.

B. Related Work Specified in Other Sections

Various sections where submittals are required.

C. Schedule of Submittals

Within fifteen (15) days after the Notice to Proceed, submit a Schedule of Submittals showing the date by which each submittal required by the Contract will be made. Indicate whether the submittal will be a “Proposed Equivalent.”

The Contractor shall make all submittals early enough to allow adequate time for the District’s review up to thirty (30) calendar days and for manufacture and for delivery to the Project site without causing delay to the Work. Submittals shall be made early enough to allow for unforeseen delays, including but not limited to:

1. Failure to obtain a favorable review because of inadequate or incomplete submittal or because the item submitted does not meet the requirements of the Contract.
2. Delays in manufacture.
3. Delays in delivery.

D. Plan of Operations

Before beginning on site work, submit a plan showing Contractor’s intended use of staging area(s). Show location of enclosing fence, access points and gates. Show location of Contractor’s field office, if applicable. Show location of Contractor’s work areas and storage areas.

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## 1.02 - SHOP DRAWINGS

Shop drawings shall be presented in a clear and concise manner. All shop drawing submittals shall be accompanied by a Standard Shop Drawing transmittal form approved by the District. References shall be made to the Specification Section or to the sheet and detail of the Contract Drawings. Shop drawings shall include sufficient detail to show kind, size, arrangement and function.

The minimum sheet size shall be 8-1/2 inches by 11 inches.

## 1.03 - PRODUCT DATA

### A. Preparation:

1. Clearly mark each copy to identify pertinent products or models.
2. Show performance characteristics and capacities.
3. Show dimensions and clearances required.
4. Show wiring or piping diagrams and controls.
5. Show external connections, anchorages and supports required.

### B. Manufacturer's Standard Schematic Drawings and Diagrams:

1. Modify drawings and diagrams to delete information that is not applicable to the Work.
2. Supplement standard information to provide information specifically applicable to the Work.

## 1.04 - SAMPLES

Samples submitted, or required by these Specifications, shall be of sufficient size and quantity to clearly illustrate the functional characteristics of the product and the full range of color, texture and pattern.

## 1.05 - CONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall review shop drawings and product data prior to submittal. They shall determine and verify field measurements, construction criteria, catalogue numbers and conformance with these Specifications prior to submittal. Submittals that contain deviations from the requirements of the Contract shall be accompanied by a separate letter explaining the deviations. The Contractor's letter shall:

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1. Cite the specific Contract requirement including the Specification Section and paragraph number for which approval of a deviation is sought.
  2. Describe the proposed alternate material, item or construction and explain its advantages and/or disadvantages to the District.
  3. State the reduction in Contract Price if any that is offered to the District should the deviation be granted.

#### 1.06 – SUBMITTAL REQUIREMENTS

Six (6) copies of each shop drawing submittal and product data or an electronic PDF shall be submitted to the District's for review. Submit three (3) copies of each sample.

##### A. Contents

Each shop drawing and product data submittal shall include:

1. The date of submission and the dates of any previous submissions.
2. The project title and number.
3. Contract identification.
4. The names of:
  - a.) Supplier
  - b.) Manufacturer
5. Applicable sections of submittal noting proposed product and the manufacturer's information data sheets provided.
6. Cross reference of the product to the Specification section number.
7. Field dimensions clearly identified as such.
8. Relation to adjacent or critical features of the Work or materials.
9. Applicable standards, such as AWWA, Sacramento County, Fair Oaks Water District, CalTrans, ASTM or Federal Specification numbers.
10. Identification of deviations from Contract Documents.
11. Identification of revisions on resubmittals.
12. A 5-inch by 3-inch blank space for District Engineer's stamp.

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13. Contractor's signature, certifying review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work and of the Contract Documents.

#### 1.07 - DISPOSITION OF SHOP DRAWINGS AND PRODUCT DATA

##### A. No Exceptions Taken (NET)

If review and checking indicate no exception, copies will be returned marked "No Exceptions Taken" and work may begin immediately on incorporating the material and equipment covered by the submittal into the Work.

##### B. Make Corrections Noted (MCN)

1. "Resubmittal Not Required". The Contractor shall make corrections noted prior to installation.
2. Resubmit Specified Items. The Contractor shall submit the items noted which are required but were not included with the submittal and/or shall resubmit unsatisfactory portions or attributes of the item as noted. The Contractor may proceed to install those portions of the submittal that will be unaffected by required resubmittal.

##### C. Amend and Resubmit (A&R)

If review and checking indicate insufficient or incorrect data have been submitted, copies will be returned marked "Amend and Resubmit". No work may begin on incorporating the material and equipment covered by this submittal until the submittal is revised, resubmitted, and returned marked either "No Exceptions Taken".

##### D. Rejected – See Remarks (R)

If review and checking indicate the material and equipment submittal is unacceptable, copies will be returned to the Contractor marked "Rejected – See Remarks". No work may begin on incorporating the material and equipment covered by this submittal until a new submittal is made and returned marked either "No Exceptions Taken, or "Make Corrections Noted.

#### **PART 2 – MATERIALS – Not Used**

#### **PART 3 – EXECUTION – Not Used**

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

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SECTION 01311

**WORK SCHEDULE**

**PART 1 – GENERAL**

**1.01 SCOPE**

The work under this Contract involves equipping an existing well for aquifer pumping, recovery and recharge, connecting well supply water to existing FOWD transmission main and to existing storm drainage facilities, installing chemical feed and control facilities, installing plumbing facilities, installing motor control and standby power improvements, constructing a new well building, completing site work, retaining walls, fences, gates, grading and pavement. The Contractor is solely responsible for developing the construction schedule and sequence of work within the constraints specified in this section and the Project Plans.

**1.02 SUBMITTALS**

The Contractor shall submit the information below in accordance with Section 01300, Shop Drawings, Product Data and Samples of these Technical Specifications:

- A. The Contractor shall submit a schedule for the completion of all work described in the Project Plans and Specifications, including all connections to existing utilities. The Contractor shall identify all critical path activities in the schedule.
- B. The Contractor shall pothole to locate the exact location of all existing utilities, and submit detailed drawings and description of proposed connections for approval by the District's Representative prior to proceeding with the subject work.
- C. A copy of this specification section, with addenda updates and all referenced sections, with each paragraph check-marked to show specification compliance or marked to show deviation.

**1.03 GENERAL REQUIREMENTS**

The Contractor shall observe the following general requirements:

The project schedule shall be updated by the Contractor on a monthly basis. Updates will be submitted in accordance with Section 01000, Summary and General Requirements, of these Technical Specifications. The Contractor shall design and provide all necessary devices, equipment, and labor to isolate work areas from pipes and/or circuits which are in service. Any bulkheads and support structures shall conform to applicable CAL/OSHA requirements.

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The Contractor shall provide all necessary temporary pumps, piping, tanks, power, electrical equipment and wiring, controls, and labor during and after all testing structures and startup of all well equipping improvements. The Contractor shall maintain adequate access to the New York Well site to allow continued inspection and oversight by District personnel.

Some shutdowns may have to take place during other than normal working hours, such as early mornings, nights, holidays, or weekends. No additional compensation will be paid to the Contractor for such work outside normal working hours, whether or not identified in the contract documents.

The Contractor shall coordinate all crafts and Subcontractors to minimize the number and duration of shutdowns. Non-coordinated shutdowns that result in a cost of manpower or materials to the District shall be backcharged to the Contractor and will be deducted from progress payments.

The Contractor shall be responsible for obtaining all necessary permits for discharging test water. The discharge point and rate of drainage and/or dewatering operations is subject to approval by the District's Representative.

New equipment, which has been connected to existing FOWD facilities, may be operated by the Contractor, but only with prior approval of the District.

The Contractor shall provide temporary power, isolation, and testing fluid supply and disposal as necessary to test the systems in conformance with Section 01660 - Installation, Testing, and Commissioning, of these Technical Specifications.

#### 1.04 CONSTRUCTION SEQUENCE

As part of the submittal process, the Contractor shall identify all critical path activities including, but not limited to, specialized equipment or structure purchases and coordination with existing utilities such as PG&E, SMUD, AT&T, Comcast, and existing District water distribution, sewer collection, and storm drainage systems.

**PART 2 - PRODUCTS - Not Used**

**PART 3 - EXECUTION - Not Used**

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

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SECTION 01330

**REQUESTS FOR INFORMATION**

**PART 1 – GENERAL**

**1.01 GENERAL**

Contractor shall prepare a Request for Information (RFI) when additional information, clarification or interpretation of the Contract Documents is needed. RFIs may also be used for apparent conflicts, inconsistencies, ambiguities, or omissions.

RFIs shall be submitted to the District's Representative sufficiently in advance of the work to permit time for investigation and preparation of a response. Any work undertaken prior to receipt of a RFI response shall be at the risk of Contractor.

RFIs shall not be used for submittals, or for substitute of material or equipment, or for waiving of requirements.

**1.02 REQUIREMENTS**

RFIs shall be submitted on an approved form and numbered consecutively. A status log shall be prepared and updated by Contractor. Each RFI shall deal with only one topic, item, issue or system.

RFIs shall clearly describe the problem and specifically state what is needed. Relevant portions of the Contract Documents shall be cited, marked-up and attached.

Contractor shall review each RFI before submitting and compare it with the Contract Documents to verify that a response is required. RFIs will only be accepted from Contractor and not from Subcontractors or suppliers.

A recommendation or proposed solution may be included when appropriate or expedient.

**1.03 RESPONSE**

The District's Representative will normally respond to RFIs within 14 calendar days. Contractor shall indicate a priority for responses if more than 5 RFIs are pending at the same time.

Contractor shall reply within 7calendar days if there is disagreement concerning the RFI response.

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Subsequent resubmittals shall be identified with the same RFI number and a letter designation. Resubmittals shall clearly state the reason for resubmitting.

**PART 2 - PRODUCTS – Not Used**

**PART 3 - EXECUTION - Not Used**

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

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SECTION 01640

**SUPPLIERS / MANUFACTURER'S SERVICES**

**PART 1 – GENERAL**

**1.01 DESCRIPTION**

This section covers the services of the supplier's and manufacturer's representatives which the Contractor shall supply during construction, testing, commissioning, and training of the District's personnel for operation of the New York Well Equipping facilities.

The chronological sequence of training and its relationship to testing of equipment and systems shall be in accordance with Table TS01660-1 in Section 01660 - Installation, Testing and Commissioning of these Technical Specifications.

**1.02 DEFINITIONS**

A. Labor Day

One labor day equals one person for 8 hours straight time, exclusive of Saturday, Sunday, or holidays.

**1.03 PROCEDURE IN PROVIDING SERVICES**

A. General

The Contractor shall include in the bid price and pay all costs for all appropriate manufacturers' services, including, but not limited to, those specified herein. Where a minimum amount of time is stated in the Technical Specifications for manufacturer's services, any additional time required to perform the specified services shall be at the Contractor's expense.

B. Fulfillment of Specified Minimum Services

Only those suppliers' and manufacturers' services receiving prior approval by the District shall act to fulfill the specified minimum man-day requirements for such supplier's and manufacturer's services. All requests to the District for prior approval shall 1) be in writing; 2) be submitted not less than 14 calendar days prior to the providing of the subject services (except 30 days minimum for training); and 3) state the service to be provided. All responses to the Contractor, approving or disapproving requests for prior approval, will be in writing. Visits of suppliers and manufacturers and their representatives to the jobsite or training classroom without prior approval as provided herein will not act to fulfill the specified minimum labor day requirements.

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## C. Construction

Competent and experienced technical representatives shall represent the manufacturers of all equipment and systems as may be necessary to resolve assembly or installation problems at the worksite, which are attributable to, or associated with, the equipment furnished. Where a manufacturer's certificate is called for in these Technical Specifications, the manufacturer's representative shall provide a certificate stating that the equipment or system has been installed in accordance with the manufacturer's recommendations and has been inspected by a manufacturer's authorized representative, that it has been serviced with the proper initial lubricants, that applicable safety equipment has been properly installed and that the proper electrical and mechanical connections have been made.

Where functional testing is called for in these Technical Specifications, the manufacturer's representative shall assist with the initial functional (or run) test, which shall include checking for operation. Initial equipment and system adjustment and calibrations shall be performed in the presence of, and with the assistance of the representative. The above-mentioned manufacturer's certificate shall include the statement that proper adjustments have been made, and that the equipment or system is ready for commissioning.

### 1.04 COMMISSIONING

When technical assistance is necessary due to any malfunction of the equipment or system furnished during the commissioning period, the manufacturer's representative shall provide such services. These services shall continue at the Contractor's expense until such times as the applicable equipment or system has been successfully performance tested and has been accepted by the District and for full-time operation.

### 1.05 TRAINING OF DISTRICT'S PERSONNEL

It is the intent of this subsection to establish the minimum requirements and procedures applicable to training to be provided by the Contractor, any Subcontractors or suppliers/manufacturers in order to fulfill the requirements of this Contract and all addenda thereto. In the event other sections provide to the contrary, this paragraph will prevail.

The objective of all Contract specified training is to provide the District's operational and maintenance personnel with sufficient information and skills training on the theory, design, site specific operation and maintenance practices (including items such as routine monitoring with normal and abnormal parameters, troubleshooting techniques, and preventative and corrective maintenance requirements) to insure that equipment and systems can be efficiently and effectively operated and maintained by the trainees upon completion of the training.

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Training called for in the Technical Specifications shall be a combination of classroom, field and "hands-on" training necessary to achieve the preceding objective.

The District will provide the Contractor, its Subcontractor or suppliers/manufacturers appropriate training facilities unless otherwise indicated herein. The District will also provide information on the type of disciplines to be trained, number of groups of each discipline, number of trainees in each group and any criteria or constraints on the length of individual sessions. The District, subsequent to approval of the Contractor's training submittal, will schedule all sessions and provide for the attendance of designated personnel. A minimum of 14 days advance notice will be given to the Contractor prior to the scheduled date(s) of training sessions. Sessions will be scheduled independently of other construction or startup activities, based upon the availability of trainees and other requirements of the District. The sessions will be scheduled and conducted during the District's regularly scheduled day shift hours, Monday through Thursday. The District may video tape the training session to keep on file.

The Contractor shall insure that all equipment and systems are accessible and available for field and "hands-on" training in order to permit the delivery of scheduled training sessions.

Three (3) copies of the following information will be submitted, as a minimum requirement, by the Contractor, its Subcontractors or designated vendors, in order to assist in determining the quality and applicability of training to be provided. Materials will be furnished in such form and format as deemed acceptable by the District. Submission materials will be reviewed and training will be scheduled only subsequent to approval by the District. The submittal shall contain, but not be limited to, the following:

1. A separate, detailed outline of the material to be covered in the training session for each separate discipline to be trained. The outline shall contain sufficient detail, including the length in minutes or hours of each major topic to permit evaluation of the proposed session. The outline shall also indicate the type or location of training, i.e., "hands-on" field or classroom and audio-visual or other training aids to be used.
2. Sufficient background on the instructor(s) for each session to permit evaluation of the proposed instructor's qualifications and capability of training the target trainee discipline.
3. A trainee manual that includes the appropriate information for the target trainee group, on the equipment or system. This shall include, but not be limited to, a description of components, operation and maintenance practices and procedures (including preventive maintenance), spare parts, assembly and disassembly procedures, tools and auxiliary equipment, lubrication techniques (including types and amounts), troubleshooting techniques, normal and abnormal operating

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parameters, safety precautions, calibration and testing procedures (including equipment required). An approved copy of the trainee manual will be provided by the Contractor, its Subcontractor or designated suppliers/ manufacturers to each trainee at the scheduled session.

The preceding materials will be submitted to the District at the earliest time, but in no event less than 30 days prior to proposed delivery of said training. Approval of a submittal will permit training to be scheduled as previously defined.

When it is deemed appropriate by the District, the use of a qualified field service technician to perform actual corrective or preventative maintenance techniques, troubleshooting or operational or maintenance problems or other specified services in conjunction with the District's designated personnel may be substituted for a specified training session. The substitution will be allowable only if a detailed outline of services to be provided is submitted and approved in advance.

All training sessions will be monitored and evaluated by the District, and any session or portion(s) thereof deemed unsatisfactory will be repeated, at the Contractor's expense, until they are acceptable. It is the intent that all cost including preparation time, audio-visual materials, trainee manuals and any direct and indirect expenses of instructors, including those related to pre-and post-startup training, are incorporated in the contract price. The Contractor will be directly liable for all costs incurred to provide training specified under this Contract, except those related directly to the District's personnel costs.

**PART 2 - PRODUCTS - Not Used**

**PART 3 - EXECUTION - Not Used**

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

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SECTION 01660

**INSTALLATION, TESTING AND COMMISSIONING**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

This section specifies the installation, testing and commissioning for mechanical, electrical and instrumentation components and systems provided or installed as part of this Contract. The Contractor shall refer to Divisions 11, 15 and 16 of these Technical Specifications for additional submittal, testing and documentation requirements and incorporate those requirements into the work. The subject equipment will not be accepted unless the requirements of this section are met. The Contractor is therefore cautioned to obtain sufficient preliminary information from the vendors to allow accurate estimation of time for installation and testing prior to the contract bid date. No additional compensation will be made for changes required to test any system to meet these specifications. Unless otherwise specified, all costs of testing shall be borne by the Contractor. Requirements of applicable codes, as listed in each division, shall supersede specifications except where specifications are more stringent. This section supplements but does not supersede specific testing requirements found elsewhere in the Technical Specifications.

Sufficient time shall be provided in the Contractor's construction schedule to complete the requirements of this section, including time for retesting as needed. No additional contract time will be provided if retesting is necessary.

**1.02 COORDINATION**

The Contractor shall coordinate the scheduling and performance of all requirements of this section with Subcontractors, suppliers, and the District's Representative. The Contractor shall prepare the testing and start-up plan described herein.

**1.03 SUBMITTALS**

The Contractor shall prepare submittals in accordance with Section 01300, Shop Drawings, Product Data and Samples, of these Technical Specifications. The Contractor shall prepare a testing plan including test report forms. The testing plan shall be in accordance with this section and with Division 16, Electrical, of these Technical Specifications.

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## **PART 2 - PRODUCTS - Not Used**

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

All mechanical, electrical, and instrumentation components provided, installed, or used under this Contract shall be installed in accordance with the specified details, the manufacturer's requirements, or accepted industry standards, whichever are more stringent. In addition, materials employed in the installation shall conform to the requirements of the Contract Documents or the recommendations of the equipment manufacturers, whichever is more stringent. Should a manufacturer's installation recommendations conflict with specific requirements of the Contract Documents, the Contractor shall immediately bring the matter to the attention of the District's Representative.

Where required by the specifications, the Contractor shall cause the installation of the subject equipment to be accomplished under the supervision of factory trained installation specialists furnished by the equipment manufacturers. Upon request by the District's Representative, the Contractor shall submit documents substantiating the skills and training of all workers engaged in the installation, testing, and start-up of all equipment.

### **3.02 TESTS AND INSPECTION**

#### **A. General Requirements**

All materials, individual mechanical, electrical, and instrumentation equipment, including that furnished by the District, systems, installation, and workmanship included in this Contract shall be tested and inspected to prove compliance with the Contract requirements to the satisfaction of the District's Representative. Refer to Division 16 – Electrical of these Technical Specifications, for more detailed electrical testing requirements.

No tests specified herein shall be applied until the item to be tested has been inspected and approval given by the District's Representative for the application of such test.

Tests and inspections, unless otherwise specified or accepted, shall be in accordance with the recognized standards of the industry. The Contractor shall ensure that scheduling and performance of all tests are coordinated with involved Subcontractors, suppliers, and the District's Representative.

No inspections or tests specified herein shall be applied until all submittals for the item and the checklists, test plans, procedures, and signoff or report forms associated with the item have been received and, when required, reviewed and returned by the District's Representative indicating "no exceptions taken" or "make corrections noted." No test shall begin until: (1) all preceding tests have been successfully completed and accepted by the

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District's Representative; (2) the item to be tested has been inspected; and (3) the District's Representative has given approval for the test to start. Each and every step in the inspection and test procedures shall be witnessed by a District's Representative.

**B. Installed Tests and Inspections for Non-Equipment Items**

Installation tests for concrete, earthwork, and other non-equipment items shall be as specified in their respective divisions.

If any test fails to meet the test requirements, the Contractor shall repair, at its expense, applicable portions of the work immediately as directed by the District's Representative. The work in question shall be retested at the Contractor's expense. The Contractor shall pay to the District all reasonable expenses incurred as a result of repeating such tests.

Where, in the case of an otherwise satisfactory test, any doubt dispute, or difference should arise between the District's Representative and the Contractor regarding the test result or the methods of equipment used in the performance of such test, the District's Representative may order the test to be repeated. If the repeat test, using such modified methods or equipment as the District's Representative may require, substantially confirms the previous test, then all costs in connection with the repeat test will be paid by the District. Otherwise the costs shall be borne by the Contractor. Where the results of any installed test fail to comply with the Contract requirements for such test, then such remedial efforts and repeat tests as may be necessary to achieve the Contract requirements shall be made by the Contractor at his expense.

**3.03 SYSTEM TESTING, TRAINING, AND ACCEPTANCE PROCEDURE**

The Contractor shall fill in (complete) Table TS01660-1, System Testing, Training and Acceptance Procedure, and submit the table to the District's Representative at the Pre-Construction Conference. The table provides a column titled "Responsible Party" which will be used to identify who is responsible for each task and a target date column. The target date shall correspond to the Contractor's critical path method schedule.

Table TS01660-1 is given in the chronological sequence for completing each phase of the work and the Contractor shall adhere to this sequence.

Table TS01660-1 shall be duplicated and used for each system including, but not limited to power distribution systems, manual well operation system, lighting systems, chemical addition systems, HVAC systems and the piping systems.

**Table TS01660-1: System Testing, Training, and Acceptance Procedure**

<b>Item</b>	<b>Major Headlines or Tasks</b>	<b>Responsible Party</b>	<b>Target Date</b>	<b>Date Completed</b>
<b>1.</b>	<b>CONSTRUCTION INSPECTION</b>			
1.1	Prepare and deliver submittals	Contractor		
1.2	Review submittals	District / Consultant		
1.3	Contractor resolves all discrepancies	Contractor		
1.4	Review / approve submittals	District / Consultant		
<b>2.0</b>	<b>O&amp;M INFORMATION</b>			
2.1	Prepare and deliver draft O & M Manuals	Contractor		
2.2	Review draft manuals	District		
2.3	Revised manuals submitted for approval	Contractor		
2.4	Approve final manuals	District		
<b>3.</b>	<b>PRE-OPERATIONAL CHECKOUT</b>			
3.1	Submit PRE-OPERATIONAL CHECKOUT Safety Plan	Contractor		
3.2	Approve system for operational testing	District		
<b>4.</b>	<b>FIELD TESTING</b>			
4.1	Conduct Field Testing	Contractor / District		
4.2	Resolve discrepancies	Contractor		
<b>5.</b>	<b>FIELD TRAINING</b>			
5.1	Prepare and deliver draft Training Plan and Schedule	Contractor		
5.2	Review draft Training Plan and Schedule	District		
5.3	Revise Training Plan and Schedule and submit for approval	Contractor		
5.4	Approve final Training Plan and Schedule	District		
5.5	Schedule training	Contractor / District		
5.6	Conduct training	Contractor		
<b>6.</b>	<b>ACCEPTANCE</b>			
6.1	Prepare final Punch List	District		
6.2	Resolve final Punch List	Contractor		
6.3	Deliver marked-up plans showing “as-built” conditions	Contractor		
6.4	Review marked-up plans showing “as-built” conditions and return to Contractor for revisions	District		
6.5	Review marked-up plans showing “as-built” conditions and submit for approval	Contractor		
6.6	Approve marked-up plans showing “as-built” conditions	District		
6.7	Accept system	District		

\*\*END OF SECTION\*\*

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## SECTION 01730

### OPERATING AND MAINTENANCE INSTRUCTIONS

#### PART 1 – GENERAL

##### 1.01 SCOPE

The Contractor shall deliver to the District four (4) printed sets of acceptable manufacturer's Operating and Maintenance Instructions and an electronic (pdf) set of Operating and Maintenance Instructions covering each item of equipment or assembly provided under this contract.

##### 1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

- Shop Drawings, Product Data and Samples, Section 01300.
- Operating and Maintenance Instructions, Respective Sections of Mechanical and Electrical Technical Specifications

##### 1.03 - CONTENT OF MANUALS

- An itemized list of all data provided.
- Name and location of the manufacturer, the manufacturer's local representative, the nearest supplier, and spare parts warehouse.
- Accepted submittal (shop drawing or product data) information applicable to operation and maintenance.
- Recommended installation, adjustment, start-up, calibration and troubleshooting procedures.
- Recommended lubrication schedule, if any.
- Recommended step-by-step procedures for all modes of operations.
- Complete elementary wiring diagrams and internal and external connection wiring diagram hard copy & software editable dwg file formats.
- Software logic & programs for all systems, electronic & hardcopy.
- Recommended preventive maintenance procedures and schedule.
- Complete parts list, by generic title and identification number, with exploded views of each assembly.
- Recommended spare parts.
- Disassembly, overhaul and reassembly instructions.
- Warranty, Bond or Service Contract.

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Following the acceptable installation and operation of an item, the item's instructions and procedures shall be modified and supplemented by the Contractor to reflect all field changes or information requiring field data.

Before final acceptance of the project, the Contractor shall bind all four sets of Operation and Maintenance Instructions in appropriately labeled, expandable post-type or ring type binders. A complete table of contents listing all items and their location in the set shall be included in each binder. For easy reference, the Contractor shall compile a complete list of manufacturer's representatives for each item.

#### **1.04 - SUBMITTAL SCHEDULE**

Contractor is to submit 2 printed and bound copies of the (draft) Operating and Maintenance Manuals and one copy submitted in pdf. format. The District shall review this submittal for compliance with these specifications. If the Manual is acceptable, one printed copy will be returned to the Contractor, one copy will be retained in the District's file. If unacceptable, both printed copies will be returned to Contractor with District's comments for revision.

Contractor is to submit 4 printed and bound final copies of the approved Operating and Maintenance Manuals and one final copy in pdf. format not less than 30 days prior to completing the Project. Final payment shall not be made to the Contractor until acceptable copies of the Operating and Maintenance Manual have been delivered to the District.

#### **1.05 - INSTRUCTIONS TO DISTRICT'S PERSONNEL**

Prior to final inspection or acceptance by the District, the Contractor or the manufacturer's representatives shall fully instruct District's designated operation and maintenance personnel in the operation, adjustment and maintenance of all equipment and systems. (This is to include any software systems & logic.)

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1.06 - Schedule

At a minimum, equipment and systems Operating and Maintenance Instructions shall be prepared for each of the following items of this Contract.

<b>Specification Section</b>	<b>Equipment or Systems</b>
08322	Overhead Rolling Door
11200	Well Pump and Motor
11250	Chemical Feed and Control System
15100	Valves and Appurtenances
15200	Aquifer Storage and Recovery Valves
15500	Air Ventilation and Conditioning Equipment
16940	Instrumentation

**PART 2 – PRODUCTS – Not Used**

**PART 1 – EXECUTION – Not Used**

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

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## SECTION 02050

### DEMOLITION

#### **PART 1 – GENERAL**

##### **1.01 SCOPE**

This section specifies the demolition, removal and disposal of existing site improvements indicated to be removed on the Contract Plans. The scope of the demolition work includes removal of existing asphalt concrete pavement at the New York Well access driveways, removal of pipe gates and perimeter fence, removal of existing transducer pad, backflow preventer and valve box, vegetation removal and capping and removing an existing 10 inch diameter WSP. The Contractor shall coordinate with SMUD and with District for the timing and access for SMUD's removal of the existing transformer. The Contractor shall reference the Contract Plans for the full extent of this work.

##### **1.02 STANDARDS**

Comply with applicable District, County and State regulations and provide safety structures and fencing as required.

##### **1.03 - RELATED WORK SPECIFIED IN OTHER SECTIONS**

Section 02100, Clearing and Grubbing  
Section 02200, Earthwork

##### **1.04 - JOB CONDITIONS**

The Contractor shall determine the actual condition of facilities to be removed.

##### **1.05 - PROTECTION OF IMPROVEMENTS TO REMAIN OR CONSTRUCTED AS PART OF THIS CONTRACT**

Provide barricades, coverings or other types of protections necessary to prevent damage to existing improvements to remain and to protect the improvements constructed as part of this Contract. Any existing improvements to remain undamaged or any improvements constructed as part of this Contract shall be restored to original condition if damaged by demolition or removal work. Access to the existing New York Well site shall be maintained throughout construction of the New York Well Equipping Project and Site Improvements Project.

As part of this Contract, it shall be the responsibility of the Contractor to locate, identify and protect existing Project area utilities, pipelines and conduits which are not to be removed.

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Existing perimeter trees are to remain. If tree pruning is required to complete construction of Project improvements, notify the District.

## **PART 2 - PRODUCTS**

### **2.01 - USE OF SALVAGED MATERIALS**

Salvaged piping and materials may not be incorporated in the Work. All piping and materials to be incorporated in the Work shall be new. Pipes, concrete, fence, asphalt and like material removed as part of this Work shall become the property of the Contractor and shall be properly disposed offsite.

The use of concrete rubble for backfill shall not be permitted.

## **PART 3 - EXECUTION**

### **3.01 - GENERAL**

The Contractor shall not commence work until conditions are acceptable to the District for demolition. All debris shall be removed from the site. Depressions shall be properly backfilled in accordance with Section 02200 of these Technical Specifications. Where items are to be “removed” they shall be completely removed from the site and excavations backfilled.

### **3.02 - SAFETY**

The Contractor is to erect fences, guard rails and shoring necessary for human safety and property protection. The Contractor shall be responsible for maintaining fences, barricades, overhead protection, and similar safety measures as necessary to protect all persons in Project areas whether engaged in the construction of improvements or to provide protection for District personnel and District representatives.

### **3.03 - DIRT, DUST AND LITTER CONTROL**

Dust and dirt shall be held to a minimum by wetting down as required. Conform to Sacramento County and Control Standards. Accumulation of debris will not be permitted. Loading and hauling shall be conducted in a careful manner to keep the route(s) to disposal area(s) free of debris. Cover or maintain a minimum of two feet of freeboard space on haul trucks transporting soil, sand or other loose materials within the Project boundaries. Trucks hauling material offsite shall have covers placed over haul materials. Onsite burning of combustible materials is not permitted.

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### 3.04 - NOISE CONTROL

Noise shall not exceed 85 dBA outside the limits of construction areas without prior written authorization from the District. Project construction activities shall be limited to daytime hours and shall not conflict with County Noise Standards.

### 3.05 - DEMOLITION WORK

Completely remove existing exposed and buried facilities shown in the Contract Plans to be removed. Protect buried piping, wiring, and conduit where continued operation of these facilities is required both during construction of new improvement and for the continued operation of existing improvements. The District's existing water transmission and distribution piping in New York Avenue must be protected.

Where existing piping and other District appurtenances are specified to be removed or are required to be removed in order to satisfactorily complete the Work, such items shall be removed in an acceptable manner. Generally, when such items are removed, the areas and surfaces from which items were removed shall be backfilled and compacted and shall be left with a finished and neat appearance compatible with the surrounding areas and surfaces. The Contractor shall do all resurfacing and other work as necessary to comply with the above requirements. Control dust per Sacramento County Standards.

### 3.06 - TEMPORARY REMOVAL

Where any part of existing fences or pipelines are temporarily removed or altered in any way to facilitate the Work, the Contractor shall restore such parts to their original condition, or replace in kind, unless permanent modifications of these facilities is specifically included as part of this Work.

### 3.07 - DISPOSAL

All material to be removed from demolition activities shall be removed from the Project Site. The Contractor shall be responsible for the transport of demolition debris to a suitable disposal site(s). The Contractor shall maintain dumpster(s) in the Project area during the construction period for deposit of miscellaneous debris. Dumpster shall be emptied as required or as directed by the District.

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

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SECTION 02100

**CLEARING AND GRUBBING**

**PART 1 – GENERAL**

**1.01 SCOPE**

This section specifies the clearing, grubbing, removal and disposal of existing rubbish and vegetation along the New York Avenue frontage and perimeter and obstructions from the Project site. The Contractor shall carefully review the limits of clearing and grubbing as shown on the Contract Plans or as directed by the District. There shall be no clearing work permitted beyond designated limits unless authorized by the District.

Work under this item also includes, but is not limited to:

- A. Preservation of trees, shrubs and other plant material beyond the limits of clearing and grubbing.
- B. Preservation or, temporary removal and relocation of existing fences and gates as directed by the District and as needed to construct the Project improvements.
- C. Protection of existing Project area improvements identified to be protected on the Contract Plans and as directed by the District and the protection of existing utilities and facilities located in New York Avenue to remain in operation.

**1.02 - RELATED WORK SPECIFIED IN OTHER SECTIONS**

Section 02050, Demolition  
Section 02200, Earthwork

**1.03 - JOB CONDITIONS**

The Contractor shall determine the actual conditions in the Project area.

**1.04 - CLEARING**

In areas to be cleared, Contractor is to remove and dispose of shrubs, brush, limbs, surface vegetation and tree roots. Remove all evidence of their presence from the surface including sticks and branches greater than 2 inches in diameter or thickness. Remove and dispose of trash piles, rubbish and fencing. Remove debris.

Protect trees, vegetative growth and fencing which are not designated for removal. Unless otherwise directed by the District, existing trees and landscape vegetation not designated for removal and that do not interfere with construction of new improvements shall remain.

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## **1.05 - GRUBBING**

After clearing is completed, remove and dispose of wood or root matter below the ground surface remaining after clearing, including stumps, trunks, roots, or root systems greater than 2 inches in diameter or thickness, to a depth of 12 inches.

## **PART 2 - PRODUCTS**

### **2.01 - TREES AND SHRUBBERY**

Inspect the site as to the nature, location, size, and extent of vegetative material to be removed or preserved, as specified herein. Preserve trees and shrubs that are specifically shown on the Contract Plans or identified by District as designated to be preserved or are located beyond the limits of clearing and grubbing. If pruning of existing trees is required to complete the Project improvements, notify the District. Note that the District will remove certain trees as identified on the Plans. District will obtain tree removal permits for trees to be removed by the District. Clearing and grubbing within the canopy of mature oak trees to remain shall be conducted with the direction of a certified arborist retained by the Contractor.

## **PART 3 - EXECUTION**

### **3.01 - General**

Remove shrubs and other vegetation or obstructions that interfere with installation of new construction, and such items elsewhere onsite or on premises specifically indicated for removal. Strippings shall not be incorporated in any pipeline backfill, embankment or engineered fill section. Strippings shall not be incorporated in the material used for construction of foundation or driveways. Voids left by the removal of the vegetation, root balls or other underground structures, if found, or any other soft or loose soil pockets shall be over-excavated and backfilled with properly compacted, approved native soils that are free of organic and other deleterious materials, or with approved imported fill.

### **3.02 - Disposal**

Except where otherwise indicated, materials cleared and grubbed shall become the property of the Contractor and shall be properly disposed of offsite in accordance with County laws, codes and ordinances. Do not burn combustible material unless prior written authorization is obtained from the District. Upon completion of the site clearing work, premises to receive new construction shall be neat, clean and in suitable condition for construction of new work.

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

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## SECTION 02200

### **EARTHWORK**

#### **PART 1 – GENERAL**

##### **1.01 SCOPE**

Furnish all material, labor, plant and equipment necessary for the filling, spreading, compaction and control of fill.

##### **1.02 - RELATED WORK SPECIFIED IN OTHER SECTION**

Section 15040, Piping  
Section 02300, Structural Excavation and Backfill, Excavation, Backfill  
and Compaction for Utilities, Pipelines and Structures  
Appendix, Geotechnical Exploration, New York Well Building, Fair Oaks Water District,  
December 13, 2019 (ENGEO)

##### **1.03 - INSPECTION**

Inspection by the District may be made during excavation, backfill and compacting operations to verify that earthwork operations were made in accordance with these Specifications.

##### **1.04 - GRADING OPERATIONS WITHOUT INSPECTION**

Any grading operations and/or placement of fill or structural backfill done without District's inspection will be at the Contractor's risk, and no responsibility will be accepted, therefore, on the part of the District. Removal and replacement of material placed without inspection by the District may be required, at the expense of the Contractor.

##### **1.05 - TESTING**

Density of soil will be determined in place by the sand cone method, ASTM D 1556 or by nuclear methods, ASTM D 2922 and D 3017. Compaction tests will be performed by the District's Engineer or Inspector. Laboratory moisture-density relations of soils will be determined per ASTM D 1557 test method. Relative density of cohesionless soils will be determined per ASTM D 4253 and D 4254. Backfill materials will be sampled per ASTM D 75. Compaction shall be deemed to comply with the specifications when no more than one test of any three consecutive tests falls below the specified relative compaction. The one test shall be no more than three percentage points below the specified compaction. The Contractor shall pay the costs of any retesting of work not conforming to the specifications.

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Required minimum compaction shall be as follows:

Structural Backfill	95%
Engineered Fill	95%
Bedding and Initial Backfill (Trench Bottom to 12" above pipe)	95%
Trench Backfill in Non-paved Areas	90%
Trench Backfill in Paved Areas	95%

Should test results indicate that the minimum compaction stated above has not been achieved the Contractor shall be required to recompact and retest failed areas until test results verify that minimum compaction has been obtained. The Contractor shall bear the cost for reworking, recompacting and retesting areas of inadequate compaction.

#### 1.06 - **PROTECTION**

Adequate protection measures shall be provided to protect Contractors, employees, District staff and District Representatives at the Project site. District owned property and nearby privately owned property shall be fully protected throughout the operations. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for working conditions at the job site, including safety of all persons and property during performance of the Work. This requirement shall apply continuously and shall not be limited to normal work hours. Any construction review of the Contractor's performance conducted by the District is not intended to include review of the adequacy of the Contractor's work.

Contractor shall designate a competent person for trench safety. This person must have specific training in and be knowledgeable about soil analysis, protective systems, and the applicable California OSHA regulations.

Grading within the limits of the canopy of mature oak trees shall be conducted with the direction of a certified arborist retained by the Contractor

#### 1.07 - **EXISTING SITE CONDITIONS**

The Contractor is presumed to have visited the site and be familiar with existing site conditions.

The Contractor, upon becoming aware of surface and/or subsurface conditions different from those apparent from site inspections and from review of the Geotechnical Study appended to these specifications shall promptly notify the District as to the nature and extent of the differing conditions, first verbally to permit verifications of the conditions and then in writing. No claim by the Contractor for any conditions differing from those anticipated will be allowed unless the Contractor has so notified the District verbally and in writing.

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Geotechnical borings indicate that the New York Well site is underlain by approximately 2 ½ to 8 feet of fill. The fill encountered is generally composed of mixtures of medium plasticity clay, sand and gravel. The Expansion Index (EI) test results of 48 indicate that the tested sample is classified as “low” expansion potential, through very close to the “medium” category. Based on likely variability of the fill material, it is the opinion of the Project Geotech Engineers that medium expansion potential clays are likely onsite. Compaction recommendations are included in these Specifications to reduce the swell potential of the clay by compacting the soil at a high moisture content and controlling the amount of compaction

A detailed exploration log of subsurface material is included in the Geotechnical Study appended to these Technical Specifications.

No groundwater was encountered to the depths explored for the Geotechnical Study.

#### **1.08 - SEASONAL LIMITS**

Fill materials shall not be placed, spread or rolled during unfavorable weather conditions. When the Work is interrupted by unfavorable conditions such as heavy rains, fill operations shall not be resumed until field tests indicate that the moisture contents of the subgrade and fill materials are satisfactory.

#### **1.09 – GEOTECHNICAL STUDY**

A Geotechnical Study was prepared for the New York Well Project by ENGEO Inc. This Study, dated December 13, 2019, is included as an Appendix to these Technical Specifications

### **PART 2 – PRODUCTS**

#### **2.01 - FILL AND EXCAVATED MATERIALS - GENERAL**

All import fill material must be submitted for review and approval by the District. Submit test results verifying gradation and that the material contains less than 1% asbestos, arsenic or cyanide by volume. Tests submitted shall be performed within sixty (60) days of the submission. All material furnished and all work performed shall be subject to rigid inspection, and no material shall be delivered to the site until it has been favorably reviewed by the District or used in the construction of improvements until it has been inspected in the field by the District.

Engineered fill used for the Project shall be either select import engineering fill, or on-site soils with less than 3 percent organic content and with no particles greater than 4 inches in maximum dimension.

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Select import engineered fill shall be inorganic, shall meet the above requirements for native material and have an Expansion Index less than 50. In addition, select import engineering fill shall meet the following particle-size gradation:

Sieve Opening	Percent Passing, by Dry Weight
4 - inch square	100
¾ - inch square	70 minimum
U.S. No. 4	60 minimum
U.S. No. 200	50 maximum

Select import engineered fill material that does not meet the above criteria shall be tested under the direction of the District's Geotechnical Engineer to determine if it has engineering properties equivalent to, or better than, the existing site materials. Samples of any proposed imported fill material shall be submitted to a Laboratory approved by the District's Geotechnical Engineer for testing and approved prior to being brought to the site.

On-site engineered fill incorporated into the Project embankments shall be inorganic, contain no rocks greater than 4-inches in maximum dimension and be free of deleterious materials. Soils containing more than 3 percent by weight of organic material shall be considered organic. Subsurface data and laboratory test data obtained for this Project indicates that the near-surface native soil encountered in the borings generally meets the criteria for import engineered fill provided that it is processed to remove organic material, debris and particles greater than 4 inches in maximum dimensions and have an expansion index of less than 50.

## 2.02 - MOISTURE CONTENT

When the moisture content of the soil material is below that necessary for proper compaction, water shall be added until the moisture content is as specified to ensure solid bonding during the compacting process. The Contractor should anticipate encountering excessively over-optimum (wet) soil moisture conditions during winter or spring grading, or during or following periods of rain. Wet soil can make proper compaction difficult or impossible. When the moisture content of the soil material is above that which will permit proper compaction, the Contractor shall reduce the moisture content by:

- A. Frequent spreading and mixing during warm dry weather;
- B. Mixing with drier materials;
- C. Stabilizing with aggregate, geotextile stabilization fabric, or both.
- D. Mixing with Lime, lime-flyash or cement product.

Option C and D shall be evaluated and approved by the District prior to implementation.

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## 2.03 - REQUIRED COMPACTION

The compaction requirements shall be as specified in Paragraph 1.05 of this Section of these Technical Specifications and shall not be less than 95% for structures, intermediate and final pipe backfill in paved areas and for placement of engineered fill. Pipe bedding and initial backfill material shall not be less than 95% relative compaction. When density tests indicate that the density of any layer of fill or portion thereof is below the required compaction, the particular layer or portion shall be reworked at the Contractor's expense until the required density has been obtained. The upper 12 inches of soil subgrade in area to receive AC pavement shall be compacted to not less than 95% relative compaction.

## PART 3 – EXECUTION

### 3.01 - SITE PREPARATION

Building pad areas shall be prepared by stripping and removal of all vegetation and buried underground utilities in conflict with the proposed construction. All stripped vegetation and debris shall be removed from the construction areas and shall not be incorporated in any of the structural fills. Voids left by the removal of buried objects shall be cleared of all loose soils and properly backfilled as described below. Strip organics from the ground surface to at least 2 to 3 inches below the surface.

After stripping of the existing grasses and surface vegetation, areas to receive fill shall be stripped of loose surface soils to expose firm, competent native material. For general fill and trench backfill, moisture condition soil to at least 3 percentage point above the optimum moisture content. Compact subgrade to minimum 92% relative compaction.

### 3.02 – SUBGRADE PREPARATION

After clearing, perform subgrade scarification and compaction in the area of building pad prior to fill placement and following clearing operations. Subgrade preparation shall include the following.

- A. Scarify to a depth of at least 12 inches;
- B. Moisture condition soil to at least 3 percentage point above the optimum moisture content.  
**and**
- C. Compact the subgrade to at least 92 percent relative compaction.

After the subgrade soil has been moisture conditioned and compacted, place and compact acceptable fill as follows:

- 
- D. Spread fill in loose lifts that do not exceed 8 inches in thickness;
  - E. Moisture condition lifts to at least 1 percentage point above the optimum moisture content;  
**and**
  - F. Compact native and improve fill to a minimum of 92 percent relative compaction.

### 3.03 – **ENGINEERED FILL PLACEMENT**

Engineered fill shall be placed in a series of horizontal layers not exceeding 8 inches in loose thickness, uniformly moisture-conditioned, and compacted to achieve a minimum relative compaction summarized in Paragraph 1.05 of this section of these Specifications. Fill soils composed of sands, silty sands, and non-plastic silts shall be uniformly moisture conditioned to between 1 and 3 percentage points above the optimum moisture content. Additional fill lifts shall not be placed if the previous lift did not meet the required relative compaction or if soil conditions are not stable. Discing and/or blending may be required to uniformly moisture-condition soils used for engineered fill.

### 3.04 – **EXCAVATIONS**

Onsite materials may be excavated with conventional earthmoving equipment. Temporary excavations less than 5 feet deep may be cut as steep as 1½ H:1V (horizontal to vertical). Deeper cuts shall be evaluated in the field on a case-by-case basis. All open cuts shall be constructed in compliance with applicable Occupational Safety Health Administration (OSHA) regulations (California Construction Safety Orders, Title 8) and shall be monitored by the District's inspectors for evidence of incipient instability.

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

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SECTION 02300

**STRUCTURAL EXCAVATION AND BACKFILL, EXCAVATION,  
BACKFILL AND COMPACTION FOR UTILITIES, PIPELINES AND STRUCTURES**

**PART 1 – GENERAL**

**1.01 SCOPE**

This section includes requirements for excavating below concrete slabs, vaults, walls, building pads, and other structures of this contract not already addressed in Section 02200, Earthwork, and for excavating, preparation of pipelaying surfaces, pipe bedding, backfill and compaction for the underground piping systems furnished and installed under this contract.

**1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS**

Section 02200, Earthwork  
Section 15040, Piping  
Appendix, Geotechnical Study, New York Well Building, Fair Oaks Water District,  
December 13, 2019 (ENGEO)

**1.03 TESTS**

The District’s Geotechnical Engineer may take samples and perform moisture content, compaction and density tests during placement of backfill materials to check compliance with these Specifications. The Contractor shall remove surface material at locations designated by the District and provide such assistance as necessary for sampling and testing. The District may direct the Contractor to construct inspection trenches in compacted or consolidated backfill to determine that the Contractor has complied with these Specifications.

Testing will be made in accordance with the following:

<b>Test</b>	<b>Standard Procedure</b>
Moisture Content	ASTM D3017
Density In-Place	ASTM D1556 or ASTM D2922
Moisture-Density Relationships	ASTM D1557

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## 1.04 SUBMITTALS

Contractor shall submit, to the District, information on the Contractor's proposed compaction procedures and equipment. Fill material shall be subject to approval by the District's Geotechnical Engineer.

## 1.05 OPEN TRENCHES

Unless otherwise permitted by the District, at the end of each working day there shall be no open trenches or pits remaining from any excavation operation. .

## PART 2 – PRODUCTS

### 2.01 BEDDING AND INITIAL BACKFILL MATERIAL – WATER MAINS

Except as specifically shown on the plans or as modified in these specifications, bedding and initial backfill placed for the water mains shall conform to the typical trench sections included on the Contract Plans. Pipe bedding and initial backfill shall consist of sand with a sand equivalent of at least 30 or the pipe manufacturers' requirements, whichever is more restrictive. The pipe bedding and initial backfill shall extend from 6 inches below the invert of the pipe to 1 foot above the pipe crown of the pipe in paved areas. The pipe bedding and initial backfill material shall be compacted to a minimum of 95% relative compaction.

Bedding and backfill material shall be clean and free from vegetative matter and other deleterious substances and shall be of such a nature that it can be compacted readily to form a firm, stable base.

### 2.02 INTERMEDIATE AND FINAL BACKFILL MATERIAL – WATER MAIN

Intermediate and final backfill shall conform to the requirements of the Fair Oaks Water District and as specified in Article 2.01 of "Earthwork," Section 02200 of these Technical Specifications. Suitable on-site fill soils and suitable non-organic native soils may be used as backfill in trenches above the pipe bedding where water mains are placed in unpaved areas. In unpaved areas the intermediate and final backfill material shall be compacted to not less than 90% relative compaction. In paved areas the intermediate backfill shall be Class 2, Aggregate Base, compacted to 95% relative compaction. In unpaved areas, utility trench backfill shall be placed in layers not exceeding a loose lift thickness of 8 inches, uniformly moisture conditions, and compacted to a minimum of 90 percent relative compaction. Within paved areas the top 12 to 18 inches of trench backfill shall be compacted to not less than 95% relative compaction per ASTM D-1557 test methods.

Jetting backfill is not an acceptable means of compaction.

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## 2.03 MOISTURE CONTENT

When the moisture content of the soil material is below that necessary for proper compaction, water shall be added until the moisture content is as specified to ensure solid bonding during the compacting process. When the moisture content of the soil material is above that which will permit proper compaction, the Contractor shall reduce the moisture content by:

- A. Frequent spreading and mixing during warm dry weather;
- B. Mixing with drier materials;
- C. Stabilizing with aggregate, geotextile stabilization fabric, or both.
- D. Mixing with Lime, lime-flyash or cement product.

Option C & D shall be evaluated and approved by the District's Geotechnical Engineer prior to implementation.

## 2.04 EXCESS EXCAVATION AND WASTE

Suitable excess excavation may be used in the construction of embankment if approved by the District's Engineer. Unsuitable excess excavation shall become the property of the Contractor and shall be removed from the site, or if approved by the District, may be spread uniformly in areas of the Project not designated for construction. Excess excavation material may also be spread uniformly in areas designated by the District. Waste shall become the property of the Contractor and shall be properly removed from the site.

## PART 3 – EXECUTION

### 3.01 GENERAL

Excavate for footings, vaults, walls, pads, and structures shown to the lines and levels indicated. Finish bottoms of excavations to a true, level surface. Exercise care when excavating for lower footings. Make excavations of sufficient size to provide ample room for construction of forms, shoring and bulkheading. Increase excavations for footings two inches on all sides where soil is stable enough to stand and forms are omitted. Remove surplus material and dispose of property or as directed by the District.

The bottom and sides of all foundation excavations shall be cleaned of all disturbed soil and rock materials. Any loose rock materials encountered in foundation excavations shall be removed. All foundation excavations shall be observed by the District's Geotechnical Engineer prior to placement of reinforcing steel.

The limits of all foundations shall be a minimum of 5 feet away from the face of cut or fill slopes.

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### 3.02 **SOFT, SPONGY OR UNSUITABLE BEARING MATERIAL**

Remove all soft, spongy, or unsuitable bearing material to provide solid bearing or base of structures. Thicken concrete footings as required where subgrade is over excavated less than 1 foot. Filling in with earth below footings will not be permitted unless depth of backfill is more than 1 foot and is compacted to a relative compaction of not less than 95% of ASTM D-1557 test method.

### 3.03 **GENERAL COMPACTION**

Compact each layer of loose lift not exceeding 8 inches in thickness. In-place density shall be not less than the percentage of maximum density specified herein. Use hand-operated, platetype, vibratory, or other suitable hand tampers in areas not accessible to larger rollers or compactors. Avoid damaging pipes, structures and protective coatings. Compaction equipment and procedures are subject to approval by the District.

### 3.04 **PLACING ENGINEERED FILL BELOW STRUCTURAL FOOTINGS AND VAULTS**

Place fill in horizontal layers not exceeding eight (8) inches in loose thickness. Compact each layer of fill to a relative compaction of at least ninety-five percent (95%). Apply water with even distribution as required to obtain proper compaction. Compaction equipment or methods that produce excessive displacement shall not be used.

### 3.05 **PLACING TRENCH BACKFILL**

A. Place and compact trench backfill as follows:

1. Trench backfill shall have a maximum particle size of 3 inches;
2. Moisture condition trench backfill to or slightly above the optimum moisture content. Moisture condition backfill outside the trench;
3. Place fill in loose lifts not exceeding 8 inches;
4. Compact the upper 12 inches of fill in asphalt paved roadways and driveways to minimum 95 percent relative compaction. (ASTM D1557).

B. Jetting of backfill is not an acceptable means of compaction

### 3.06 FILL COMPACTION

Areas to receive fill shall be scarified to a depth of 8 inches, moisture conditioned and recompacted to provide adequate bonding with the initial lift of fill. Fill and backfill shall be placed with a lift thickness no greater than 8 inches or the depth of penetration of the compaction equipment used, whichever is less. The following compaction recommendations shall be used for the placement and compaction of fill and backfill.

<b>RELATIVE COMPACTION AND MOISTURE CONTENT REQUIREMENTS</b>			
<b>DESCRIPTION</b>	<b>MATERIALS</b>	<b>MINIMUM RELATIVE COMPACTION (%)</b>	<b>MINIMUM MOISTURE CONTENT (percentage points above optimum)</b>
Well Building Structural Fill	Select Granular Fill PI<12	95	1
General Fill and Utility Trench Backfill	Expansive Soil	90	3
	Granular Soil	90 (unpaved areas) 95 (paved areas)	1 1
FOWD Driveway and Paving Areas	Subgrade	95	2
	Class II Aggregate Base	95	1

Where fill or subgrade materials contains more than 30 percent rock retained on a ¾-inch sieve, a performance specification shall be used to evaluate compaction.

Compaction testing shall be conducted and verified by the District’s Geotechnical Engineer. The Contractor shall coordinate with the District’s Representative scheduling of compaction tests by the District’s Geotechnical Engineer.

### 3.07 TEMPORARY SHORING

Temporary construction excavations may require shoring. Temporary shoring shall be designed to resist lateral earth pressure from adjoining material and any surcharge loads from traffic, adjacent buildings, or construction equipment and materials. The following design criteria is provided for design of temporary shoring.

<b>RECOMMENDED LATERAL EARTH PRESSURE FOR TEMPORARY SHORING</b>	
<b>EARTH PRESSURE</b>	<b>EQUIVALENT FLUID DENSITY, DRAINED CONDITION (pcf)</b>
Active	50
At-Rest	80
Passive	300

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The above lateral earth pressures assume level backfill conditions and no surcharge loading. The pressures are based on an equivalent fluid pressure in pounds per cubic foot (pcf). The Contractor shall select the type of temporary shoring that meets the above requirements. Temporary shoring placed by the Contractor shall be subject to review and approval by the District.

### 3.08 **SURFACE AND SUBSURFACE DRAINAGE CONTROL**

Surface drainage shall be constructed with grading to prevent ponding and to enable water to drain away from foundations, slabs and edges of pavements toward suitable collection or discharge facilities. A positive surface drainage of at least 2 percent shall be provided within 10 feet of all foundations. In other areas, positive surface drainage not less than 1½ percent shall be provided to allow for rapid removal of surface water. Refer to Contract Grading Plans.

### 3.09 **FOUNDATIONS**

All foundation improvements shall be constructed in accordance with the 2019 CBC, Title 24, Chapter 17 (Structural Tests and Special Inspections), Chapter 18 (Soil and Foundations), and all other sections applicable to the proposed structural improvements.

### 3.10 **WELL BUILDING PAD PREPARATION**

The well building pad shall be cleared of surface and subsurface deleterious materials, including organics, buried utilities and irrigation lines, debris and tree roots and existing fill. After clearing remove existing fill to competent native soil, as evaluated by the District's Geotechnical Engineer. Existing fill shall be removed to at least 5 feet beyond the building footprint. The proposed building footprint is underlain by approximately 2-½ to 8 feet of fill, with the depth of fill increasing to the west. The lateral extent and depth of fill is expected to vary. Review soils exploration logs in the Appendix of these Specifications.

Perform subgrade scarification and compaction prior to fill placement, following cutting operations and in areas left at grade as follows.

1. Scarify to a depth of at least 10 inches;
2. Moisture condition soil to at least 3 percentage points above the optimum moisture content;  
**and**
3. Compact the subgrade to a minimum to 92 percent relative compaction.

After the subgrade soil has been moisture conditioned and compacted, place and compact acceptable fill as follows:

1. Spread fill in loose lifts that do not exceed 8 inches in thickness;

- 
2. Moisture condition lifts to at least 3 percentage points above the optimum moisture content;  
**and**
  3. Compact fill to a minimum of 95% percentage relative compaction.

### **3.11 FINISH GRADING**

Finished surfaces shall be smooth, compacted and free from irregularities. The degree of finish shall be that normally obtainable with a blade-grader.

Finish grade shall be as specified by the contours and proposed elevation plus or minus 0.10 foot.

Grade areas within grading limits indicated to cross-sections and finish grades shown on the Plans. Remove all vegetation, wood, and rubbish from areas to be graded. Construct drainage swales to provide drainage from all areas. Compact areas by rolling with grading equipment. Do not allow water to pond near foundation, pavements or exterior flatwork.

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

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SECTION 02500

**ASPHALT CONCRETE PAVING AND SURFACING**

**PART 1 – GENERAL**

**1.01 SCOPE**

This section specifies the work necessary to furnish and install asphalt concrete pavement consisting of aggregate base and asphaltic concrete. Asphalt concrete pavement shall be placed to the limits shown on the Contract Plans.

**1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS**

Section 02200, Earthwork  
Section 02550, Aggregate Base Paving and Surfacing

**1.03 SUBMITTALS**

The Contractor shall submit asphalt pavement design mix information in accordance with Section 01300 of these Technical Specifications to substantiate compliance with these Specifications.

**PART 2 - PRODUCTS**

**2.01 AGGREGATES**

The grading and proportioning of aggregates shall be such that the combined mineral aggregate conforms to the specified requirements.

- A. Aggregates for asphalt concrete pavement base course and for the surfacing of non-A.C. paved Project areas shall conform to Section 26 of the State of California Standard Specifications, Class 2, for 3/4" maximum size gradation.
- B. Aggregate for asphaltic concrete shall conform to Section 39 of the State of California Standard Specifications, Type A for individual test results conforming to 1/2" maximum size gradation, medium.

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## 2.02 ASPHALTIC MATERIALS

Asphalt concrete shall be Type A and shall conform to Section 39 of the State of California Standard Construction Specifications.

The paving asphalt shall be Performance Grade (PG) 64-10 per AASHTO M320-04 Specifications, as approved by the District. The amount of asphalt binder will be determined by the Contractor in accordance with CAL 367. Tolerance, upper and lower limit, will be determined to meet stability air voids and potential flushing requirements.

Asphaltic emulsions shall conform to "Asphaltic Emulsions Binder (Tack Coat)" specified in Section 94 of the State of California Standard Specifications. Tack coat shall be CCSI / CCSIh or SSI / SSIh specified in Section 94 of the State Standard Specifications

## PART 3 – EXECUTION

### 3.01 PROTECTION OF AREAS ADJACENT TO AREAS TO BE PAVED

Existing structures and improvements adjacent to the paving operations shall be protected. Contractor shall be responsible for damage caused by his employees or equipment and shall make necessary repairs. Buildings and other surfaces shall be covered with paper or other protection, where required.

Where pavement is to be placed adjacent to existing paved surfaces, the existing pavement shall be first "neat cut" to a clean, solid, vertical face, free of all loose material.

If the edge of pavement is damaged or replaced during construction of these improvements, shoulder backing shall be constructed by the Contractor at no additional charge.

### 3.02 PREPARATION OF SUBGRADE

In areas receiving Class 2 Aggregate Base Surfacing, subgrade shall be prepared in accordance with Sections 19-5 "Compaction" and 19-6 "Embankment Construction" of the State of California Standard Specifications.

### 3.03 PLACEMENT OF AGGREGATE BASE MATERIAL

Place aggregate base in accordance with requirements of Section 26 of the State of California Standard Specifications and to the thickness shown on the drawings. Grade and compact in maximum 4" thick layers to at least 95% of maximum density ASTM D1557.

For areas to receive asphaltic pavement, maintain the base course until the asphaltic pavement is in place. Maintenance shall include drainage, rolling, shaping, and water as necessary to maintain the course in proper condition. Maintain sufficient moisture at the surface to prevent a dusty condition by light sprinkling with water.

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The surface tolerance of aggregate base material shall comply with Section 26 of the State of California Standard Specifications. The finish surface of base course placed for roadways improvements when tested for uniformity of slope, shall not deviate in any point more than 3/8" from bottom of a 10 ft. straight edge laid in any direction. When base course is constructed in more than one layer, specified smoothness requirements shall apply to top surface.

### 3.04 **PLACEMENT OF ASPHALT CONCRETE, GENERAL**

The bituminous concrete shall consist of mineral aggregate, uniformly mixed with bituminous material in a central plant in accordance with Section 39 of the State of California Standard Specifications. The percentage of asphalt cement binder shall be between 4% and 7%. The mixing plant and construction equipment shall conform to the requirements of Section 39 of the State of California Standard Specifications.

Deliver bituminous mixtures to the Project site at temperatures specified in Section 39 of the State of California Standard Specifications. Spread in accordance with Section 39 of the State of California Standard Specifications. Cover all loads with tarpaulin or other material during transportation.

Initial or breakdown rolling and the final rolling of the uppermost layer of the asphalt concrete shall be in accordance with Section 39 of the State of California Standard Specifications. Compaction by vehicular traffic shall not be permitted.

Carefully make joints between old and new pavement or between successive days' work in such manner as to insure a continuous bond between old and new sections of the course. Expose and clean edges of existing pavement. Cut edge to straight, vertical surfaces. Paint all joints with a uniform coat of paint binder before the fresh mixture is placed. Prepare joints in the new pavement in accordance with Section 39 of the State of California Standard Specifications.

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

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SECTION 02550

**AGGREGATE BASE PAVING AND SURFACING**

**PART 1 – GENERAL**

**1.01 SCOPE**

This section specifies the work necessary to furnish and install new aggregate base surfacing and to repair or replace existing aggregate base surfacing removed and/or damaged during the installation of the Project improvements.

Class 2 Aggregate Base conforming to the requirements of the Caltrans Standard Specifications is to be furnished and installed.

**1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS**

Section 02500, Asphalt Concrete Paving and Surfacing

**1.03 SUBMITTALS**

The Contractor shall submit aggregate base grading and quality information in accordance with Section 01300 of these Technical Specifications to substantiate compliance with these Specifications.

**PART 2 - PRODUCTS**

**2.01 AGGREGATES**

The grading and proportioning of aggregates shall be such that the combined mineral aggregate conforms to the specified requirements.

- A. Aggregates shall conform to Section 26 of the State of California Standard Specifications, Class 2, for 3/4" maximum size gradation.

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## **PART 3 – EXECUTION**

### **3.01 - Preparation of Subgrade**

In areas receiving Class 2 Aggregate Base Surfacing, subgrade shall be prepared in accordance with Sections 19-5 "Compaction" and 19-6 "Embankment Construction" of the State of California Standard Specifications. Furnish and install weed block approved by the District and applied in accordance with manufacturer's recommendations.

### **3.02 - Placement of Aggregate Base Material**

Place aggregate base in accordance with requirements of Section 26 of the State of California Standard Specifications and to the thickness shown on the Drawings. Grade and compact in maximum 4" thick layers to at least 95% of maximum density ASTM D1557.

Maintain surfacing by providing drainage, rolling, shaping, and water as necessary to maintain the surface in proper condition. Maintain sufficient moisture at the surface to prevent a dusty condition by light sprinkling with water.

The surface tolerance of aggregate base material shall comply with Section 26 of the State of California Standard Specifications. The finish surface of the aggregate surfacing when tested for uniformity of slope, shall not deviate in any point more than 3/8" from bottom of a 10 ft. straight edge laid in any direction. Maintain the surface shape, elevation and smoothness until construction of improvements is complete by blading and adding material, if required.

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

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SECTION 02810

**ORNAMENTAL IRON FENCE AND GATES**

**PART 1 – GENERAL**

The Contractor shall provide all labor, materials and appurtenances necessary for installation of the welded ornamental iron fence and gate system as shown on the Contract Plans and as defined herein.

**1.01 SYSTEM DESCRIPTION**

The manufacturer shall supply a fence system of ornamental iron, security picket design as shown on the Contract Plans and as described herein. The system shall include all components (i.e., panels, posts, swing gate, gate operator, card reader, safety loops, exit loop, and hardware) required.

**1.02 QUALITY ASSURANCE**

The Contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

**1.03 REFERENCES**

*ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.*

*ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.*

*ASTM D523 - Test Method for Specular Gloss. 0020*

*ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.*

*ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.*

*ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.*

*ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.*

*ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).*

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*ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.*

*ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.*

#### **1.04 SUBMITTALS**

- A. All submittals shall be submitted prior to commencement of work in accordance with the provisions of Section 01300 of the Technical Specifications.
- B. The manufacturer's literature shall be submitted for approval prior to installation.

#### **1.05 PRODUCT HANDLING AND STORAGE**

Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

#### **1.06 PRODUCT WARRANTY**

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufacturer's warranty shall be guaranteed for five (5) years from date of original installation.

### **PART 2 - MATERIALS**

#### **2.01 MANUFACTURER**

The fence and gate system shall be manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma, or approved equal. Fence shall be Ameristar Montage II, Invincible Fence Product, or approved equal.

#### **2.01 MATERIAL**

- A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.60 oz/ft<sup>2</sup> (184 g/m<sup>2</sup>), Coating Designation G-60. Furnish and install (nominal) 8 foot high iron fence panels.

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- B. Material for pickets shall be 1" x 1" x 0.083" wall square steel tubing. Material for the rails shall 2" x 2" x .120" wall square steel tubing (nominal).
  - C. Material for fence post shall be ASTM 12.0 gauge steel pipe. Refer to plans for size of line posts, corner posts and gate posts.
  - D. Gate operator shall be DoorKing Model 9000 slide gate operator, or approved equal, installed on Portland Cement Concrete foundation. The slide gate operator shall be compatible with the District's existing gate control devices, key-tabs and card readers.
  - E. Prox reader as manufacturer by Door King, Series 815-350, or equal. Prox reader shall be installed on a gooseneck post and stand.
  - F. Key Switch as manufactured by Knox, Series 3500, model 3502, or equal.
  - G. Knox Box as manufactured by Knox, Series 3200, model 3262, or equal.

## 2.03 FABRICATION

- A. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Commercial Weight Fences under ASTM F2408.
- B. The manufactured panels and posts shall be subjected to an inline electrode position coating (E-Coat) process consisting of a multistage pretreatment / wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements shall meet or exceed the coating performance criteria of ASTM F 2408.

## PART 3 – EXECUTION

### 3.01 PREPARATION

All new installation shall be laid out by the contractor in accordance with the construction plans.

### 3.02 INSTALLATION

Fence post shall be spaced 96" maximum on center, plus or minus 1/4". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the

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manufacturer. Posts shall be set in concrete footers. Minimum depth of footers shall be as shown on the Contract Plans. Section 02300, Earthwork and Division 3, Concrete of these Technical Specifications shall govern material requirements for the concrete footer.

### 3.04 FENCE INSTALLATION MAINTENANCE

Fence and gate installation maintenance shall conform to the manufacturer's recommendations.

### 3.05 GATE INSTALLATION

Gate posts shall be as shown on the Plans and spaced according to the manufacturer's gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturer's gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacture of the gate and shall be installed per manufacturer's recommendations.

Install gate operator on concrete equipment base pad. The gate operator shall be operable with the District's existing gate control devices. Contractor shall provide programming for the new gate operator to function with the District's existing gate control devices.

Install warning signs as recommended by the manufacturer.

Non-contact sensors (photo electric sensors) shall be installed to protect both open and close gate cycles.

Install exit loop detector sawed into asphalt concrete pavement and connected to dedicated detector for vehicle exit. Contractor to coordinate with District for location of detector loops.

Install Door King 815-350 prox-reader. The prox-reader shall be mounted on a gooseneck style post and be placed as shown on the Contract Plans at the vehicle gate.

Install Knox Key Switch model 3502 per Sacramento Metro Fire District requirements. The Knox Key Switch shall be placed near the New York Avenue man gate as shown on the Contract Plans.

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

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SECTION 02900

**HYDROSEEDING**

**PART 1 – GENERAL**

**1.01 SCOPE**

Work included: Furnish all labor, materials, tools and equipment required to hydroseed for erosion control and complete the hydroseeding as specified herein. Exposed unpaved areas of the Project, as shown on the Contract Plans, shall be hydroseeded.

**1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS**

Section 02200, Earthwork

**1.03 SUBMITTALS**

Contractor submittals shall be in accordance with Section 01300 of these Specifications demonstrating compliance with material and construction specifications and showing dimensioned layouts of all materials required under this section.

Submit a signed certification from each source of supply for each material indicating that the material meets the Specification requirements.

**1.04 – QUALITY ASSURANCE**

Hydroseeding shall be performed by personnel familiar with the procedures required of their trade and shall be supervised by a qualified planting foreman.

All materials shall be of standard, approved first grade quality and shall be in prime condition when installed and accepted. Any commercially processed or packaged materials shall be delivered to the site in the original unopened containers bearing the manufacturer's guaranteed analysis.

**1.05 – JOB CONDITIONS**

A. Planting Conditions

No hydroseeding shall occur during weather conditions which will adversely affect materials or installation or when soil is in a muddy condition.

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B. Preservation of property

The hydroseeding operations shall be conducted in such a manner that no damage shall result to site improvements and plantings. The Contractor shall be responsible for any damage resulting from his operations, and shall repair or replace such damage at his own expense and to the satisfaction of the District.

C. Schedule

Hydroseeding shall not begin until improvements have been installed and inspected by the District in each area that is to receive hydroseeding. Contractor must receive approval to proceed from District prior to starting hydroseeding work.

Notify the District at least 48 hours in advance of all seeding.

## **PART 2 - MATERIAL**

### **2.01 HYDROSEEDED GRASS**

A. Materials

1. Seed:

Seed shall comply with Section 20-2.10, "Seed", of the State of California, Department of Transportation, Standard Specifications.

Seed shall be labeled and shall be delivered to the job site in unopened original containers, bearing the dealer's label and guaranteed analysis. Seed shall be certified seed, clean, delivered in original unopened containers bearing an analysis of the contents and guaranteed 95% pure, and have a minimum germination rate of 80%. The seed containers shall be stored immediately in a dry, weather and damp proof structure. Any seed which has become wet, moldy or damaged in transit or storage will not be acceptable.

2. Seed Mix Percentage shall be:

50% - Zorro Fescue  
20% - California Brome  
15% - Hykon Rose Clover  
10% - Persian Clover  
5% - Bolea Balaksa Clover  
Application rate: 70 lbs. per acre.

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3. Fertilizer:

Fertilizer shall be delivered mixed as specified in standard size unopened containers showing weight, analysis and name of manufacturer. Store in a weatherproof storage place and in such a manner that it will be kept dry and its effectiveness not impaired.

Fertilizer shall have the following guaranteed Ingredient Percentage: Nitrogen 15%; Phosphoric Acid 15%; Water Soluble Potash 15%.  
Application rate: 350 lbs. per acre.

4. Cellulose:

The mulch shall be green colored, fibrous, wood cellulose mulch containing no growth or germination inhibiting factors. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with fertilizer, seed, water and other approved additives, the fibers in the material will become uniformly suspended to form a homogeneous slurry; and that when hydraulically sprayed on the ground, the material will form a blotter-like ground cover impregnated uniformly with seed; and which after application, will allow the absorption of moisture and allow the rainfall to percolate to the underlying soil. Alternative mulches will be considered for approval by the District.

Cellulose shall be certified to indicate that laboratory and field testing of the product has been accomplished and that it meets all of the foregoing requirements.

Weight specifications of this material from suppliers and for all applications shall refer only to air dry weight of the fiber material. Each package of the cellulose fiber shall be marked by the manufacturer to show the air dry weight content.  
Application rate: 2,000 lbs. per acre.

5. Tackifier:

The tackifier shall be an organic material derived from the plantago husk, "R - Binder" as manufactured by Clyde Robbins Seed Co., or approved equal. Inorganic tackifiers of any type are not acceptable.  
Application rate: 100 lbs. per acre.

6. Water:

Water for hydroseeding shall be clean, potable and added to the slurry mixture in sufficient amount to spread uniformly the required quantity of hydroseed solids.  
Application rate: approx. 3,000 gallons per acre.

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B. Cleared and Chipped Vegetative Material

Cleared vegetative material that can be chipped may, with the approval by the District, be spread for erosion control within the limits of the area shown on the Contract Plans to be protected by hydroseeding.

**PART 3 - EXECUTION**

**3.01 – FINISHED GRADING**

Prior to any hydroseeding, all finish grading in areas to be hydroseeded shall have been completed and approved by the District.

Water exposed area as needed prior to seeding. Take care not to cause erosion or otherwise damage the slope profile and integrity.

**3.02 – HYDROSEEDING**

Installation of all piping, spray field equipment and other screening plants shall be completed prior to hydroseeding operations, unless directed otherwise by the District.

A. Equipment

Hydroseeding equipment used for the application of the seed, fertilizer and slurry of prepared wood pulp shall be of the type as approved by the District. This equipment shall have a built-in agitation system and operating capacity sufficient to agitate, suspend and homogeneously mix a slurry containing up to 40 pounds of fiber and tackifier plus combined total of 70 pounds fertilizer solids and seed for each 100 gallons of water.

The slurry distribution lines shall be large enough to prevent stoppage. This discharge line shall be equipped with a set of hydraulic spray nozzles which will provide a continuous nonfluctuating discharge and delivery of the slurry in the prescribed quantities uniformly, without misses, waste, or erosion.

The District may authorize equipment with smaller tank capacity provided that the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.

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B. Preparation

The slurry preparation shall take place on the site. The slurry preparation shall begin by adding water to the tank when the engine is at half throttle. When the water level has reached the height of the agitating shaft, good recirculation shall be established; and at this time, the seed shall be added. Seed shall not be agitated for more than 20 minutes before application is to begin. Fertilizer shall then be added, followed by wood pulp and tackifier. The wood pulp and tackifier shall be added to the mixture after the seed has been added and when the tank is at least one-third filled with water.

The engine throttle shall be opened to full speed when the tank is half filled with water. All the wood pulp and tackifier shall be added by the time the tank is two-thirds or three-fourths full. Spraying shall commence immediately when the tank is full.

C. Application

All areas to receive hydroseeding shall be sprayed with a uniform, visible coat by using the green color of the wood pulp as a guide.

The slurry shall be applied in a sweeping motion, in an arched stream, so as to fall like rain allowing the wood fibers to build on each other until a good coat is achieved, and the material is spread at 2,000 pounds wood fiber (plus seed, fertilizer and tackifier) per acre.

D. Time limit

Any slurry mixture which has not been applied within four hours after mixing shall not be used and shall be removed from the jobsite.

E. Protection of Work:

All hydroseeded areas shall be protected against trespassing and from damage at all times. If areas are damaged, they shall be reseeded. No work shall be performed in hydroseeded areas without proper safeguards. Protective barriers shall be removed at time of final acceptance.

### 3.03 – CLEAN UP

Neatly dress and finish all hydroseeded areas.

Rinse excess hydroseeded material from asphalt, concrete or aggregate base paved surfaces.

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### 3.04 – PRELIMINARY INSPECTION

At the completion of work, the Contractor shall request a preliminary inspection to determine the condition of hydroseeding.

Hydroseeding considered ready for inspection shall show a uniform, smooth ground surface without eroded ruts or gullies.

All debris shall be removed from site.

### 3.05 – REPLACEMENT

Replace hydroseeded erosion control material in any area of 50 square feet or more, and in washout gullies, where growth is not initiated within 30 days, following initial application. Washout gullies will require scarification of existing soil and placement of topsoil to fill washout and grade to specifications prior to reseeding.

The replacement erosion control material shall be of the same formulation and quality as the original and shall be installed as per these specifications.

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

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SECTION 03100

**CONCRETE FORMWORK**

**PART 1 – GENERAL**

**1.01 SUMMARY**

The work of this Section includes providing concrete formwork, bracing, shoring, and supports.

**1.02 REFERENCES**

A. Except as otherwise indicated, the current editions of the following apply to the work of this Section:

- PS 1 U.S. Product Standard for Concrete Forms, Class I
- ACI 117 Standard Tolerances for Concrete Construction and Materials
- ACI 318 Building Code Requirements for Reinforcing Concrete
- ACI 347 Recommended Practice for Concrete Formwork

**1.03 SUBMITTALS**

A. The following shall be submitted in compliance with Section 01300:

1. Falsework Calculations and Drawings: The Contractor's attention is directed to the provisions of the California Division of Industrial Safety, Construction Safety Orders, which requires that all falsework or vertical shoring installations where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure, exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or provision for vehicular or railroad traffic through falsework or vertical shoring is made, shall be approved and signed by a civil engineer, registered in the State of California; provided further, that a copy of the falsework plan or shoring layout shall be available on the job site at all times.
2. Catalog information on:
  - a. Form ties and all related accessories, including taper tie plugs, if taper ties are used
  - b. Form gaskets
  - c. Form release (“bond breaker”).

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## **PART 2 - PRODUCTS**

### **2.01 – GENERAL**

- A. Materials for concrete forms and falsework shall be new or in new condition.
- B. Except as otherwise expressly accepted, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material or in new condition. All forms shall be smooth surface forms except as specified on contract drawings.

### **2.02 FORM AND FALSEWORK MATERIALS**

- A. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:
  - 1. Lumber shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20.
  - 2. Plywood for concrete formwork shall be waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.
  - 3. Form materials shall be metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade shown.
  - 4. Unless otherwise indicated, all exterior corners in concrete members shall be provided with 3/4-inch or 5/8-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.
- B. Materials for formwork hardware and reinforcing spacers:
  - 1. All formwork hardware left inside the concrete shall have at least 2” clear cover.
  - 2. Concrete dobies are not permitted on the interior surface of fluid-containing structures.

## **PART 3 - EXECUTION**

### **3.01 - General**

- A. Tolerances: The variation from established grade or lines shall not exceed the tolerances of ACI 117.

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- B. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The Contractor shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the work and replaced at the Contractor's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.
  - C. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Drawings, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete within 1/8" at exposed surfaces and 1/4" elsewhere.
  - D. At exposed surfaces, plywood, grain, or other formwork irregularities shall not imprint concrete surface.

### 3.02 FORM DESIGN

- A. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete.
- B. The forms shall be tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the Engineer. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, form windows shall be provided in the size and spacing needed to allow placement of concrete to the requirements of Section 03300 – Cast-in-Place Structural Concrete. The size, number, and location of such form windows shall be acceptable to the Engineer.
- C. Form windows are required for wall pour depths greater than 25 feet tall. At least one window shall be provided for each pour, but no less than one per 60 linear feet of horizontal wall length.
- D. Forming systems for walls taller than 14 feet or horizontal spans greater than 16 feet require

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a formal and site-specific design and submittal, stamped by a licensed civil engineer.

- E. Forms and falsework to support the roof and floor slabs shall be designed based on nationally recognized standards, but in no circumstance be less than the total dead load, plus a live load of 50 psf for horizontal surfaces, and a lateral load of 100 lbs per foot at top of forms.
- F. Lateral pressures used for form design shall conform to ACI 347-latest edition, but in no case be less than 60 lbs per cubic foot multiplied by the depth of the forms for continuous pours.

### 3.03 CONSTRUCTION

- A. Vertical Surfaces: All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is shown. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Where soil slope or face cannot hold its shape during concrete operations, formwork shall be used.
- B. Construction Joints: Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete.
- C. Pipe stubs and anchor bolts shall be set in the forms where required.
- D. Form Ties
  - 1. Embedded Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as indicated in Section 03300 – Cast-in-Place Structural Concrete. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1.5 inches back from the formed face or faces of the concrete.

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2. Removable Ties: The larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink or regular cement grout for above-grade walls that are dry on both sides. Exposed faces of walls shall have the outer 2 inches of the exposed face filled with a polymer-modified cement grout that shall match the color and texture of the surrounding wall surface.
  3. Factor of safety = 2.0 against tensile failure

### 3.04 Reuse of Forms

- A. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces that are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

### 3.05 REMOVAL OF FORMS

- A. Careful procedures for the removal of forms shall be strictly followed, and this work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. In the case of roof slabs and above-ground floor slabs, forms shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 75 percent of the 28-day strength specified in Section 03300 – Cast-in-Place Structural Concrete; provided, that no forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained 75 percent of the specified 28-day strength and has been in place for a minimum of 7 days. The time required to establish said strength shall be as determined by test cylinder results from concrete used in the first pour. If the time so determined is more than the 7-day minimum, then that time shall be used as the minimum length of time. Forms for all vertical walls and columns shall remain in place at least 1 day after the concrete has been placed, provided that average air temperature is between 10 degrees F and 115 degrees F and concrete has sufficient strength to maintain form.
- B. Apply curing as required after form removal.

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### 3.06 MAINTENANCE OF FORMS

Forms shall be cleaned, treated with a releasing agent, and maintained in accordance with ACI 347 and the following. The form surfaces shall be treated with a nonstaining mineral oil or other lubricant acceptable to the Engineer. Any excess lubricant shall be satisfactorily removed before placing the concrete. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

### 3.07 FALSEWORK

Falsework, including staging, walkways, forms, ladders, and similar appurtenances, shall be designed, engineered, constructed, and maintained according to the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, and the requirements of the Construction Safety Orders of the California Division of Industrial Safety.

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

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SECTION 03200

**REINFORCEMENT STEEL**

**PART 1 – GENERAL**

**1.01 SUMMARY**

The work of this Section includes providing all concrete reinforcement steel, welded wire fabric, couplers, and concrete inserts for use in reinforced concrete and masonry construction, including all the wires, clips, supports, chairs, spacers, and other accessories.

**1.02 REFERENCES**

ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete
CRSI MSP-1	Concrete Reinforcing Steel Institute Manual of Standard Practice
WRI	Manual of Standard Practice for Welded Wire Fabric
AWS D1.4	Structural Welding Code - Reinforcing Steel
ASTM A82	Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A185	Specification for Welded Steel Wire Fabric For Concrete Reinforcement
ASTM A615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
ASTM A775	Specification for Epoxy-Coated Reinforcing Steel Bars

**1.03 SUBMITTALS**

A. The following shall be submitted in accordance with Section 01300:

1. Reinforcing Shop Drawings
  - 1) Bill of Materials
  - 2) Placing Drawing
  - 3) Splices
  - 4) Mechanical Splices

- 
- 5) Shop Bending Diagrams
  - 6) Embeds
  - 7) Anchor Bolts
  - 8) Sleeves
  - 9) Gates
  - 10) Conduits
  - 11) Dowels
2. General Contractor shall coordinate all of the various discipline and subcontractor submittal prior to submitting for review by the engineer of record.
  3. Mill certificates for all reinforcing at time of site delivery
  4. Proof of CRSI membership, or equivalent trade membership
- B. Details of the concrete reinforcement steel and concrete inserts shall be submitted by the Contractor at the earliest possible date. Details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements indicated. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop drawings shall include bar placement diagrams that clearly indicate the dimensions of each bar splice.
- C. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, manufacturer's literature shall be submitted which contains instructions and recommendations for installation for each type of coupler used; furnish current research reports by ICC.
- D. If reinforcement steel is spliced by welding at any location, the Contractor shall use A 706 reinforcing. All welding shall comply with AWS D1.4. The Contractor shall submit a written welding procedure ("WPS") for each type of weld for each size of bar which is to be spliced by welding.

#### 1.04 STORAGE

- A. Reinforcing, embeds and accessories shall be kept clean and free from dirt or grease.

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## **PART 2 - PRODUCTS**

### **2.01 – REINFORCEMENT STEEL**

A. Reinforcement steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:

1. Bar reinforcement shall conform to the requirements of ASTM A 615 or A 706 for Grade 60 Billet Steel Reinforcement.
2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A185 or deformed ASTM A497 and as indicated; provided, that welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W4 size shall be furnished in flat sheets only.

B. Accessories

1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. All bar supports shall meet the requirements of the CRSI Manual of Standard Practice including special requirements for supporting epoxy coated reinforcing bars. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating. Plastic shall be gray in color.
2. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located, and be used for horizontal bars at grade only. Wire ties shall be embedded in concrete block bar supports. Concrete blocks shall not be used on the inside face of hydraulic structures.
3. Epoxy coating for reinforcing and accessories, where specified or shown, shall conform to ASTM A775.

### **2.02 MECHANICAL COUPLERS**

- A. Mechanical couplers shall be provided where shown and where approved. The couplers shall be Type 2, as determined by ACI 318.
- B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied. This shall apply to all mechanical splices, including those splices intended for future connections.
- C. Approved couplers are Bar-Lock (Dayton) or Xtender (HRC) or equal.

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## **PART 3 - EXECUTION**

### **3.01 – GENERAL**

- A. All reinforcement steel, welded wire fabric and other reinforcement shall be free of materials deleterious to bond. Minor rust that is not scaling or loose is acceptable.

### **3.02 FABRICATION**

- A. Reinforcement steel shall be accurately formed to the dimensions and shapes shown, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as indicated. Bars shall be bent cold.
- B. Fabricating Tolerances: Bars used for concrete reinforcement shall meet the fabricating tolerances defined in ACI 315.

### **3.02 PLACING**

- A. Reinforcement steel shall be accurately positioned and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers that are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties that are embedded in the blocks. For concrete over formwork, the Contractor shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.
- B. Limitations on the use of bar support materials shall be as follows.
  - 1. Concrete Dobies: permitted at all locations except where architectural finish is required, or at interior side of fluid-containing wall.
  - 2. Wire Bar Supports: permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
  - 3. Plastic Bar Supports: permitted at all locations except on grade.
- C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- D. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in ACI 318 and ACI 117.

- 
- E. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to the approval of the Engineer.
  - F. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters. Slab bolsters shall be spaced not more than 30 inches on centers, shall extend continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane indicated.
  - G. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction.
  - H. Epoxy coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating. Non-abrasive slings made of nylon and similar materials shall be used. Specially coated bar supports shall be used. All chips or cracks in the epoxy coating shall be repaired with a compatible epoxy repair material prior to placing concrete.
  - I. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.
  - J. Tack welding of reinforcing bar is prohibited.

### 3.04 **SPLICING**

- A. General: Reinforcement bar splices shall only be used at locations indicated. When it is necessary to splice reinforcement at points other than where shown, locations and details shall be included on shop drawings.
- B. Bending or Straightening: Reinforcement shall not be straightened or rebent in a manner that will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by the Engineer. Bars partially embedded in concrete may be field-bent one time at an angle up to 30 degrees, and bent back to its original position. Rebending more than once will render the bar unacceptable.
- C. Couplers that are located at a joint face shall be a type that can be set either flush or recessed from the face as shown. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. Couplers intended for future connections shall be recessed a minimum of 1/2 inch from the concrete surface. After the concrete is placed, the coupler shall be plugged with plastic plugs that have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged. Maintain minimum edge distance and concrete cover. Couplers shall be installed as required by manufacturer.

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**3.05 CLEANING AND PROTECTING**

- A. Reinforcement steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it. Mild non-flaking surface rust is acceptable.
- B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary recleaned.

**3.06 INSPECTION**

- A. Testing Agency and District shall be provided at least 48 hours advance notice to schedule inspections as required by the contract drawings and building code.

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

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SECTION 03300

**CAST-IN-PLACE STRUCTURAL CONCRETE**

**PART 1 – GENERAL**

1.01 1.01 **SUMMARY**

A. Section Includes

1. Cast-in-place structural reinforced concrete
2. Concrete accessories

1.02 1.-2 **REFERENCES**

A. American Concrete Institute (ACI)

ACI 117	Standard Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete for Buildings
ACI 304	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305	Hot Weather Concreting
ACI 306	Cold Weather Concreting
ACI 308	Guide to Curing Concrete
ACI 309	Consolidation of Concrete
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Environmental Engineering Concrete Structures

B. American Society for Testing and Materials (ASTM)

ASTM C31	Practices for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Specification for Concrete Aggregates
ASTM C39	Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Specification for Ready-Mixed Concrete
ASTM C143	Test Method for Slump of Portland Cement Concrete
ASTM C150	Specification for Portland Cement

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ASTM C157	Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
ASTM C172	Standard Method of Sampling Freshly Mixed Concrete
ASTM C192	Method of Making and Curing Concrete Test Specimens in the Laboratory
ASTM C260	Specification for Air-Entraining Admixtures for Concrete
ASTM C289	Test Method For Potential Reactivity of Aggregates (Chemical Method)
ASTM C309	Specifications for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Specification for Chemical Admixtures for Concrete
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction & Criteria for Laboratory Evaluation

### 1.03 DEFINITIONS

- A. “Contractor” includes the general contractor in direct contract with the District, subcontractor, or any tradesman responsible for construction.
- B. “District’s Representative” includes the Inspector, Engineer of Record, or Construction Manager representing the District’s interests, and not directly compensated by the Contractor.
- C. “Cold Weather” is defined as a period when, for more than 3 consecutive days, the following conditions exist:
  - 1. Average daily air temperature is less than 40 F degrees (5 C) and
  - 2. Air temperature is not greater than 50 F degrees (10 C) for more than one-half of any 24-hour period.
- D. “Hot weather” is defined by any one of the following conditions:
  - 1. Ambient air temperature above 90 F degrees (32 C).
- E. “Mass Concrete” refers to single pour cast-in-place concrete that is greater than 2’-10” thick, or an area larger than 500 square feet.

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#### 1.04 SUBMITTALS

- A. General: All submittals must be provided for Engineer of Record approval at least 3 weeks prior to construction.
- B. Submit concrete mix design for each concrete type per ACI 301:
  - 1. Mix proportions
  - 2. Concrete materials
  - 3. Admixtures
  - 4. Water test results
  - 5. Waterstop samples for hydraulic structures
- C. Shrinkage test results from prior test mixes per ASMT C157 for hydraulic structures.
- D. Curing methods and product data per ACI 301.
- E. Repair procedures for repair per ACI 224.1 and ACI 301.
- F. Special procedures for hot weather concreting.
- G. Special procedures for cold weather concreting.
- H. Special procedures for mass concrete.

#### 1.05 QUALITY ASSURANCE

- A. Qualifications: All foremen supervising construction shall have a minimum of 3 years experience in similar work, and at least 3 previous projects of similar type, and shall be familiar with ACI 301.
- B. Field Testing
  - 1. Daily inspection written reports shall be provided to the District's Representative and engineer of record providing detailed information of work completed within 24 hours.
  - 2. During concrete placement, the following duties shall be performed by the special inspector to be designated by the District:
    - a. Ambient air temperature test
    - b. Concrete temperature test

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- c. Concrete slump test
  - d. Collection of samples for lab testing
  - e. Confirm accuracy of batch ticket
3. Pre-pour conference: after submittals have been provided and before construction has been commenced, a concrete conference shall be coordinated between the Inspector, Engineer of Record, and Contractor.

C. Lab Testing

1. Compression testing per ACI 318 chapter 5.
2. Shrinkage testing per ASTM C157 for hydraulic structures.
  - a. One shrinkage test is required for the first batch of concrete, and every 500 cubic yards of fresh concrete thereafter.
  - b. Acceptance criteria is 0.038% (0.00038) shrinkage at 28 days.

1.06 **PROJECT CONDITIONS**

A. Soil subgrade

1. Prior to setting reinforcing and pouring concrete on soil, the District's Geotechnical Engineer of record shall approve of the soil.

B. Environmental Requirements:

1. Concrete placement shall be limited to temperature ranges per ACI 301.
2. Concrete placement shall be limited to weather conditions per ACI 301.

- C. Wet weather construction. Between the months of October and April, the contractor shall provide a 2" thick minimum mud-mat and sump pit at the bottom of foundation excavations that will be open for more than 72 hours prior to structural concrete placement. In all cases, where rainwater has saturated the bottom of foundation excavation grade prior to structural concrete placement, the grade shall be recompacted prior to concrete placement.

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## **PART 2 - PRODUCTS**

### **2.01 – GENERAL**

- A. Except as noted below, all products and materials used in proportioning, mixing, transport, placement, consolidation, curing, and repair shall satisfy ACI 301 and the Construction Drawings.

### **2.02 MATERIALS**

- A. Concrete materials
  - 1. Aggregate per ACI 301
  - 2. Cementious materials per ACI 301
    - a. Cement shall be portland cement.
    - b. Fly ash shall be provided at 15% minimum, 25% maximum of cementious materials.
  - 3. Admixtures
    - a. Provide as necessary to meet design and workability requirements
    - b. Mixes for hydraulic structures require shrinkage-reducing admixture, such as Eclipse by W.R. Grace.
  - 4. The minimum 28-day strength and type of concrete shall be as specified on the Structural Drawings.
- B. Water shall be potable, and have the following limitations:
  - 1. Chlorides (as Cl) no more than 250 mg/L per EPA method 300.
  - 2. Sulfates (as S04) no more than 250 mg/L per EPA method 300.
  - 3. Total dissolved solids no more than 500 mg/L per EPA method 160.
  - 4. Water quality shall be analyzed by EPA methods. Test results shall be provided to the Engineer of Record for the first batch of concrete, and every 500 cubic yards of fresh concrete thereafter.
- C. Curing compounds per ACI 301.

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D. Concrete Sealer and Densifier

1. Water based, colorless, VOC compliant.
2. Product containing silicate and silicate.
3. Dayton Superior, Sure Hard Densifier J17; Euclid Chemical Company, Euco Diamond Hard; Master Builders, HD 200WB; or equal.

E. Miscellaneous Materials

1. Waterstops are Greenstreak PVC 6" tall flat ribbed.
2. Plugs for formwork wall-tie holes are Dayton Sureplug A-58.
3. For formwork ties that are left in place, provide plastic cone spacers for 1.5-inch breakback.

2.03 **EQUIPMENT**

1. Equipment shall conform to ACI 301.

**PART 3 – EXECUTION**

3.01 **PREPARATION**

- A. Construction shall not be commenced until the applicable submittals have been approved by the Engineer of Record, and the Inspector has been scheduled.
- B. Reinforcing, embedded items, sleeves, and inserts shall be set and secured prior to fresh concrete placement. Interconnect anchor bolt groups with steel templates.
- C. Construction Joints:
  1. Construction joints shall be water-blasted prior to casting fresh concrete against existing concrete.
  2. New concrete shall not be placed adjacent to existing concrete younger than 3 days old for hydraulic structures; 2 days otherwise.
- D. Bonding agent shall not be used except where specially required on the Construction Drawings.

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- E. Formwork temperature is verified per ACI 301.
  - F. Subgrade or hardened concrete to be cast against conforms to ACI 301.

### 3.02 **INSTALLATION**

- A. Placement of fresh concrete in forms per ACI 301.
- B. Placement of fresh concrete on soil per ACI 301.
- C. Placement of fresh concrete shall be limited to weather constraints per ACI 301.
- D. Depositing fresh concrete per ACI 301 with the following requirements:
  - 1. For hot weather conditions, maximum time from batching to discharge shall not exceed 45 minutes.
  - 2. For normal weather conditions, maximum time from batching to discharge shall not exceed 60 minutes.
  - 3. Time between lift placement shall not exceed 30 minutes for hot weather placement; 60 minutes otherwise.
- E. Consolidate fresh concrete per ACI 301.
- F. Construction joints: Contractor shall not move construction joints from locations shown on Construction Drawings without approval by Engineer of Record.
- G. Concrete Sealer and Densifier
  - 1. Apply concrete sealer to all interior floor slabs.
  - 2. Apply per manufacturer's recommended procedures.
    - a. Apply to freshly finished concrete or hardened concrete.
    - b. Apply at recommended rates.
  - 3. For hardened concrete thoroughly clean prior to application.
    - a. Remove curing compound prior to application.
- H. Finishing formed surfaces
  - 1. Exposed edges shall have 5/8-inch chamfers.

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2. Filling Tie Holes:

- a. No sooner than 14 days after formwork removal, clean and roughen the entire tie hole, and cone taper zone where exists, using an aggressive wire brush.
- b. Use Dayton Sure Plug A-58 to plug round tie holes on both wall faces.
- c. Recess plug back 1.0 inches deeper than face of wall or recess cone taper.
- d. Use Sikatop 123 Plus mortar or approved equal to fill and patch hole.

I. Finishing Unformed Surfaces:

1. Fresh concrete placement per ACI 301.
2. Finishes definitions per ACI 301 with the following requirements:
  - a. Broom finish coarseness shall not exceed 1/16-inch amplitude, and shall be applied perpendicular to the predominate slope of the finished concrete.
  - b. Scratch Finish may also be termed “Roughened Surface” on the Construction Drawings.
3. Finish schedule
  - a. Scratch Finish shall be applied to:
    - 1) Construction joints.
    - 2) Surfaces intended to receive bonded cementitious mixtures.
  - b. Float Finish shall be applied to:
    - 1) Walks, drives, steps, ramps, and for surfaces intended to receive waterproofing, roofing, insulation, or tiling.
  - c. Trowel Finish shall be applied to:
    - 1) Floor intended as interior walking surfaces.
    - 2) Exterior walking surfaces with less than 2 percent slope.
  - d. Boom Finish shall be applied to:
    - 1) Exterior walking surfaces with more than 2 percent slope.

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2) Elevated slabs, overhangs, bridges where guardrailing is required.

J. Curing shall conform to ACI 301 with the following additional requirements

1. Where a protective coating will be applied to the concrete after curing, liquid (“membrane”) curing compounds shall not be used.
2. Where a liquid curing compound is used, the compound shall be pigmented. Pigmentation shall be removable without special chemicals.

K. Tolerances per ACI 117.

### 3.03 **PROTECTION**

A. Protection shall be per ACI 301.

### 3.04 **REPAIR**

A. Repair shall be per ACI 301 with the following requirements:

1. Patching mortar shall be Sikatop 123 Plus or approved equal.
2. Use Sikadur 32 HiMod bonding agent or approved equal.
3. Honeycombs and defects deeper than 38 mm (1.5 inches) shall require approval by Engineer of Record prior to commencing repair work.
4. Cracks wider than 0.5 mm (0.02 inches) for hydraulic structures shall be repaired prior to leak testing.
5. Cracks wider than 1 mm (0.04 inches) shall be repaired.

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

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SECTION 03310

**CAST-IN-PLACE SITEWORK CONCRETE**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. The work of this Section includes providing finished cast-in-place concrete, sitework concrete, air placed concrete, including formwork, steel reinforcement, mixing, placing curing, and repairing.
- B. Sitework concrete includes curbs, gutters, catch basins, sidewalks, steps on grade, pavements, fence and guard post embedment, underground duct bank encasement, and all concrete work indicated to be sitework concrete.

**1.02 REFERENCE**

Reference	Title
ACI 117	Standard Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete for Buildings
ACI 318	Building Code Requirements for Structural Concrete
Caltrans	California Dept of Transportation Standard Specifications, latest edition

**1.03 SUBMITTALS**

- A. Submittals shall be made in compliance with Section 01300.
- B. Required submittals shall be provided in accordance with the requirements of Section 03300 – Cast-in-Place Structural Concrete.

**1.04 QUALITY CONTROL**

- A. Tests on component materials, for the compressive strength of concrete, and for construction tolerances shall be performed in accordance with the requirements of 03300 - Cast-in-Place Structural Concrete.
- B. Inspection: Prior to casting concrete or setting reinforcing, the geotechnical engineer of record shall observe and approve the subgrade.

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## **PART 2 – PRODUCTS**

### **2.01 CONCRETE MATERIALS**

- A. Concrete component materials, including curing materials and joint materials shall be in accordance with Section 03300 – Cast-in-Place Structural Concrete, with the exception that all cast-in-place sitework concrete shall be as follows:
  - 1. Reinforced concrete pavement for vehicular traffic: Shall have developed a minimum compressive strength of 4,000 pounds per square inch at 28 days.
  - 2. All other sitework concrete: 5 sack (minimum) and shall have developed a minimum compressive strength of 2,500 pounds per square inch at 28 days.
- B. Abandoned formwork. Except where explicitly shown on the Contract Documents, formwork shall not be left in place.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. Proportioning and mixing, preparation of surfaces for concreting, handling, transporting and placing concrete, finishing and curing concrete surfaces and related procedures shall be performed in accordance with Section 03300 – Cast-in-Place Structural Concrete.
- B. Concrete shall not be cast in a line longer than 70 feet in a single day.
- C. Delays between adjacent pours shall be at least 48 hours.
- D. Sitework concrete cast against structural concrete shall be separated by building paper or other barrier to prevent bond, except as explicitly shown on the Drawings.
- E. For non-structural paving, no single placement shall exceed 200 square feet or 14 feet in any direction without a shrinkage contraction joint.

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

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SECTION 03315

**GROUT**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. The work of this Section includes providing grout other than that required for masonry work.
- B. The following types of grout are included in the work of this Section:
  - 1. Non-Shrink Grout: This type of grout shall be used wherever grout is required, unless another type is specifically indicated.
  - 2. Cement Grout
  - 3. Topping Grout and Concrete Fill
- C. Except as otherwise indicated, the current versions of the following apply to the work of this Section:

<u>Reference</u>	<u>Title</u>
CRD-C 621	Corps of Engineers Specification for Non-shrink Grout
ASTM C109	Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens)
ASTM C531	Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical- Resistant Mortars, Grouts, and Monolithic Surfacing
ASTM C579	Test Methods for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacing
ASTM C827	Test Method for Early Volume Change of Cementitious Mixtures
ASTM D696	Test Method for Coefficient of Linear Thermal Expansion of Plastics

**1.02 SUBMITTALS**

- A. The following shall be submitted in compliance with Section 01330 – Submittals Procedures:
  - 1. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of non-shrink and epoxy grouts proposed for use in the work.

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2. Certified test results verifying the compressive strength, shrinkage, and expansion properties.

### 1.03 **QUALITY CONTROL**

#### A. Field Tests

1. When a project is used without documentation, compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the Engineer to insure continued compliance with these specifications.
2. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.
3. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the District's representative. A set of three specimens will be made for testing at 7 days, and each earlier time period as appropriate.

- B. The cost of all laboratory tests on grout will be borne by the District, but the Contractor shall assist the District's representative in obtaining specimens for testing. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The Contractor shall supply all materials necessary for fabricating the test specimens.

## **PART 2 – PRODUCTS**

### 2.01 **CEMENT GROUT**

- A. Cement grout mix design shall satisfy the same requirement as structural concrete, except that cement grout has no large aggregate requirement when the grout thickness is less than 3”.

### 2.02 **PREPACKAGED GROUTS**

#### A. Non-Shrink Grout

1. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout indicated herein shall be that recommended by the manufacturer for the particular application.

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2. Class A non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C827; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD C 621.
  3. Class B non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi and shall meet the requirements of CRD C 621.

#### B. Application

1. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is specified in the contract documents; except, for those applications for Class B non-shrink grout and epoxy grout indicated herein. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.
2. Class B non-shrink grout shall be used for the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

### 2.03 TOPPING GROUT AND CONCRETE FILL

- A. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement grout. All materials and procedures specified for concrete in Section 03300 – Cast-in-Place Structural Concrete shall apply except as indicated otherwise herein.
- B. Topping grout and concrete fill shall contain a minimum of 564 pound of cement per cubic yard with a maximum water cement ratio of 0.45. Where concrete fill is thicker than 3 inches, structural concrete as indicated in Section 03300 – Cast-in-Place Structural Concrete may be used.
- C. Strength: Minimum compressive strength of topping grout and concrete fill at the end of 28 days shall be 4000 psi.

### 2.04 CURING MATERIALS

- A. Curing materials shall be as indicated in Section 03300 – Cast-in-Place Structural Concrete for cement grout and as recommended by the manufacturer of prepackaged grouts.

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## 2.05 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow.
- B. Unless otherwise noted on contract dwgs, grout for base plates and equipment leveling shall have flowable, semi-flowable, and packable viscosities. Flowable and semi-flowable consistencies requires formwork.

## 2.06 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement is not an acceptable method of measurement.

## PART 3 – EXECUTION

### 3.01 GENERAL

- A. All surface preparation, curing, and protection of cement grout shall be as required. The finish of the grout surface shall be troweled smooth unless noted otherwise.
- B. Where pre-packaged product is used, the manufacturer's representative shall provide on-site technical assistance upon request.
- C. Base concrete or masonry must have attained its design strength before grout is placed. When bonding to an existing cementitious material is expected, waterblasting or sandblasting to roughen the substrate is required.

### 3.02 GROUTING PROCEDURES

- A. Base Plate Grouting
  - 1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a grout thickness not exceeding 2x the anchor bolt diameter.
  - 2. After the base plate has been set in position at the proper elevation double nutted on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout. The grout shall be placed so there are no voids between the bottom of the base plate and the concrete.

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## B. Topping Grout

1. All mechanical, electrical, and finish work shall be completed prior to placement of topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or waterblasting to ensure bonding to the base slab.
2. The minimum thickness of grout topping and concrete fill shall be one inch. Where the finished surface of concrete fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2-inches wide by 1-1/2-inches deep.
3. The base slab shall be thoroughly cleaned and wetted prior to placing topping and fill. No topping concrete shall be placed until the slab is complete free from standing pools or ponds of water. The topping and fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.
4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping and fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.

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

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SECTION 03400

**PRECAST CONCRETE VAULTS AND VALVE BOXES**

**PART 1 – GENERAL**

**1.01 SCOPE**

This section includes furnishing and installing, complete and in place, precast concrete valve boxes, utility boxes and vaults.

**1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS**

Fair Oaks Water District Standard Specifications  
Section 03310, Cast-In-Place Sitework Concrete  
Section 15100, Manual, Self Activated and Automaticlaly Controlled Valves

**1.03 CODES**

Valve boxes, utility boxes and vaults shall be capable of meeting AASHTO Loading Class HS 20-44 design loads where specified in the plans to be "traffic rated" or when they are placed in areas subject to traffic loadings.

Aggregates used in the concrete mix either coarse or fine, excluding light-weight aggregates shall conform to specifications as outlined by ASTM C-33-86.

All light-weight aggregates, fine or coarse, shall conform to specifications as outlined by ASTM C-330-85T.

Both types of aggregates shall be properly graded and free of any deleterious substances so as to produce a homogeneous concrete mix when blended with cement.

The cement shall be Type II low alkali Portland Cement and shall meet ASTM C-150 Type II standards.

**1.04 SUBMITTALS**

The Contractor shall submit information and shop drawings in accordance with Section 01300 of these Specifications, indicating compliance with the material, construction and performance specifications indicated herein.

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## 1.05 STANDARD SPECIFICATIONS

Precast valve boxes, utility boxes and vaults shall conform Fair Oaks Water District Specifications and Standards and to the details and dimensions shown on the Contract Plans.

## 1.06 STORAGE AND PROTECTION

Precast concrete items delivered to the jobsite shall be stored by the Contractor in a secured area until the time of installation. Contractor shall not accept delivery of more precast items than they can safely store and protect at any one time.

## PART 2 - PRODUCTS

### 2.01 PRECAST VALVE BOXES, UTILITY BOXES AND VAULTS

Valve boxes, utility boxes and vaults shall be provided consistent with the size and depth shown on the Contract Plans. Boxes shall be capable of supporting AASHTO Loading Class HS 20-44 traffic loads when designated as a "traffic rated" enclosure on the plans or when box is placed in areas subject to traffic loadings. Vault sections shall be sealed with "Ram-Nek" joint seal or equal. Barrel sections, bases and riser covers shall be compatibly sized and keyed and be the products of the same manufacturer. Joints shall be tongue and groove. Vault construction shall be in the form of monolithic walls; do not use panel walls. Valve boxes, utility boxes and vaults shall be as manufactured and supplied by Jensen Precast, Santa Rosa Precast Products, Brooks Precast Concrete Products, Christy Concrete Products or approved equal.

Precast utility vaults furnished and installed for the meter installations shall be minimum 5'-0" wide by 6'-0" long by 6'-0" deep, inside dimensions.

### 2.02 PEDESTRIAN RATED ACCESS DOORS

Where utility vaults are to be installed with Pedestrian rated access doors, furnish and install double leaf, watertight, aluminum doors fabricated with structural grade aluminum diamond plate. Plate shall be 3/16" thick, designed to support 300 lbs./s.f. live load. Doors shall be equipped with an automatically locking hold open arm which locks the door in the open position. Doors shall include compression spring assist opening hardware. Doors shall have a stainless steel recessed lift handle. Frame shall be extruded with anchor flanges and an integral aluminum nut rail to accept 1/2" nuts. Frame shall be a channel type, equipped with a neoprene gasket and 1-1/2" drain coupling. All hardware shall be stainless steel. Hinges shall be stainless steel with stainless steel pins and tamper proof fasteners. Factory finish shall be a mill finish with a bituminous coating applied to the exterior of frame. Lock shall be a staple for a padlock or stainless steel snap lock with removable handle. Pedestrian rated

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access doors shall be manufactured and supplied by Utility Vault Company, Access Manufacturing or approved equal.

### **2.03 TRAFFIC RATED ACCESS DOORS**

Where utility vaults are to be installed with traffic rated access doors, furnish and install double leaf watertight steel doors fabricated with grade A36 steel diamond plate designed to support AASHTO H20 truck loading. Doors shall be equipped with an automatically locking hold open arm which locks the doors in the open position. Doors shall include compression spring assist opening hardware. Doors shall have a recessed lift handle. Frame shall be a channel type, equipped with neoprene gasket and 1-1/2" drain coupling. All hardware shall be stainless steel. Hinges shall be stainless steel with stainless steel pins and tamper proof fasteners. Factory finish shall be primary paint. Lock shall be a staple for a padlock or stainless steel snap lock with removable handle. Traffic rated access doors shall be manufactured and supplied by Utility Vault Company, Access Manufacturing or approved equal.

### **2.04 WALL PENETRATION SEALS**

Pipelines entering and exiting the valve vaults shall be furnished and installed with wall seals to prevent the intrusion of groundwater into the vaults. Seals shall be suitable for sealing ductile iron pipe. Seal shall be Model C Link-Seal or approved equal. Furnish and install with 316 stainless steel nut and bolts and EPDM rubber interconnecting rubber links.

## **PART 3 - EXECUTION**

### **3.01 GENERAL INSTALLATION**

All precast concrete items shall be installed in accordance with the Contract Plans and in accordance with manufacturer's recommendations.

### **3.02 TESTING**

Precast concrete items shall be subject to testing or as directed by the District. Failure of a test due to an improperly installed or defective precast concrete item shall necessitate repair or replacement of that item and retesting at the Contractor's expense.

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

**REINFORCED CONCRETE BLOCK MASONRY**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. The work of this Section includes providing concrete masonry work complete, including reinforcing steel, embedded items, and all other appurtenant work.

**1.02 REFERENCES**

- A. Except as otherwise indicated, the current editions of the following apply to the work of this Section:

<u>Reference</u>	<u>Title</u>
ACI 315	Manual of Standard Practice for Detailing Reinforced Concrete Structures
ACI 530	Building Code Requirements for Concrete Masonry Structures
ACI 530.1	Specifications for Masonry Structures
ASTM A615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
ASTM C5	Specification for Quicklime for Structural Purposes
ASTM C55	Building Brick, Concrete
ASTM C90	Specification for Hollow Load-Bearing Concrete Masonry Units
ASTM C140	Method of Sampling and Testing Concrete Masonry Units
ASTM C144	Specification for Aggregate for Masonry Mortar
ASTM C145	Solid Load-Bearing Concrete Masonry Units
ASTM C150	Specification for Portland Cement
ASTM C207	Specification for Hydrated Lime for Masonry Purposes
ASTM C270	Specification for Mortar for Unit Masonry
ASTM C331	Specification for Lightweight Aggregates for Concrete Masonry Units
ASTM C404	Specification for Aggregates for Masonry Grout
ASTM C426	Test Method for Drying Shrinkage of Concrete Block
ASTM E476	Grout for Reinforced and Nonreinforced Unit Masonry
ASTM E447	Test Method for Compressive Strength of Masonry Prisms
Portland Cement Association	Concrete Masonry Handbook

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## 1.03 SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300 of these Specifications.
1. Samples of concrete masonry unit colors with texture ranges as specified under “Part 2 - Products” shall be submitted to the construction manager for selection of color. Full size samples of the blocks selected shall be submitted for final approval by the District after color and texture selection. Samples of mortar colors shall be submitted for color selection by the District’s Representative.
  2. Concrete masonry block unit material certificate, and documented conformance to ASTM C 140 shall be submitted showing material compliance with these Specifications. The District’s Representative’s approval shall be obtained prior to delivery of concrete masonry units to the job site.
  3. Mill Certificates: Steel producer's certificates of mill analysis, tensile and bend tests for reinforcement steel.
  4. Drawings shall be submitted for fabrication, bending, and placement of reinforcement bars. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures." Bar schedules, diagrams of bend bars, stirrup spacing, lateral ties and other arrangements and assemblies shall be shown as required for fabrication and placement.
  5. Mortar product information.
  6. Ready-mix design for grout.
  7. Test results of masonry prisms (where required).
  8. Anchor, fastener, tie, and metal accessory hardware catalog and technical documentation.
  9. Sealants for movement (“control”) joints.
  10. Hot weather construction procedures.
  11. Cold weather construction procedure.

## 1.04 QUALITY ASSURANCE

- A. Testing of Mortar and Grout

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1. Contractor shall ensure that mortar mixing is consistent throughout the project. Where prism testing is required, mortar mixing method used for prism shall be utilized for production.

B. Testing of Masonry Prisms

1. The District will have masonry prisms tested where required by the contract drawings. Tests will be taken at the following times:
  - a. Prior to production, at least three masonry prisms shall be made for each type of block indicated herein; except separate prisms are not required for block which only varies by texture.
  - b. At any change in materials during construction, at least five masonry prisms shall be made for each type of block affected.
  - c. One set of at least three masonry prisms shall be made for each masonry structure, besides, and every 5,000 square feet of wall.
- C. The prisms shall be constructed by the Contractor in the presence of the District's Representative and approved inspector. The same personnel who are laying the block in the structure shall construct the masonry prisms.
- D. The masonry prisms shall be constructed and will be constructed and tested per ASTM C 1314.
- E. Compression tests will include three prisms tested at 28 days after grouting.
- F. The average compressive strength of prisms tested at 28 days shall exceed the value calculated by ASTM C 1314.
- G. If the compressive strength of the prisms fails to meet the requirements of the contract drawings, adjustments shall be made to the mix designs for the mortar, or grout, or both, as needed to produce the specified strength. The masonry units shall also be laboratory tested to verify compliance with the requirements of ASTM C 90, Grade N-1.
- H. If the compressive strength of the prisms, made during construction of the work and tested as indicated herein, fails to meet the requirement, prisms or cores shall be cut from the walls in sufficient numbers and in sufficient locations to adequately determine the strength of the walls. Those portions of the walls represented by specimens failing to meet the required compressive strength shall be subject to removal and replacement.

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## 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Cement, lime, and other cementitious materials shall be delivered to the site and stored in dry, weather-tight sheds or enclosures, in unbroken bags, barrels, or other containers, plainly marked and labeled with the manufacturers' names and brands.
- B. Mortar and grout shall be stored and handled in a manner which will prevent the inclusion of foreign materials and damage by water or dampness.
- C. Masonry units shall be handled with care to avoid chipping and breakage, and shall be stored as directed in the Concrete Masonry Handbook. Materials stored on floors or slabs shall be stacked in such manner that the uniformly-distributed loading does not overload floor.
- D. Masonry materials shall be protected from contact with the earth and exposure to the weather and shall be kept dry and clean until used. Where daily temperature exceeds 90°F, fog spray newly constructed masonry until damp for first three days.

## PART 2 - PRODUCTS

### 2.01 CONCRETE MASONRY UNITS

- A. Concrete masonry units shall conform to ASTM C90, Type I, with maximum linear shrinkage of 0.065 percent from standard to oven-dried condition. Units shall be medium weight unless indicated otherwise.
- B. Concrete masonry units shall be 8-inch by 8-inch by 16-inch modular size standard units, with one end open or both ends open.
- C. All bond beam, corner, lintel, sill, and other specially shaped blocks shall be provided and used where required or necessary. Specially shaped non-standard blocks may be constructed by saw cutting.
- D. Concrete masonry units shall be made with integral water repellant admixture:
  - 1. Liquid polymeric admixture per ASTM C1382
  - 2. Does not reduce the flexural bond strength for exposed units.
  - 3. Amounts used shall be as submittal and approved.
  - 4. Verify compatibility with liquid water repellant admixture being used in the fabrication of concrete masonry units.

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## 2.02 MATERIALS FOR MORTAR AND GROUT

A. Materials for mortar and grout shall conform to the following requirements:

1. Portland cement shall be Type II, low alkali, conforming to ASTM C150.
2. Lime paste shall be made with pulverized quicklime, or with hydrated lime, which shall be allowed to soak not less than 72 hrs before use; except, that hydrated lime processed by the steam method shall be allowed to soak not less than 24 hrs and shall be made by adding the lime to the water. In lieu of hydrated lime paste for use in mortar, the hydrated lime may be added in the dry form. Hydrated lime shall be Type S, conforming to ASTM C207. Pulverized quicklime shall conform to ANSI/ASTM C5, shall pass a No. 20 sieve, and 90 percent shall pass a No. 50 sieve.
3. Sand shall conform to ASTM C 144. Coarse aggregate shall conform to ASTM C 404. Largest aggregate shall be 3/8 inches or less.
4. Water for mixing shall be clear potable water.
5. Reinforcing steel shall be per contract drawings.
6. Admixture for mortar shall not be detrimental to the bonding or help the process of efflorescence.
7. Ready-mix grout is preferred over site mix. Where grout is site-mixed, full time special inspection is required.

## 2.03 – MANUFACTURERS

A. Products shall be of the following manufacture and type (or equal):

1. Efflorescence control admixture for Mortar
  - a. GCP Applied Technologies, Dry-Block Mortar Admixture
  - b. Tamms, HydraTite Plus Water Repellent and Shrinkage Control Mortar Admixture
  - c. BAASF, Rheopel Plus Mortar Admixture
2. Water reducing admixture for Grout
  - a. Sika Chemical Co. "Sika Grout Aid" Type II
  - b. Master Builder's "MasterPozzoloth 80" normal

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## **PART 3 – EXECUTION**

### **3.01 GENERAL**

- A. Concrete masonry shall conform to the ACI 530.1.
- B. Concrete masonry units shall not be placed when air temperature is below 40 degrees F (4 degrees C) and shall be protected against direct exposure to the wind and sun when erected when the ambient air temperature exceeds 99 degrees F (37 degrees C) in the shade with relative humidity less than 50 percent.
- C. Concrete masonry shall conform to the following:
  - 1. Lay concrete masonry units cured, dry, and with surfaces cleaned.
  - 2. Lay masonry units true, plumb and level.
  - 3. Protect partially laid wall as well as units in storage from moisture.
- D. Tolerances for concrete masonry units shall conform to the following:
  - 1. Maximum variation from plumb in walls and corners:
    - a. 1/4-inch over 10 feet
  - 2. Maximum variation from level or indicated elevations:
    - a. 1/4-inch in any bay or 20 feet
    - b. 1/2-inch in 40 feet.
  - 3. Maximum variation from plan position indicated on the Drawings:
    - a. 1/2-inch maximum
- E. Measurements for mortar and grout shall be accurately made. Shovel measurements are not acceptable. Mortar proportions shall be accurately controlled and maintained.

### **3.02 SHORING AND BRACING**

- A. All shoring and bracing shall be provided as required for the Work. Shoring and bracing shall be constructed to required shapes and sizes, capable of supporting and sustaining the

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loads to which they will be subjected without failure or deflection. Shores and bracing shall be left in place until concrete masonry can safely carry all required live and dead loads.

- B. Concrete masonry walls shall be adequately braced to withstand all forces to which they will be subjected during construction.

### 3.03 MORTAR

- A. Mortar for concrete block masonry shall conform to ASTM C270.
- B. Mortar color shall match block color, except where specified differently on contract drawings.

### 3.04 CONSTRUCTION – GENERAL

- A. All work shall be performed in accordance with the provisions of the applicable code for reinforced concrete hollow-unit masonry.
- B. The Contractor shall set or embed in his work all anchors, bolts, reglets, sleeves, conduits, and other items as required.
- C. All block cutting shall be by machine.
- D. Masonry units shall be supported off the ground and shall be covered to protect them from rain. Only clean, dry, uncracked units shall be incorporated into the work. Concrete masonry units shall not be wetted.
- E. All reinforcing steel shall be cleaned of all loose rust and scale, and all oil, dirt, paint, laitance, or other substances which may be detrimental to or reduce bonding of the steel and concrete.
- F. Immediately before starting work, the concrete upon which the masonry will be laid shall be cleaned with water under pressure.
- G. A full mortar joint for first course shall be provided.
- H. Units shall be shoved tightly against adjacent units to assure a good mortar bond.

### 3.05 EQUIPMENT

- A. All equipment for mixing and transporting the mortar and grout shall be clean and free from set mortar, dirt, or other foreign matter.

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### 3.06 MIXING

- A. Mortar shall be mixed per ASTM C 270. Retempering shall be done on the mortar board by adding water within a basin formed within the mortar, and the mortar reworked into the water. Mortar which is not used within one hour shall be discarded.

### 3.07 ERECTION OF CONCRETE BLOCK MASONRY

- A. Masonry work shall be erected in-plane, plumb, level, straight, and true to dimensions shown and executed in accordance with acceptable practices of the trade.
- B. Concrete masonry units shall be laid with full-face shell mortar beds. Vertical head joints shall be solidly filled with mortar from face of unit to a distance behind the face equal to not less than the thickness of longitudinal face shells. Cross-webs of starting course courses shall be solidly bedded in mortar.
- C. Unless noted or shown otherwise, masonry shall be laid up in straight uniform courses with running bonds.
- D. All masonry shall be erected to preserve the unobstructed vertical continuity of the cells measuring not less than 3-inch by 3-inch in cross-section. Walls and cross webs shall be fully bedded in mortar. All head and end joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells.
- E. Where horizontal reinforced beams are shown, special units shall be used or regular units shall be modified to allow for placement of continuous horizontal reinforcement bars. Small mesh expanded metal lath or wire screening shall be used in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or units shall be provided with solid bottoms.

### 3.08 JOINTS

- A. Vertical and horizontal joints shall be uniform and approximately 3/8-inch wide. Joints shall be concave-tooled to a dense surface. Depth of rake shall be no deeper than 1/8-inch. Special care shall be used in tooling joints so as to match existing construction.

### 3.09 CLEANOUTS

- A. Cleanout openings shall be provided at the bottoms of all cells to be filled at each lift or pour of grout, where such lift or pour is over 5 ft in height. Cleanout size shall be 3-inch minimum. Any overhanging mortar or other obstructions or debris shall be removed from the insides of such cell walls. The cleanouts shall be sealed before grouting and after inspection. Cleanout openings shall match the finished wall in exposed masonry.

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### 3.10 REINFORCEMENT

- A. Reinforcement bars shall not be used with kinks or bends not shown on the drawings or final shop drawings, nor shall bars be used with reduced cross-section due to excessive rusting or other causes.
- B. Reinforcement shall be positioned accurately at the spacing indicated. Vertical bars shall be supported and secured against displacement. Horizontal reinforcement shall be placed as the masonry work progresses.
- C. Reinforcement bars shall be spliced where shown on contract drawings; bars shall not be spliced at other points except as submitted on the shop drawings. Laps may be contact or non-contact.
- D. Prefabricated horizontal joint reinforcement shall be embedded as required on contract drawings.
- E. Deep cut bond beam blocks shall be used where horizontal reinforcing steel is embedded.
- F. Knock-out openings shall have no steel or joint reinforcing running through the opening. Head, jambs, and sill blocks shall be used to provide an even finish surface to install the window unit when blocks are removed. Joints at head, jambs, and sills shall be stacked and continuous.

### 3.11 GROUTING

- A. All cells and bond beam spaces shall be filled solidly with grout unless indicated otherwise. Grouting shall not be started until the wall has cured for 24 hours. Grout heights poured per table 7 ACI 530.1.
- B. All grout shall be consolidated at time of pouring by puddling or vibrating. Where the grouting operation has been stopped for one hour or longer, horizontal construction joints shall be formed by stopping the grout pour 1-1/2 inches below the top of the uppermost unit.

### 3.12 PROTECTION

- A. Protect tops of walls at all times. Cover tops of walls with waterproof paper when rain or snow is imminent and when work is discontinued.
- B. Wall surfaces shall be protected from droppings of mortar or grout during construction.
- C. Masonry materials shall be protected from contact with the earth and exposure to the weather and shall be kept dry and clean until used.

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**3.13 JOINT SEALANT**

- A. All movement joints that have no mortar or deeply raked joints shall be sealed against moisture and provide at least 1/8" movement.

**3.14 FINISHING AND CLEANING**

- A. Masonry shall not be wet-finished unless exposed to extreme hot weather or hot wind and then only by using a nozzle-regulated fog spray sufficient only to dampen the face but not of such quantity to cause water to flow down over the masonry.
- B. Finish masonry shall be cleaned and pointed in a manner satisfactory to the District's Representative, based upon the standards established by the approved sample panel.
- C. All exposed to view interior and exterior colored masonry work shall be cleaned by light sandblasting to remove all stains and other imperfections.
- D. All exposed masonry surfaces of openings and window and door openings such as sills, heads, and jambs shall be finish block surfaces, not formed surfaces, unless indicated otherwise. Closed bottom bond beam blocks shall be used at heads and sills

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

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SECTION 05040

**ANCHOR BOLTS AND POWDER ACTUATED FASTENERS**

**PART 1 – GENERAL**

**1.01 SCOPE**

This section specifies anchor bolts complete with washers and nuts as well as powder actuated fasteners. Unless otherwise specified, anchor bolts shall be hotdip galvanized or type 304 or 316 stainless steel.

**1.02 QUALITY ASSURANCE**

A. References

The publications referred to hereinafter form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed standards, the requirements of this section shall prevail.

International Conference of Building Official (ICBO) Publications

*CBC California Building Code, 2013 Edition*

American Society for Testing and Materials (ASTM) Publications

*ASTM A307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength*

*ASTM A325 Structural Bolts, Steel, Heat Treated 120/105 KSI Minimum Tensile Strength*

*ASTM A320 Alloy Steel Bolting Materials for LowTemperature Service*

**1.03 SUBMITTALS**

The Contractor shall submit information in accordance with Section 01300, of these Technical Specifications, to substantiate compliance with this specification. In addition, the following specific information shall be submitted.

- A. Data indicating load capacities.
- B. Chemical resistance.
- C. Temperature limitations.
- D. Installation instructions.

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- E. Manufacturer's data and catalogue numbers.
  - F. ICC-ES evaluation reports for expansion and adhesive type anchors as specified in Subsections 3.03 and 3.04 in this section.
  - G. Design calculation in accordance with Subsection 2.04 in this section.

## **PART 2 - PRODUCTS**

### **2.01 ANCHOR BOLTS**

#### **A. General**

Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 25 percent, up to a limiting maximum oversizing of 1/4 inch. Minimum anchor bolt diameter shall be 1/2 inch. Anchor bolts shall be furnished with leveling nuts, the faces of which shall be tightened against flat surfaces as shown to not less than 10 percent of the bolt's safe tensile stress.

Tapered washers shall be provided where mating surface is not square with the nut. Expansion shields set in holes drilled in the concrete after the concrete is placed will not be permitted in substitution for anchor bolts except where otherwise specified. Upset threads shall not be acceptable.

#### **B. Materials**

Anchor bolt materials shall be as specified in Table A for concrete installation unless otherwise specified on the Project Plans. Anchor bolt materials shall be as specified in Table B for CMU installations unless otherwise specified on the Project Plans.

**TABLE A  
ANCHOR BOLT MATERIALS IN CONCRETE**

<b>Anchor Bolt Type</b>	<b>Carbon Steel Assemblies</b>	<b>Equipment Anchorage/Aluminum Assemblies/Stainless Steel Assemblies</b>
Cast-in-Place Anchor Bolts	ASTM A307, Grade C, or ASTM A325 hot dip galvanized	ASTM A320 Type 316 SST
Adhesive Anchors	HILTI RE 500-SD with ASTM A193, Grade B7 Threaded Rod or Simpson "SET-XP" with ASTM A307 Grade C Threaded Rod, or equal	HILTI RE 500-SD with ASTM F593 CW1 Type 316 SST Threaded Rod, or Simpson "SET-XP" with ASTM A193 Grade B6 SST Threaded Rod, or equal
Expansion Anchors	HILTI KWIK-BOLT-TZ, Simpson Strong-Bolt, or equal	Type 304 SST HILTI KWIK-BOLT-TZ, Type 304 SST Simpson Strong-Bolt, or equal
Headed Anchor Studs	Nelson Stud, or equal	Nelson Stud, or equal.

Note: All anchor bolts supporting crane loads shall be high strength steel per ASTM A325. All anchor bolts supporting centrifuge loads shall be Type 316 SST.

**TABLE B  
ANCHOR BOLT MATERIALS IN CMU**

<b>Anchor Bolt Type</b>	<b>Carbon Steel Assemblies</b>	<b>Equipment Anchorage/Aluminum Assemblies/Stainless Steel Assemblies</b>
Cast-in-Place Anchor Bolts	ASTM A307, Grade C, or ASTM A325 hot dip galvanized	ASTM A320 Type 316 SST
Adhesive Anchors	HILTI "HIT HY-150 Max" with ASTM A193 B7 Rod or Hilti HIT-TZ rods or Simpson "SET" with A307 Threaded Rod , or equal	HILTI "HIT HY-150 Max" with A304 Threaded rods or Simpson "SET" with A304 Threaded Rods, or equal
Expansion Anchors	HILTI Kwik-Bolt 3, Simpson Wedge-All, or equal	SST HILTI Kwik-Bolt 3, Type 304, SST Simpson Wedge-All Type 304, or equal
Headed Anchor Studs	Nelson Stud, or equal	Nelson Stud, or equal.

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## 2.02 POWDER ACTUATED FASTENERS

### A. General

All powder actuated fasteners shall be as manufactured by Hilti incorporated, Simpson Strong-Tie Co., or an approved equal. The approved equal shall be equal in materials, strength, and intended use. Reference shall be made to the Hilti "Product Technical Guide", or Simpson's SAS Technical Manual for additional information.

### B. Materials

1. Powder actuated fasteners driven into steel base material shall be 0.145 inch-diameter shank. Length of fastener shall be as required to penetrate through the steel base material. Minimum edge distance to any connected part shall be 1/2 inch and minimum fastener spacing shall be 2 inch.
2. Powder actuated fasteners driven into aluminum base material shall be X-CR type with P8 washers. Length of fastener shall be as required to penetrate through the aluminum base material. Minimum edge distance to any connected part shall be 1/2 inch and minimum fastener spacing shall be 2 inch.
3. Powder actuated fasteners driven into concrete base material shall be 0.145 inch-diameter shank. Length of fastener shall be as required to penetrate 1-1/2 inch into the concrete base material. Minimum edge distance to any concrete material shall be 3-inch and minimum fastener spacing shall be 4-inch.
4. Powder actuated fasteners driven into concrete base material through metal deck shall be 0.145 inch-diameter shank. Length of fasteners shall be as required to penetrate 1 inch into the concrete through the low flute. Fasteners shall be centered in the low flute. The minimum fastener spacing shall be 4-inch.
5. Where steel washers are indicated on the Project Plans, powder actuated fasteners shall be 0.145 inch-diameter shank with 3/4-inch minimum diameter premounted steel washers.

## 2.03 STEEL FASTENERS LUBRICANT (ANTI-SEIZING)

Where stainless steel anchor bolts, adhesive anchors, and expansion anchors are used, the Contractor shall apply an anti-seizing lubricant to the threads prior to making up the connections. The lubricant shall contain substantial amounts of molybdenum disulfide, graphite, mica, talc, or copper.

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## 2.04 DESIGN

Anchor bolts for equipment frames and foundations shall be designed in accordance with the CBC for Seismic Design Category D or to resist a minimum lateral seismic force of 40 percent of the operating weight of the equipment whichever is greater. This force shall be considered acting at the center of gravity of the piece under consideration. Calculations and shop drawings shall be submitted with the equipment submittal in accordance with Section 01300, of these Technical Specifications for all anchorage details. All calculations must be developed and signed by a civil or structural engineer currently registered in the State of California.

## PART 3 - EXECUTION

### 3.01 GENERAL

Fieldwork, including cutting and threading, shall not be permitted on galvanized items. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators. All stainless steel anchor bolts and fasteners shall be assembled with anti-seize compound.

### 3.02 CAST-IN-PLACE ANCHOR BOLTS

Anchor bolts to be embedded in concrete shall be placed accurately and held in correct position while the concrete is placed. The surfaces of metalwork in contact with concrete shall be thoroughly cleaned.

All anchor bolts shall not touch reinforcing steel. After anchor bolts have been embedded, their threads shall be protected by grease and the nuts run on. In anchoring machinery bases subject to heavy vibration, two nuts shall be used, one serving as a locknut. At locations where anchor bolts are to be installed in existing concrete, adhesive anchors or expansion anchors shall be used as specified in Subsections 3.03 and 3.04 of this section.

### 3.03 ADHESIVE ANCHORS

Use of adhesive anchors shall be subject to the following conditions:

1. Use shall be limited to locations where exposure, on an intermittent or continuous basis, to acid concentrations higher than 10 percent, to chlorine gas, or to machine or diesel oils, is extremely unlikely.
2. Use shall be limited to applications where exposure to fire or exposure to concrete or rod temperature above 120° F is extremely unlikely. Overhead applications (such as pipe supports) because of the above concerns, shall be disallowed.

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3. Approval from the District's Representative for specific application and from supplier of equipment to be anchored, if applicable.
  4. Anchor diameter shall be per contract documents or per equipment supplier specifications. Anchor shall be threaded or deformed full length of embedment and shall be free of rust, scale, grease, and oils.
  5. Embedment depth shall be as specified on the Project Plans or as directed by the District's representative.
  6. All installation recommendations by the anchor system manufacturer shall be followed carefully, including, but not limited to, maximum hole diameter, minimum embedment, minimum concrete thickness and minimum edge distance. Special Inspection, if required, shall be provided by the District's representative.
  7. Holes shall have rough surfaces, such as can be achieved using a rotary drill.
  8. Holes shall be blown clean with compressed air and be free of dust or standing water prior to installation.
  9. Anchor shall be left undisturbed and unloaded for full adhesive curing period as required by manufacturer.
  10. Concrete temperature (not air temperature) shall be compatible with curing requirements of adhesives per adhesive manufacturer. Anchors shall not be placed in concrete below 40 degrees F.

The Contractor shall supply the District's Representative with the current ICC-ES evaluation report from the ICC Evaluation Service for the particular brand of adhesive anchors to be used.

#### **3.04 EXPANSION ANCHORS**

Use of expansion anchors shall be subject to conditions 2, 3, 4, 6, 7, and 8 specified in Subsection 3.03 of this section.

The Contractor shall supply the District's Representative with the current ICC-ES evaluation report from the ICC Evaluation Service for the particular brand of expansion anchors to be used.

#### **3.05 POWDER ACTUATED FASTENERS**

Powder actuated fasteners shall be provided and installed as specified on the Project Plans. Fastener installation shall be per the requirements of these specifications and the fastener manufacturer's recommendations. Use of powder actuated fasteners other than as shown on

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the Project Plans shall not occur unless specifically approved by the District's Representative.

The Contractor shall supply the District's Representative with the current ICC-ES evaluation report from the ICC Evaluation Service for the particular brand of powder actuated fasteners to be used.

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

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SECTION 05100

**STRUCTURAL AND MISCELLANEOUS METALS**

**PART 1 – GENERAL**

**1.01 – SUMMARY AND SCOPE OF WORK**

This section specifies structural metals consisting of standard shapes, fasteners, rods and plates that are used in structural supports and connections, and for miscellaneous fabrications, principally at the concrete well pad and well pedestal.

**1.02 - QUALITY ASSURANCE**

All structural mill sections or welded-up plate sections shall be designed in accordance with the latest edition of AISC “Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings” and all cold-formed steel structural members shall be designed in accordance with the latest edition of AISC “Specifications for the Design of Cold-Formed Steel Structural Members”.

**1.03 - RELATED WORK SPECIFIED IN OTHER SECTIONS**

Section 03300, Cast-in-Place Structural Concrete and Reinforcement

**1.04 - SUBMITTALS**

The Contractor shall submit information and shop drawings in accordance with Section 01300 of these Technical Specifications demonstrating compliance with material and construction specifications and showing dimensioned layout of all materials required under this section.

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## **PART 2 - PRODUCTS**

### **2.01 - STEEL**

Materials for structural steel shall be as specified in the following Table.

<b>Material</b>	<b>Specification</b>
Structural bars, plates and similar items	ASTM A36 or A283
Stainless Steel	ASTM A666, Grade A, Type 316
Stainless Steel bolts, anchor bolts, nuts and washers	ASTM A320, Type 316
Steel Bolts, hex head	ASTM A307, Grade A
Expansion Anchors	Hilti, McCulloch Industries, Liebigor or equal, Type Stainless Steel
Wedge Anchors	ITT, Phillips Drill Co., or equal, Type 316, Stainless Steel
High Strength Bolts	ASTM A325 or A490 Bolts by The Research Council or Structural Connections of the Engineering Foundation, latest edition

### **2.02 - ALUMINUM**

Unless otherwise specified, aluminum shall be extruded from 6061-T6 or 6063-T6 alloy, conforming to ASTM B308.

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## **PART 3 - EXECUTION**

### **3.01 - FABRICATION**

Fabricate items of structural steel and aluminum in accordance with the drawings, AISC Specifications, Aluminum Association Standards and as indicated on the final reviewed shop drawings. All welding shall be in accordance with the requirements of the UBC and the Structural Welding Code, AWS D1.1, latest edition, of the American Welding Society. Shop welding shall be performed only in shops approved by the Building Official, per UBC Section 306(g).

Fabrication and erection of structural and miscellaneous steel shall be in accordance with the requirements of the latest edition of the Specification for the Design, Fabrication and Erection of Structural Steel for Buildings of the American Institute of Steel Construction (AISC). Also comply with requirements of the AISC Code of Standard Practice.

### **3.02 - INSTALLATION**

Measurements shall be verified at the job. Holes shall be punched 1/16" larger than the nominal size of the bolts, unless otherwise specified. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or drilled. No drilling of bolts nor enlargement of holes will be allowed to correct misalignment.

Mismatched holes shall be corrected with new material. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators. Aluminum in contact with concrete or grout shall be protected with a heavy coat of bituminous paint.

Prime all steel surfaces with an approved primer, except surfaces to be embedded in concrete, contact areas of high strength bolted connections and surfaces to receive field weld. Touch-up field welds and other exposed steel surfaces after erection.

Metalwork to be embedded in concrete shall be as specified in Section 03100, Cast-in-Place Concrete and Reinforcement. Metalwork shall be placed accurately and held in correct position while the concrete is placed; or, if specified, recesses or blockouts shall be formed in the concrete after design strength is attained, and the metalwork shall be grouted in place in accordance with Section 03100 of these Specifications. The surfaces of metalwork in contact with or embedded in concrete shall be thoroughly cleaned.

Anchor bolts shall be cast in place when concrete is placed unless otherwise approved by the District. For all anchor bolts which have been embedded, their threads shall be protected by grease and the nuts run on. In anchoring machinery bases subject to heavy vibration, two nuts shall be used, one serving as a locknut.

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Structural steel completely encased in concrete shall not be galvanized or painted and shall have a clean surface for bonding to concrete. Metalwork which is bent, broken or otherwise damaged shall be repaired or replaced by the Contractor.

### 3.03 - WELDING

Welding shall be conducted by welding operators who have been certified by AWS qualification tests to perform the type of work required. The quality of welding shall conform to AWS Code for the Arc Welding in Building Construction, Section 4, "Workmanship".

### 3.04 - CLEANING

After installation, damaged surfaces of shop primed metals shall be cleaned and touched up with the same material used for the shop coat. Damaged surfaces of galvanized metals shall be repaired.

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

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SECTION 06190

**PREFABRICATED WOOD TRUSSES**

**PART 1 – GENERAL**

**1.01 – SUMMARY**

- A. Provide wood trusses where shown on the Contract Plans

**1.02 REFERENCES**

- A. "Timber Construction Standards" of the American Institute of Timber Construction.
- B. TPI 1 "Quality Control Manual" of the Truss Plate Institute.
- C. California Building Code

**1.03 SUBMITTALS**

- A. Product Data:

1. Manufacturer's specifications and calculations needed to prove compliance with the specified requirements and the California Building Code.
2. The truss design shall be stamped and signed by a structural or civil engineer registered in California. The design shall consider vertical loads along with specified axial forces in the truss chords as shown on the drawings, for the span, profile and arrangement of each truss.
3. Shop Drawings showing species, sizes, and stress grades of lumber proposed to be used: pitch, span, camber configuration, and spacing of trusses: connector type, thickness, size, location, and design values; and bearing, blocking, and bracing details.
4. Manufacturer's recommended installation procedures which, when approved by the Construction Manager, will become the basis for accepting or rejecting actual installation procedures used on the work.

**1.04 QUALITY ASSURANCE**

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

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## 1.05 DELIVERY, STORAGE AND HANDLING

- A. Trusses shall be transported and stored at the job site in a manner to prevent damage.
- B. Trusses shall be protected from sun and rain by opaque tarp.

## PART 2 - PRODUCTS

### 2.01 WOOD TRUSSES

- A. Fabrication
  - 1. Prefabricate in accordance with the approved submittals.
  - 2. Truss members shall be 2x nominal minimum, unless noted otherwise on drawings.

### 2.02 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

- A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this section.
- B. Install the work of this section in strict accordance with the original design, the approved Shop Drawings, pertinent requirements of governmental agencies having jurisdiction, and the manufacturer's recommended installation procedures as approved by the Construction Manager anchoring all components.
  - 1. Hoist the trusses into position with proper bracing secured at designated lifting points.
  - 2. Exercise care to keep out-of-place bending of trusses to a minimum.
  - 3. Install temporary horizontal and cross bracing to hold trusses plumb and in safe condition until permanent bracing is installed.
  - 4. Install permanent bracing and roof diaphragm prior to application of loads to trusses.

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5. Restrict construction loads to prevent overstressing of truss members.
  6. Do not cut or notch any members of trusses except as permitted at gable end trusses for outriggers.

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

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SECTION 06200

**FINISH CARPENTRY**

**PART 1 – GENERAL**

**1.01 SUMMARY**

A. This Section includes the following:

1. Exterior wood trim.
2. Preformed mineral-fiber cement soffit panels.
3. Provide miscellaneous accessories, flashings, exposed sheet metal, trim, fasteners, and sealants associated with the work of this Section.

B. Related Sections:

1. Section 07410 – Standing Seam Metal Roof Panels.
2. Section 07920 – Joint Sealants.
3. Section 09900 – Coating Systems.

**1.02 SUBMITTALS**

A. Product Data: Submit literature for manufactured items.

B. Submittals shall comply with the General Requirements.

C. Shop Drawings: Indicate materials and wood specifies, component profiles, fastening, joining details, finishes, and accessories.

D. Samples: Furnish samples of each type of wood trim and plastic lumber.

E. Certificates:

1. Quality Standards Certification: WIC certification will not be required, however, Agency reserves right to retain WIC if quality of work is questionable.
2. Wood Product Certification: Furnish certification indicating wood products are from “well-managed” forests.
3. Submit certification that mineral-fiber cement siding is asbestos-free.

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### 1.03 QUALITY ASSURANCE

- A. Standards: Perform finish carpentry in accordance with standards of Woodwork Institute of California (WIC) “Manual of Millwork”.
- B. Certified Wood Products: Wood products to be from forests certified “well-managed” by an agency accredited by forest Stewardship Council (FSC) including SmartWood Program and Forest Conservation Program.
- C. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible, do not delay job progress, allow for trimming and fitting.

### 1.04 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver materials until site conditions are adequate to receive work; protect items from weather while in transit.
- B. Store wood materials indoors, in ventilated areas with constant but minimum temperature of 60 degrees F and maximum relative humidity of 25% to 55%.
- C. Protect the finished surfaces from damage and abrasion during delivery, storage, and handling. Any surface having noticeable and objectionable damage of abrasion, as deemed by the Engineer will be rejected.
- D. Stack planks and panels on edge or laid flat on a smooth, level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing. If sheet should become wet, allow to dry thoroughly before installing.
- E. Immediately remove from site materials with visible mold and materials with mildew.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Exterior Wood Trim and Fascia.
  - 1. Grade and Grain: WCLIB “C and Better Clear”, maximum 19 percent moisture content, 6 foot lengths minimum.
  - 2. Species: WRCLA Western Red Cedar.
  - 3. Texture: S4S (surfaced four sides), with smooth face.
- B. Anchors Nails and Screws: Select the material, type, size and finish required by each substrate for secure anchorage and as recommended by manufacture; provide toothed steel or lead expansion bolt screws for drilled-in-place anchors.
- C. Wood Filler: Color to match wood being filled

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D. Fiber-Cement Soffit:

1. Manufacturer: James Hardie Building Products "Hardiplank", Certainteed, or equal
2. Standard: Conforming to ASTM C1186, Type A - Exterior, Grade II
3. Combustibility: Non-combustible, in accordance with ASTM E184
4. Fire Resistance: ASTM E84: Flame spread = 0; smoke developed = 5
5. Size/Profile: 5/8" thick.
6. Texture: Same as Hardisoffit " Smooth Soffit Panel"

**2.02 ACCESSORY MATERIALS**

- A. Underlayment: 30-pound asphalt-saturated unperforated roofing felt, conforming to ASTM D2178 (glass-fiber).
- B. Formed Sheet Metal Trim, Corners, Flashings, Joint Backing, and Other Exposed Items: Galvanized sheet metal. Refer to Section 07600.
- C. Fasteners for Planks and Trim over Wood Framing: 6d common nails, hot-dip galvanized finish, or stainless steel.
- D. Lap Sealant: Single component silicone rubber sealant, as recommended by panel manufacturer.
- E. Perimeter Sealant As specified in Section 07900.

**2.03 FABRICATION**

- A. Fabricate finish carpentry items in accordance with specified quality standard.
- B. Use exposed fastening devices or nails only when approved and unavoidable; arrange neatly.

**PART 3 – EXECUTION**

**3.01 EXAMINATION**

- A. Verify surfaces are ready to receive work and field measurements are as shown on shop drawings.
- B. Beginning installation signifies acceptance of conditions.
- C. Ensure mechanical and electrical items affecting work are properly placed, complete, and have been inspected by applicable authorities prior to commencement of installation.
- D. Inspect each piece of finish carpentry and discard damaged and defective pieces

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### 3.02 INSTALLATION AND WOOD TRIM AND FIBER CEMENT SOFFIT

- A. Install work consistent with specified WIC quality grade, plumb, level, true and straight with no distortions; shim as required, using concealed shims.
  - 1. Prime paint surfaces in contact with cementitious materials prior to installation; comply with requirements of Section 09800 – Architectural Painting.
- B. Secure work to blocking or framing with countersunk, concealed fasteners and blind nailing as required for a complete installation.
- C. Scribe and cut for accurate fit to other finished work.
- D. Install trim in single, unjointed lengths for openings and for runs less than 10'-0".
  - 1. For longer runs, use only one piece less than 10'-0" in any straight run; provide scarf joints between members.
  - 2. Stagger joints in adjacent members.
  - 3. Cope at returns and miter at corners.
- E. Accessories: Install accessories in accordance with manufacturer's recommendations in locations indicated or as directed by Engineer.
- F. Acceptable Tolerances:
  - 1. Variation from True Position: Maximum 1/16" at any position and maximum 1/8" in any 10'-0" length.
  - 2. Adjoining Surfaces of Same Material: No variation permitted.
  - 3. Offset with Abutting Materials: Maximum 1/32".
- G. Preparation for Field Finishing:
  - 1. Sand work smooth and set exposed nails and screws.
  - 2. Apply wood filler in exposed nail and screw indentations and leave ready to receive site-applied finishes.
  - 3. Seal Concealed and semi-concealed surfaces; brush apply only, using primer consistent with finish coats specified under Section 09800.

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

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SECTION 07410

**STANDING SEAM ROOF PANELS**

**PART 1 – GENERAL**

**1.01 SCOPE**

This section includes furnishing and installing complete and in place, standing seam metal roof panels at the New York Well Building.

**1.02 RELATED WORK SPECIFIED IN OTHER SECTION**

Section 07600 – Flashing and Sheet Metal

**1.03 SUBMITTALS**

A. Shop Drawings

1. Fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

B. Samples

1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures and other metal panel accessories.

C. Product Test Reports

1. Tests performed by a qualified testing agency

D. Field Quality – Control Reports

1. Field Quality Control Reports completed by District or District's Inspector.

E. Close Out Submittals

1. For metal panels to include in maintenance manual.

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F. Quality Assurances

1. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by Manufacturer.

1.04 **DELIVERY, STORAGE AND HANDLING**

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.05 **WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

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2. Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
1. Warranty Period: 20 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.01 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
1. Deflection Limits: For wind loads, no greater than 1/180 for uplift loading and 1/240 for positive loading of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 1680.
1. Test-Pressure Difference: [1.57 lbf/sq. ft. (75 Pa)] [6.24 lbf/sq. ft. (300 Pa)].
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646.
- D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
1. Uplift Rating: UL 90.
  2. Fire Classification: Class A-90.
  3. Hail Resistance: MH, UL Class 4 Impact Resistant.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

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## 2.02 STANDING SEAM METAL ROOF PANELS

- A. General: Provide pre-formed metal roof panels designed to be installed in continuous lengths and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
- B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ultra Seam Incorporated; or a comparable product by one of the following:
    - a. CENTRIA Architectural Systems.
    - b. Fabral.
    - c. Garland Company, Inc. (The).
    - d. MBCI Metal Roof and Wall Systems
  2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet (Galvalume) complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
    - a. Nominal Thickness: 0.022 inch.
    - b. Exterior Finish: Two-coat fluoropolymer.
    - c. Color: Suntan; Provide District with color palette to confirm selection
  3. Panel Coverage: 16 inches.
  4. Panel Height: 1.5 inches.
  5. Clips: One-piece fixed to accommodate thermal movement.
    - a. Material: 0.028-inch nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.

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## 2.03 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 40 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: Stable after testing at 245 deg F; ASTM D 1970.
  2. Low-Temperature Flexibility: Passes after testing at minus 15 deg F; ASTM D 1970.
  3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlisle Residential; a division of Carlisle Construction Materials.
    - b. Grace Construction Products; W.R. Grace & Co. -- Conn.
    - c. MFM Building Products.
    - d. Tamko Building Products.

## 2.04 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fascia, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fascia, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 120-inch long sections, of size and metal thickness according to SMACNA's "Architectural Sheet

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Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (914 mm) o.c. Finish gutters to match metal roof panels.

- E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.
- F. Roof Curbs: As approved by Manufacturer.
- G. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- H. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 7/8 inch wide and 1/8 inch thick.
  - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
  - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

## 2.05 FABRICATION

- A. General: Fabricate and finish metal panels and accessories, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site or in factory using certified, roll-forming equipment. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs, striations, or intermediate stiffening ribs, if any, for full length of panel.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

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1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  2. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  3. Conceal fasteners and expansion provisions where possible.

## 2.06 FINISHES

### A. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 1 mil.

### B. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Certified installer shall examine substrates, areas, and conditions, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
  2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

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- a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
  - B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
  - C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

### 3.03 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches.
- B. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07600 "Flashing and Sheet Metal."

### 3.04 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  - 2. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 3. Install flashing and trim as metal panel work proceeds.
  - 4. Align bottoms of metal panels and fasten with self-tapping screws. Fasten flashings and trim around openings and similar elements with rivets and self-tapping screws.
  - 5. Provide weathertight dectite for pipe- and conduit-penetrating panels.

- 
- B. Fasteners:
1. Steel Panels: Use painted galvanized-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
1. Install clips to supports with recommended fasteners.
  2. Install bearing plates at locations indicated in manufacturer's written installation instructions.
  3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging.
  4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, and metal roof panel are completely engaged.
  5. Watertight Installation:
    - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    - c. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel

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manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
1. Provide elbows at base of downspouts to direct water away from building.
  2. Connect downspouts to underground drainage system indicated.
- J. Roof Curbs: Install flashing around bases where they meet metal roof panels.
- K. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

### 3.05 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

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**3.06 FIELD QUALITY CONTROL FOR WEATHERTIGHT WARRANTY**

- A. Manufacturer's Field Service: Authorized service representative will inspect metal roof panel installation, including accessories.
- B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

**3.07 CLEANING AND PROTECTION**

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

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

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SECTION 07600

**FLASHING AND SHEET METAL**

**PART 1 – GENERAL**

**1.01 SCOPE**

- A. Head and sill flashing for doors, skylight and louvers.
- B. Miscellaneous sheet metal as necessary for a complete watertight condition.

**1.02 - SUBMITTALS**

- A. Submit Shop Drawings in accordance with Section 01300 of these Specifications showing shapes, dimensions, material, gauge and finish of each piece to be fabricated.

**PART 2 - PRODUCTS**

**2.01 - MATERIALS**

- A. Sheet Metal Flashing:  
Galvanized steel, ASTM 361, 24-gauge minimum. Prefinished to match roofing/siding to greatest extent practical. Where not prefinished, field paint.
- B. Cleats, brackets, spacers, fasteners, etc. shall be of same material and gauge as flashing.

**PART 3 - EXECUTION**

**3.01 - INSTALLATION**

- A. Install with watertight seams.
- B. Slope to provide positive drainage.
- C. Provide sufficient hold down clips to insure true alignment and security against wind.
- D. Provide 4-inch minimum overlap.
- E. Allow sufficient tolerance for expansion and contraction.
- F. Insulate work to prevent electrolytic action.

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**3.02 - ADJUSTING, CLEANING**

A. Leave metals clean and free of defect, stains, and damaged finish.

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

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SECTION 07920

**JOINT SEALANTS**

**PART 1 – GENERAL**

**1.01 SECTION INCLUDES**

- A. Sealant, caulking and back-up material.

**1.02 SUBMITTALS**

- A. Product data for each specified item.
- B. Standard range of colors for each specified item.
- C. Instructions for application for each specified item.
- D. Provide submittals in accordance with Section 01300 of these Specifications.

**1.03 DELIVERY AND STORAGE**

- A. Materials shall be delivered in their original, tightly sealed containers or unopened packages, all clearly labeled with the manufacturer's name, product identification, and lot numbers where applicable.
- B. Materials shall be stored in strict accordance with the manufacturer's printed instructions.

**PART 2 - PRODUCTS**

**2.01 MATERIALS**

- C. Exterior Building Sealant: One component silicone.
  - 1. G.E. Silpruf.
  - 2. Dow Corning 790.
  - 3. Tremco Spectrem 1.
  - 4. Or approved substitute.

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- D. Interior Door, Skylight and Threshold Sealant: One component polyurethane.
    - 1. Vulkem 116.
    - 2. Bostik Chem-Calk 900.
    - 3. Pecora Dynatrol 1.
    - 4. Or approved substitute.
  - E. General Purpose Interior Building Sealant: White paintable acrylic latex.
    - 1. Sonneborn Sonelac.
    - 2. Adco AL-800.
    - 3. Bostik Chem-Calk 600.
    - 4. Or approved substitute.
  - F. Primers: Compatible with, and as specified by, sealant manufacturer.
  - G. Back-up Material: Polyethylene backer rod, diameter as recommended by manufacturer for size of joint to be sealed.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Joint dimensions for sealant shall be reviewed in accordance with sealant manufacturer's printed instructions. In no case shall sealant application be less than 1/4 inch deep.

### **3.02 SURFACE PREPARATION**

- A. Surfaces shall be clean, dry, structurally sound and free of loose materials, coatings, rust, oil, grease, wax or bitumens. Clean, if necessary, by wire brushing. Clean metal surfaces with solvent, washing and drying before solvent evaporates.
- B. Prime all exterior joints, all painted surfaces and other surfaces as recommended by sealant manufacturer.

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### 3.03 APPLICATION

- A. Apply materials in accordance with printed recommendations of manufacturer of material used.
- B. Joint Dimensions: Size and shape as shown on Drawings. Pack with specified back-up material in accordance with sealant manufacturer's printed directions. Sealant depth shall not be greater than 1/2 width and not less than 1/4 – inch wide.
- C. Apply caulking with gun having proper size nozzle, using sufficient pressure to fill all voids and joints solidly, and provide smooth, even finish, free from sags and wrinkles.
- D. Install back-up material in accordance with sealant manufacturer's printed directions, taking care to avoid stretching or twisting. Use bondbreaker strip in joints where sufficient room for back-up material does not exist.
- E. Apply masking tape along edges of joint. Prime joint faces in accordance with sealant manufacturer's instructions.
- F. Apply sealant from cartridges, tool and finish as required to produce smooth face and straight edges.
- G. After joints have been completely filled, they shall be neatly tooled to eliminate air pockets or voids, and to provide a smooth, neat-appearing finish in intimate contact with interfaces. After tooling, surface of sealant shall be free of ridges, wrinkles, sags, air pockets and embedded impurities.

### 3.04 CLEAN-UP

- A. Clean adjacent surfaces free of caulking or sealant with mechanical action or solvent as necessary, avoiding damage to other materials.
- B. Remove masking tape immediately after tooling joints, leaving finished work in neat and clean condition.

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

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SECTION 08110

**METAL DOORS AND FRAMES**

**PART 1 – GENERAL**

**1.01 SECTION INCLUDES**

- A. Steel doors.
- B. Steel frames for doors.

**1.02 RELATED SECTIONS**

- A. Section 08710 – Door Hardware
- B. Section 09900 – Coating

**1.03 REFERENCES AND STANDARDS**

- A. ANSI and Steel Door Institute (SDI) Steel Door and Frames Standards and Specifications.

**1.04 SUBMITTALS**

- A. Manufacturer's product data.
- B. Manufacturer's published details.
- C. Certification of Compliance with SDI Standards.
- D. Provide submittals in accordance with Section 01300 of these Specifications.

**1.05 QUALITY ASSURANCE**

- A. Manufacture in accordance with the latest applicable standards and specifications of the Steel Door Institute (SDI).

**1.06 DELIVERY, STORAGE AND HANDLING**

- A. Deliver, store and handle metal doors and frames in a manner to prevent damage and deterioration.

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- B. Provide packaging such as cardboard or other containers, separators, banding, spreaders and paper wrappings as required to completely protect all metal doors and frames during transportation and storage.
  - C. Store doors and frames in upright position, in a protected area, at least 1” or more off the ground and floor and with at least 1/4" air space between individual pieces.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Steelcraft; an Allegion Company.
- B. Amweld Building Products.
- C. Titan Metal Products, Inc.
- D. Or approved substitute.

### **2.02 STEEL DOORS**

- A. ANSI/SDI-100 Specifications.
  - 1. Flush Design: Extra-heavy-duty, 1<sup>3</sup>/<sub>4</sub>", seamless.
  - 2. Louvers:
    - a. Non-vision, inverted “Y” design.
    - b. 18-gauge frame, 20 gauge blades.
    - c. 50% free area.
    - d. Vandal-proof flanged frame mounting.
    - e. Bird Screen.
    - f. Air Louvers, Inc., Model 800, or approved substitute. Factory prime finish.
    - g. Sizes as indicated on Contract Plans.
  - 3. Honeycomb core.

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## 2.03 STEEL FRAMES

- A. ANSI/SDI-100 Specifications.
- B. Formed 16-gauge galvanized rolled steel. Joints mitered, accurately fitted, welded and all exposed welds ground smooth to produce an invisible joint, frames fully factory prime, labeled as rated on Drawings.
- C. SDI-111A details, unless detailed otherwise on Drawings.
- D. Size as required per wall assembly thickness. Where wall assembly's thickness is not applicable, provide 5½" wide frames.

## PART 3 - EXECUTION

### 3.01 DOOR AND FRAME INSTALLATION

- A. Install frames plumb, rigid, and in true alignment, and fasten so as to retain their position and clearance during construction of partitions. Fill frames in masonry walls with mortar as the wall is laid up.
- B. Set hollow metal frames accurately in position with three (3) anchors per jamb. The bottom spreader bar for jambs shall remain in place and be set into the concrete foundation. Protect inside faces of frames in plaster or masonry construction with a 1/8" thick layer of fibered asphalt emulsion coating over the shop primer.
- C. Marred prime coat finish shall be thoroughly cleaned, touched-up and sanded smooth to match prime coat.
- D. Seal perimeter of frames with sealant as required to fill voids.
- E. Install doors plumb and in true alignment in the prepared opening and fasten to achieve maximum operational effectiveness and appearance of unit.
- F. Damaged work will be rejected and shall be replaced at no cost to Owner.

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

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SECTION 08322

**OVERHEAD COILING DOOR**

**PART 1 – GENERAL**

**1.01 SUMMARY**

Section Includes: Overhead coiling door to be furnished and installed at New York Well Building.

**1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 01300: Submittals
- B. Section 08110: Metal Doors and Frames
- C. Section 09900: Painting

**1.03 REFERENCES**

- A. International Conference of Building Officials (ICBO): Uniform Building Code (UBC).
- B. National Electrical Manufacturers Association (NEMA).

**1.04 SYSTEM DESCRIPTION**

Design Requirements

- A. Compatibility with Space and Service Requirements:
  - 1. Doors and equipment items provided shall be compatible with space limitations specified and indicated on the Contract Plans.
  - 2. Make modifications to doors and equipment items necessary to conform with space limitations or with utility services specified for rough-in.
  - 3. Provide items complete including all necessary ancillary equipment as may be required for complete and trouble-free operation.
  - 4. Electrical work under this Section shall be in accordance with Division 16, unless specifically specified otherwise.

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B. Maintenance Requirements: For ease of maintenance, provide overhead coiling door complying with following requirements:

1. Provide door assembly as complete unit produced or supplied by one manufacturer, including frames, sections, brackets, operating mechanisms, hardware, and all necessary accessories for installation of complete in openings indicated.

## 1.05 SUBMITTALS

A. Product Data:

1. General: Submit data completely describing products, including rough-in diagrams.
2. Chain Operators: Submit complete manufacturer's data for all components for chain operators.
3. Provide operation and maintenance manuals in accordance with Specification Section 01730.

B. Shop Drawings:

1. Drawings showing complete installation details, required clearances, relation to building structure, complete electrical rough-in requirements required for installation of operators for doors.
2. Show location and size of access doors required to perform maintenance on doors and auxiliary equipment.

C. Samples: Submit samples of finishes for finish selection.

D. Quality Control Submittals

E. Manufacturer's Instructions:

1. Installation instructions including manufacturer's data, operating instructions, and maintenance data.
2. Furnish installer copy of diagrams and installation instructions.

F. Contract Closeout Submittals

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G. Project Record Documents:

1. Operation and Maintenance Data: Provide manufacturer's operation and maintenance data, complete with manufacturer's list of recommended spare parts and their prices, and name and address of nearest maintenance organization approved by door manufacturer.
2. Warranty: Provide manufacturer's standard warranty.

1.06 **QUALITY ASSURANCE**

Regulatory Requirements

- A. Wind loading in accordance with the Uniform Building Code.
- B. Seismic requirements for door anchorage and support systems in accordance with the Uniform Building Code.

1.07 **DELIVERY, STORAGE, AND HANDLING**

- A. Packing, Shipping, and Storage: Protect door during shipment and storage to prevent warping, bending, and corrosion.
- B. Deliver materials only after proper facilities are available. Provide clean dry surfaces or platform as required and protect from deterioration and foreign matter.

1.08 **PROJECT CONDITIONS**

Field Measurements: Field verify all opening dimensions and clearances prior to fabricating door. Fitting door to openings is the responsibility of the Contractor.

1.09 **SEQUENCING AND SCHEDULING**

Inserts and Anchorages: Furnish inserts and anchoring devices, which must be set into concrete or built into masonry. Provide setting drawings, templates, and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay to the contract.

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## **PART 2 – MATERIALS**

### **2.01 MANUFACTURED UNITS**

#### **A. Steel Overhead Coiling Door**

1. Mounting: Face of wall.
2. Operation: Chain operator.
3. Curtain:
  - a. Slats:
    - 1) Exterior Slat: Minimum 18 gauge galvanized steel, interlocking flat-faced slats, manufacturer's standard size with ends of alternate slats fitted with metal end locks to hold curtain in alignment.
    - 2) Bottom Bar: Fitted with 2 equal sized steel angles minimum 1/8 inch thick, with lift handle and cylindrical lock with housing capable of receiving cylinder to match District standard.
  - c. Weatherstripping:
    - 1) Bottom Bar: Manufacturer's standard vinyl loop-type or solid flexible foam weatherstripping.
    - 2) Door Jambs: Manufacturer's standard vinyl extrusion seals.
    - 3) Hood and/or Lintel:
      - a) Hood: Manufacturer's standard waterproofed canvas baffle.
      - b) Lintel: Manufacturer's standard brush typed.
4. Guides: Formed of roll formed galvanized steel channels and angles or structural angles of sufficient depth to provide a groove of adequate depth on each jamb to hold curtain firmly in guides under design wind and seismic pressure.
5. Brackets: Galvanized steel plate with permanently sealed ball bearings designed to enclose ends of coil and provide support for counterbalance pipe at each end.
6. Barrel and Counterbalance Mechanism: Galvanized steel pipe of sufficient size to carry door load with maximum deflection of 0.03 inch per foot of opening width and counterbalanced by helical springs, oil tempered torsion type designed with

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minimum safety factor of 25 percent safety factor, and having cast iron barrel plugs that anchor springs to tension shaft and pipe.

7. Gears: All gears shall be cast iron with teeth cast from machine cut patterns. The pinion gears shall be not less than 3-inch pitch diameter. Gear ratio shall be designed for a maximum manual effort of not more than 35 pounds.
8. Hood: Fabricated minimum 24 gauge galvanized steel, designed to enclose curtain coil and counterbalance mechanism.

**B. Door Operators:**

1. Chain Operator: Hand chain operation, galvanized, 35 pounds maximum pull. Provide a continuous hand chain and gearing on coil side of door for over-ride on motor failure.
2. Lock: Manually operated doors shall have chain keeper locks. Motor operated doors shall have interior bottom bar slide bolt.
3. Unless otherwise shown on the Control Plans, operator shall be mounted on the side of the coil barrel.

## **2.02 ACCESSORIES**

Fasteners: Sizes and types as recommend by reviewed door manufacturer.

## **2.03 FINISHES**

Steel and Galvanized Steel: Curtain and hood shall be galvanized, chemically treated for paint adhesion then pre-finished with a baked-on gray epoxy primer. All other exposed surfaces shall be given one coat of rust inhibiting paint. Shop prime finish compatible with finish paint system as specified in Section 09900. Entire door system shall be finished painted in the field.

## **2.04 MANUFACTURERS**

Door type: One of the following or equal:

- A. The Cookson Company.
- B. Wayne-Dalton Corp., Kinnear Division.

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- C. Or equal.
  - D. The naming of a manufacturer in this specification is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified

## **PART 3 – EXECUTION**

### **3.01 EXAMINATION**

- A. Verification of Conditions: Examine openings to receive overhead coiling door and verify:
  - 1. Dimensions and correctness of backing or support conditions.
  - 2. Absence of defects that would adversely affect installation.
- B. Do not start work until unsatisfactory conditions are corrected.

### **3.02 PREPARATION**

- A. Verify dimensions and design of opening.
- B. Coordinate details with other work supporting or adjoining coiling door.
- C. Furnish fastening devices as required to mount door properly.

### **3.03 INSTALLATION**

- A. Install doors in strict accordance with manufacturer's installation instructions.
- B. Install assemblies plumb, square, and level at their proper elevations and in their proper planes.
- C. Securely anchor assemblies to interior face of openings, in manner that provides full opening clearance, perfectly aligned and adjusted for smooth operation.
- D. Interface with Other Products: Separate or isolate dissimilar metals with neoprene gaskets, sleeves, or washers, or with an acceptable coating.

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3.04 **ADJUSTING**

- A. Verify that door assemblies are securely anchored to structure, guides are perfectly aligned, doors are adjusted for smooth operation.
- B. Upon completion of installation, ensure doors are free from warp, twist, or distortion and are lubricated and properly adjusted to operate freely.

3.05 **CLEANING**

- A. Thoroughly clean surfaces of grease, oil, and other impurities.
- B. Replace any damaged or otherwise disfigured doors with new prior to final acceptance.

3.06 **DEMONSTRATION**

Provide Owner's maintenance employees with minimum of 2 hours of maintenance instruction.

3.07 **PROTECTION**

Protect installed doors from damage until final acceptance.

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

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SECTION 08620

**SKYLIGHT**

**PART 1 – GENERAL**

**1.01 SCOPE**

This section includes furnishing and installing complete and in place unit skylight mounted on site-erected curbs at the New York Well Building.

**1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS**

Section 07410 – Standing Seam Metal Roof Panels

Section 07600 – Flashing and Sheet Metal

Section 07920 – Joint Sealants

**1.03 SUBMITTALS**

**A. Product Data:**

1. Include construction details, material descriptions, dimensions of individual components and profiles and finishes for unit skylights.

**B. Shop Drawings for Unit Skylight Work.**

1. Include plans, elevations, sections, details and connections to supporting structure and other adjoining Work.

**C. Aluminum Finish Samples**

**D. Glazing Samples: 12 inches square and of same thickness indicated for the final Work.**

**E. Qualification Data: For Qualified Installer and Manufacturer**

**F. Field Quality-Control Reports**

**G. Sample Warranty**

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## 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating unit skylights that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports and calculations.
- B. Installer Qualifications: An installer acceptable to unit skylight manufacturer for installation of unit required for this Project.

## 1.05 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of unit skylights that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Uncontrolled water leakage.
    - b. Deterioration of metals, metal finishes and other materials beyond normal weathering.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Provide Bristolite Daylighting Systems, Inc.; or comparable product by one of the following.
  - 1. CPI Daylighting Inc.
  - 2. Kalwall Corporation
  - 3. Skyco Skylights

### 2.02 PERFORMANCE REQUIREMENTS

- A. Unit Skylight Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for windows, doors and skylights.
  - 1. Performance Class and Grade: Class CW-PG
  - 2. Compliance with NFRC for Thermal Performance

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B. Thermal Transmittance: NFRC 100 maximum U-factor of 45 Btu/sq. ft. x h x deg F.

Options in “Solar Heat-Gain Coefficient (SHGC)” Paragraph below are based on ENERGY STAR and National Green Building Standard requirements. Requirements vary according to climate zone.

C. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum SHGC of 26.

D. Wind-borne-Debris-Impact Resistance: Provide unit skylights that pass basic protection testing requirements in ASTM E 1996 for Wind Zone 3 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than unit skylights indicated for use on Project and shall be installed in same manner as unit skylights indicated for use on Project.

### 2.03 UNIT SKYLIGHT

A. General: Provide factory-assembled unit skylights that include glazing, extruded aluminum glazing retainers, gaskets and inner frames that are capable of withstanding performance requirements indicated.

B. Basis-of-Design Product: Bristolite Daylighting Systems, Inc. or approved equal.

C. Performance Requirements: as specified herein.

D. Unit Shape and Size: Square, 48 inches x 48 inches inside curb.

E. Acrylic Glazing: ASTM D 4802, thermoformable, monolithic sheet, category as standard with manufacturer, Finish 1 (smooth or polished), Type UVF (formulated with UV absorber).

1. Single-Glazing Profile: Dome, 25 percent rise

a. Thickness: 0.177 inch

b. Color: White, translucent

F. Glazing Gaskets: EPDM, neoprene, partially vulcanized butyl tape or liquid-applied elastomeric sealant.

G. Integral Curb: Extruded-aluminum, self-flashing type.

1. Extruded-aluminum Shapes: ASTM B 221, alloy and temper to suite structural and finish requirements but with not less than the strength and durability of Alloy 6063-T52.

2. Height: 8 inches

3. Construction: Single

4. Insulation: Manufacturer’s standard rigid or semirigid type.

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- H. Condensation Control: Fabricate unit skylight with integral internal gutters and nonclogging weeps to collect and drain condensation to the exterior.
  - I. Thermal Break: Fabricate unit skylight with thermal barrier separating exterior and interior metal framing.
  - J. Operable Systems: Equip operable unit skylight with manufacturer's standard hinges and weather-sealing gaskets. In open position Skylight shall provide 48" x 48" opening for access to well pump and motor.

#### 2.04 ACCESSORY MATERIALS

- A. Fasteners: Same metal as metal being fastened, nonmagnetic stainless steel, or other noncorrosive metal as recommended by manufacturer. Finish exposed fasteners to match material being fastened. Provide non-removable fastener heads.
- B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat.

#### 2.05 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker
  - 1. Color: As selected by District

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected

#### 3.02 INSTALLATION

- A. Coordinate installation of unit skylight with installation of roofing material and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Skylight shall be removable for access to well pump and motor. Center installation of Skylight over wellhead as shown on the Plans.

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- B. Comply with recommendations in AAMA 1607 and with manufacturer's written instructions for installing unit skylights.
  - C. Install unit skylights level, plumb, and true to line, without distortion.
  - D. Anchor unit skylights securely to supporting substrates.
  - E. Where aluminum surfaces of unit skylights will contact another metal or corrosive substrates, apply bituminous coating on concealed metal surfaces or provide other approved permanent separation recommended in writing by unit skylight manufacturer.

Insert requirements for continuous vaults and multiple-unit skylight assemblies if required. These unit skylights are often delivered as factory-assembled modules that require partial field assembly. Consult manufacturers for recommendations.

### 3.03 FIELD QUALITY CONTROL

- A. After completion of installation and nominal curing of sealant and glazing compounds but before installation of interior finishes, test for water leaks according to AAMA 501.2.
- B. Perform test for total area of each unit skylight.
- C. Work will be considered defective if it does not pass tests and inspections.
- D. Additional testing and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Prepare test and inspection reports.

### 3.04 CLEANING

- A. Clean exposed unit skylight surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes.
- B. After excess sealants, glazing materials, dirt, and other substances.
- C. Remove and replace glazing that has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect unit skylight surfaces from contact with contaminating substances resulting from construction operations.

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

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SECTION 08710

**DOOR HARDWARE**

**PART 1 – GENERAL**

**1.01 SECTION INCLUDES**

- A. Hanging, latching and controlling hardware for doors.
- B. Locks and cylinders.
- C. Door trim.
- D. Auxiliary hardware.

**1.02 RELATED SECTIONS**

- A. Section 081100 – Metal Doors And Frames.
- B. Provide submittals in accordance with Section 01300 of these Specifications.

**1.03 SUBMITTALS**

- A. Hardware List: Show manufacturer's name and designation number for each item on list.

**1.04 STORAGE, HANDLING AND MARKING**

- A. Furnish hardware in proper "hand" for doors. Package and mark hardware for door number, hardware type, and location.
- B. Store in clean, dry area until installed.

**1.05 TEMPLATES**

- A. Furnish templates for hardware to be secured to metal work, and for other hardware requiring templates, to provide accurate setting and fitting. Furnish in ample time so as not to delay work.

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1.06 **WARRANTY**

- A. Five year warranty on closers and exit devices.
- B. Two year warranty on all other hardware.

**PART 2 - PRODUCTS**

2.01 **MANUFACTURERS**

- A. Item: Manufacturer Specified and Approved Substitutes

<u>Item</u>	<u>Approved Mfgr.</u>	<u>Approved Substitutes</u>
Butts	Hager	H.Soss, Lawrence, McKinney
Locksets, latchsets	Corbin	Schlage, Yale
Exit devices	Von Duprin	Precision
Cylinders and cores	Medico	No substitutes
Closers	LCN	Norton, Dorma
Overhead holders and stops	Glynn-Johnson	Rixson
Flushbolts, coordinators	Glynn-Johnson	Ives, LCN, Norton
Trim, floor stops and astragals	Builders Brass Works	Stanley, Ives
Door bottoms, thresholds and seals	Pemko	Ultra
Panic Hardware	Yale	Van Duprin

2.02 **MATERIALS**

- A. Screws, Bolts and Fastening Devices:

Exposed heads oval Phillips type in countersunk holes, unless otherwise specified or required. Use screws, bolts, washers, grommets, nuts, and other fastening devices of appropriate length, type, head metal and finish, as necessary for proper match and application of hardware.

- B. Finishes:

- 1. Exterior Hinges: US32D stainless steel.
- 2. Remaining Hardware: US26D satin chrome.

2.03 **MANUFACTURED UNITS**

- A. Butt Hinges:

- 1. Heavy-duty ball bearing.

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2. Full mortise.
  3. Stainless steel at exterior doors.
  4. Steel at interior doors.
  5. Sizes as recommended by manufacturer.
  6. 1 ½ pair doors up to 7'-0", two pair doors over 7'-0".
  7. Set screw on hinge pins.

B. Locksets and Latchsets:

Heavy-duty, cylindrical type, lever trim, style similar to Schlage Sparta unless specified otherwise.

C. Thresholds:

Extruded aluminum, Pemko, or approved substitute, unless specified otherwise, closed or mitered ends; open ends not permitted. Provide at all exterior doors unless shown otherwise.

D. Door Bottoms:

Neoprene blade sweep, Pemko 315AN, or approved substitute at all exterior doors unless specified otherwise.

E. Silencers:

Gray rubber type for metal frames. Provide at doors not specified to have weatherstripping or gasketing.

F. Kick Plates:

Stainless steel.

G. Panic Hardware

Stainless Steel Yale 6100 Series, suitable for installation in chemical rooms.

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## 2.04 KEYING

- A. Key to District's Master Key System. Key all locks alike in groups (KA) or key different (KD). Master key, grand-master key, and great-grand-master key locks to be keyed in accordance with keying schedule furnished by the owner.
- B. Furnish six permanent keys for each lockset or KA group and six masters. Stamp all keys "Fair Oaks Water District Do Not Duplicate". Label and deliver by registered mail or personal messenger direct from manufacturer to District. Submit complete set of factory key records with shipment of permanent keys.
- C. Provide Construction Keying: Furnish six construction keys.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install hardware in precise manner, in accordance with manufacturer's instructions; for clearance and hardware placement as specified. Predrill pilot holes in wood for screws. Drill and tap for surface mounted hardware in metal. Set hinge leaves snug and flat mortises; turn screws to flat seat (do not drive).
  - 1. Unless detailed otherwise on Plans, provide following door clearances:
    - a. Floor Clearances:

Labeled Doors:	3/8" maximum over floor or threshold.
No Threshold: for wood doors.	1/4" max. for metal doors, 1/4" max.
Threshold:	1/8" typical.
Carpet:	1/8" over top of nap.
    - b. Head and Jamb Clearances: 1/8" maximum.
  - 2. Unless detailed otherwise, place hardware at following height above finish floor.

a. Strike (centerline) for locks and latches:	40-5/16"
b. Hinges	Manufacturer's Standard
c. Door Pull (centerline)	42"
d. Pushplate (centerline)	44"
- B. Mount door closers for maximum swing of door before setting stops. Silencers in place before adjusting strikes. Drive hinge pins down and tighten set screws.

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- C. Install locks with keyways in proper position, and knobs, roses and escutcheons firmly affixed.
  - D. Set thresholds in waterproof sealant and secure with lead shields or plastic and countersunk screws of same finish as threshold.
  - E. Do not install hardware until completion of painting and finishing work.
  - F. Adjust hardware so that moving parts operate freely without bind or excessive play. Installed hardware shall be free from paint, corrosion or damage.

### 3.02 - INSTALLATION AIDS, INSTRUCTIONS AND MAINTENANCE GUIDES

- A. Upon completion of installation and adjustment, turn over to Owner dogging keys, closer valve keys, lock spanner wrenches, and other factory furnished installation aids, instructions and maintenance guides.

### 3.03 - HARDWARE SCHEDULE:

Use a guide only. In case of omissions, furnish hardware in accordance with that schedules for a like opening.

#### A. All Single Leaf Doors:

1 ½ Pair Butts	Hager BB1191 4 ½ x 4 ½ x NRP x 26D
1 Lock Set	Schlage D80PD x Sparta x 626
1 Floor Stop	Trimco 1224-5 x 26D
1 Threshold	Pemko 171A
1 Door Bottom	Pemko 216AV
1 Kickplate	Trimco K0050 x 12" x SS
1 Lock Astragal	Trimco 5002 x 26D

#### B. Panic Hardware: Chemical Room Doors

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

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SECTION 08910

**METAL WALL LOUVERS**

**PART 1 – GENERAL**

**1.01 REFERENCES**

- A. The publications listed below form a part of this specification to the extent referenced.
  - 1. AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)
    - a. AMCA 500-D (2012) Laboratory Methods of Testing Dampers for Rating
    - b. AMCA 511 (2013) Certified Ratings Program for Air Control Devices
  - 2. ASTM INTERNATIONAL (ASTM)
    - a. ASTM A653/A653M (2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

**1.02 SUBMITTALS**

- A. Shop Drawings
  - 1. Wall louvers
- B. Product Data
  - 1. Door Louvers
- C. Provide submittals in accordance with Section 01300 of these Specifications.

**1.03 DELIVERY, STORAGE, AND PROTECTION**

- A. Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers shall be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

**1.04 DETAIL DRAWINGS**

- A. Show all information necessary for fabrication and installation of wall louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

**1.05 COLOR SAMPLES**

- A. Colors of finishes for wall louvers shall closely approximate colors selected for building doors and frames.

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## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

#### **A. Galvanized Steel Sheet**

1. ASTM A653/A653M, coating designation G90.

### **2.02 METAL WALL LOUVERS**

A. Weather resistant type, with bird screens and made to withstand a wind load of not less than 30 pounds per square foot. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-D and AMCA 511. The rating shall show a water penetration of 0.20 or less ounce per square foot of free area at a free velocity of 800 feet per minute.

#### **B. Formed Metal Louvers**

1. Formed of zinc-coated steel sheet not thinner than 16 U.S. gage.

#### **C. Screens and Frames**

1. For steel louvers, provide 1/2 inch square mesh, 12 or 16 gage zinc-coated steel; 1/2 inch square mesh, 16 gage copper; or 1/4 inch square mesh, 16 gage zinc-coated steel or copper bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

### **2.03 - FASTENERS AND ACCESSORIES**

A. Provide zinc-coated or stainless steel screws and fasteners for steel louvers. Provide other accessories as required for complete and proper installation.

### **2.04 - FINISHES**

#### **A. Steel**

1. Provide factory-applied coating. Clean and phosphate treat exposed surfaces and apply rust-inhibitive primer and baked enamel finish coat, one mil minimum total dry film thickness, color as shown on Plans.

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## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

#### **A. Wall Louvers**

1. Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

#### **B. Screens and Frames**

2. Attach frames to louvers with screws or bolts.

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

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SECTION 09290

**GYPSUM WALLBOARD**

**PART 1 – GENERAL**

**1.01 SCOPE**

- A. Install gypsum wallboard in the ceiling of the MCC Room and Chemical Rooms of the New York Well Building.

**1.02 ENVIRONMENTAL CONDITIONS**

- A. Do not install wallboard or joint compounds if building temperature is below 55°F or if proper ventilation is not provided to eliminate excessive moisture.

**PART 2 - PRODUCTS**

**2.01 MATERIALS**

- A. Gypsum Board: ASTM C36 ends square cut, tapered edge, maximum lengths available to minimize end joints: USG, Gold Bond, or approved substitute.
  - 1. Water-resistant (WR) gypsum board, ASTM C 630, 5/8” thickness.
- B. Tape: ASTM C475 USG Perf-A-Tape reinforcement, or approved substitute.
- C. Joint Compound: ASTM C475 USG Brand Joint Compound – Taping, or approved substitute.
- D. Joint Finishing Compound: USG Brand Joint Compound – Topping, or approved substitute.
- E. Screws: ASTM C 1002 Type S minimum 3/8” longer than gypsum board thickness.

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## **PART 3 - EXECUTION**

### **3.01 SURFACE CONDITIONS**

- A. Report unacceptable sub-surfaces to Contractor for corrective action before proceeding with installations. Starting of work will indicate acceptance of such surfaces.

### **3.02 WORKMANSHIP**

- A. Workmanship shall be of highest quality. Joints, corners, screws and nailheads shall be finished with long tapered finish, smooth, and even in texture. Surfaces shall be prepared to receive FRP finish, joints shall be wider than 3/16", but no greater than 5/16".

### **3.03 INSTALLATION**

- A. General: Install wallboard in accordance with GA-216.
- B. Sheet Arrangement Layout: Use long sheets to restrict joints to minimum. Conditions met and not covered by plans and specifications shall be resolved in conformity with best practices of trade.
- C. Joints: Butt sheets loosely together with tapered edges always placed together (butt edges placed next to tapered edges are not permitted). Sand or kerf cut edges and mill ends to provide smooth jointing on exposed face. Stagger end joints. Shim wallboard on wood framing to get even joints without offsets.
- D. Fasteners: Place fasteners 3/8" from edges of boards. Install fasteners with head dimples slightly below surface; do not cut through paper. Spacing shall not to exceed 12" o.c. for ceilings and 16" oc. for walls.
- E. Partitions: Place boards with long dimension either vertical or horizontal (but not combination of both) on studs. Locate joints at least 12" from jambs of openings. Keep end joints to a minimum.
- F. Cutting and Scribing: Cut neatly to fit around outlets, switchboxes and other protrusions, using keyhole saw or specifically-designed cutting tool for opening of exact shape and size needed, maximum gap 1/8".
- G. Trim: Edge exterior corners with specified bead set to true plumb line. Where wallboard joins or abuts any material other than wallboard, cover end of board with specified metal casing, leaving sufficient for installation of caulking.

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3.04 **FINISHING**

H. Finish per GA214-90, Levels of Gypsum Board Finish, Level 3.

3.05 **CLEAN-UP**

A. Remove all empty containers, scraps of material, and all other debris, and leave premises broom clean. Clean all adjoining work, spotted or otherwise defaced by this operation.

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

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SECTION 09900

**COATING SYSTEMS**

**PART 1 – GENERAL**

**1.01 - SCOPE**

The work covered by this section consists of furnishing all labor, equipment and material necessary to perform surface preparation and to furnish and apply all paint, protective coatings and finishes as specified herein and/or as indicated on the Plans.

**1.02 – QUALITY ASSURANCE**

A. References

The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed standards, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
American Society for Testing and Materials (ASTM) Publication:	
ASTM D1653	Test Method for Water Vapor Permeability of Organic Coating Films
ASTM D2200	Pictorial Surface Preparation Standards for Painting Steel Surfaces
ASTM D2246	Testing Finishes on Primed Metallic Substrates for Humidity - Thermal Cycle Cracking
ASTM D3960	Practice for Determining Volatile Organic Contents (VOC) of Paints and Related Coatings
ASTM D4259	Standard Practice for Abrading Concrete
ASTM D4585	Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation

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ASTM E84                      Test Method for Surface Burning Characteristics of Building Materials

National Sanitation Foundation Standards:

ANSI/NSF61                      Drinking Water System Components – Health Effects

ANSI/AWWA C213                      Fusion Bonded Epoxy Coatings for the Interior or Exterior Of Steel Water Pipelines

Federal Specifications (Fed. Spec.) Publications:

Fed. Spec. F595A                      Federal Standard Colors

The Society for Protective Coatings (formerly Steel Structures Painting Council [SSPC]) Specifications:

SSPC-SP-1                      Solvent Cleaning

SSPC-SP-11                      Power Tool Cleaning to Bare Metal

SSPC-SP-5/NACE 1                      White Metal Blast Cleaning

SSPC-SP-6/NACE 3                      Commercial Blast Cleaning

SSPC-SP-7/NACE 4                      Brush-Off Blast Cleaning

SSPC-SP-10/NACE 2                      Near-White Blast Cleaning

SSPC-SP-13/NACE 6                      Surface Preparation of Concrete

## B. Experience

The Coating subcontractor shall hold a current C-33 painting and decorating license and have a minimum of 5 years practical experience and successful history in the application of specified products to surfaces. At the request of the District they shall substantiate this requirement by furnishing a list of references from similar projects.

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### 1.03 - DELIVERY AND STORAGE

All materials shall be delivered to the site in the manufacturer's sealed containers. Each container shall be labeled by the manufacturer, and the label shall be intact upon delivery. Labels shall give the manufacturer's name, brand, type of paint, batch number, color of paint, date of manufacture, storage life and instructions for reducing. Job mixing or job tinting may be done when approved by the District and for sample colors.

The Contractor shall store all paint materials and equipment in a storage place protected from weather and excessive heat and cold. Necessary precautions shall be taken to reduce hazards to a minimum. Materials exceeding the storage life recommended by the manufacturer shall be removed from the site.

Where shop-primed or shop-finished items are to be shipped to the job site, protect coatings from damage by the use of battens, padded straps and nonmetallic slings. Excessive shipping damage will be considered grounds for rejection of shop primers and shop finishes.

### 1.04 - SUBMITTALS

Furnish complete manufacturer's product data, certificates, test data. Label each paint submittal with paint type and intended use. Provide NSF61 certification. Highlight coating thickness used for certification.

Furnish color chips for color selection by District. District will prepare color schedule after submittals. Contractor will provide colors in accordance with the approved schedule.

Complete data on each type and kind of paint and primer shall be submitted to the District in accordance with Section 01300 demonstrating the product's compliance with these specifications. This shall be done whether or not the product is named herein. Submittals shall also include manufacturer's published instructions and indicate where each product is intended for application.

Furnish sample of blast material and MSDS.

Furnish chart for coatings showing cure times, recoat times, for different temperatures and film thicknesses.

Contractor shall submit ventilation plan and paint drift control plan.

### 1.05 - JOB CONDITIONS

Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied. Do not apply finish coats in areas where dust is

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being generated. Air and surface temperature shall be within those parameters recommended by manufacturer for coating being applied.

Provide 40 ft to 50 ft candles of illumination on all surfaces in areas to be painted, including floors, walls and ceilings.

Use temporary dust barriers to close off areas being painted from areas where other work is being performed.

#### 1.06 **COMPLIANCE WITH REGULATORY REQUIREMENTS**

The Contractor shall comply with all applicable federal, state, and local regulatory agency requirements during the course of this work. The Contractor's attention is directed to the following list of requirements that generally apply to coatings work. The Contractor is responsible for identifying and complying with any other agencies or requirements not listed.

- A. OSHA - Personnel protection during all phases of work, including exposure to airborne solvents, dust, and lead.
- B. CAL/OSHA - Personnel protection; requirements may supersede OSHA regulations.
- C. California Title 22 - Environmental requirements, including definition of abrasive blast materials and residue relative to hazardous waste disposal requirements.
- D. Sacramento County Air Pollution Control District - Environmental requirements for limiting airborne emissions from equipment, products, and methods of operation.

#### 1.07 **MANUFACTURER'S REPRESENTATIVE**

The coating manufacturer shall provide a representative to visit the Project site during surface preparation and coating as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these specifications, and as may be necessary to resolve field problems attributable to, or associated with, the manufacturer's products furnished under this contract.

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## **PART 2 - PRODUCTS**

### **2.01 - GENERAL**

All paint and coating materials furnished for each coating system shall be the products of a single manufacturer.

Only compatible materials shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats.

The volatile organic content (VOC) of the applied coatings, as determined in accordance with ASTM D3960, shall comply with prevailing air pollution regulations.

The Contractor shall base their bid on using the products specified. If the specified products are not available in formulations that meet applicable VOC level regulations at time of application, the Contractor shall submit for review products of equivalent quality and function that comply with regulations in effect at that time.

If the Contractor applies any coatings which do not meet regulations for VOC content, or if coatings are applied that have been modified or thinned other than as recommended by manufacturer, he shall be responsible for any fines, costs, remedies, or legal actions that may result.

The paints, primers, and coatings shall be the product of the Ameron Protective Coatings Group, Brea, CA; Sherwin-Williams, Industrial Maintenance Coatings, Cleveland, OH, Tnemec Company, Inc., North Kansas City, MO; ICI Devoe Coatings, Cleveland, OH; the Carboline Company, St. Louis, MO, or approved equal. Examples of paint systems from these manufacturers are listed in the following specifications (where available). The "or equal" clause refers to dry film thickness, generic type of primer, paint or coating, and ingredients in the coating. Contractor shall furnish dry mill gauge.

No request for substitution on an "equal" will be considered which decreases the film thickness designated, the number of coats to be applied, solids content by volume, the general type of coating, paint, or primer, or the quantity, quality and type of ingredients in the coating specified. Paints not listed in the specifications shall be submitted with certified ingredients analysis so that a complete comparison between specified and proposed paint may be made.

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## **PART 3 - EXECUTION**

### **3.01 - PREPARATION**

All surfaces to be coated or painted shall be in the proper condition to receive the material specified before any coating or painting is performed. No more sandblasting or surface preparation than can be coated or painted in a normal working day will be permitted.

### **3.02 - APPLICATION**

Each coat of paint shall be of the consistency as supplied by the manufacturer, or thinned if necessary, and applied in accordance with the manufacturer's written instructions. Each coat shall be well brushed, rolled, or sprayed to obtain a uniform and evenly applied finish. Work shall be free from "runs", "bridges", "shiners", or other imperfections due to faulty intervals. Particular care shall be taken to obtain a uniform, unbroken coating over all bolts, threads, nuts, welds, edges and corners. Further, all weld splatter shall be removed at all welds neutralized with thinner. No coatings shall be applied at thicknesses greater than that of the manufacturer's recommendations.

### **3.03 - SHOP APPLIED PRIME COATS**

Except as otherwise specified, prime coats may be shop or field applied. Shop applied primer shall be compatible with the specific coating system and shall be applied at the minimum dry film thickness recommended by the manufacturer. Approved submittal data identifying the shop primer used shall be provided to the onsite finish coat applicator and to the District before delivery of items to the jobsite. Damaged, deteriorated and poorly applied shop coatings that do not meet the requirements of this section shall not be permitted. Damaged, deteriorated or poorly applied shop coatings shall either be rejected or shall receive a field blasting and coating as directed by the District. Field coating may consist of touching up the prime coat and then applying the finish coats to achieve the specified film thickness and continuity. Shop primer applications shall be inspected. Contractor shall notify District 1 week before paint date to allow District time to inspect shop coating.

### **3.04 - PREPARATION OF METALLIC SURFACES**

Metallic surfaces shall be prepared in accordance with applicable portions of surface preparation specifications of the Steel Structures Painting Council (SSPC) specified in each coating system. The solvent in solvent cleaning operations shall be as recommended by the manufacturer.

Preparation of metallic surfaces shall be based upon comparison of SSPC-Vis1-67T (ASTM D2200), and as described herein. To facilitate inspection, the Contractor shall, on the first day of sandblasting operations, sandblast metal panels to the standards specified. Panels shall measure a minimum of 8-1/2" x 11". Panels meeting the requirements of the specifications shall be initialized by the Contractor and the District and coated with a clear

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non-yellowing finish. One of these panels shall be prepared for each type of sandblasting and shall be used as the comparison standard throughout the project.

### **3.05 - PREPARATION OF CONCRETE AND MASONRY SURFACES**

Remove all dirt, dust, stains and grease before painting. Fill cracks and irregularities with Portland cement grout to provide uniform surface texture. Fill concrete masonry unit surfaces with block filler except interior surfaces to be painted with latex. Do not paint until moisture content falls below 8%.

### **3.06 - GUARANTEE AND INSPECTION**

The Contractor shall guarantee all coating work for a period of two years following the date of final acceptance of the Project by the District. The Contractor is hereby notified that the District will inspect the Project during the twenty third month following the date of final acceptance. The Contractor shall be notified by certified letter as to the date and time of the twenty third month inspection and will be expected to attend along with his coating subcontractor. All defects in workmanship and materials shall be repaired by the Contractor at no cost to the District in accordance with this specification and to the satisfaction of the District or their appointed representative. The water storage tank will be drained to permit a dry inspection.

### **3.07 - COATING SYSTEMS**

Specific coating systems, colors and finishes for galleries, piping, equipment, and other items which are painted or have other architectural finishes are specified in the following coating system schedule. Unless otherwise specified in the coating system schedule, the work "interior" shall mean the inside structure, and the work "exterior" shall mean outside exposure to weather elements.

Coating systems for different types of surfaces are specified below:

#### **A. Ferrous Metal - Continuously or Intermittently Submerged**

1. General: All submerged metalwork, gates, equipment valves, exposed pipe work and other metalwork within areas which will be submerged, except as may be noted hereinafter, or on the Plans, shall be painted with this coating system.
2. Surface Preparation: All metal surfaces shall be field sandblasted according to SSPC-SP-5 (White Metal Blast Cleaning) to provide a surface depth of 1.5 to 2 mils. Where metal is galvanized, pretreat in accordance with Paint System "D" (Metal-Galvanized, Aluminum, Copper and Brass). Blast profile shall be inspected with comparator test equipment consistent with and for the blast material used.

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3. Coatings:

- a. Tnemec: Prime coat shall consist of Tnemec N69-1211 HB Epoxoline to a minimum dry film thickness of 5 mils. Finish coats shall consist of one or more coats of Series N69-Color Epoxoline II to a minimum dry film thickness of 10 mils. Total dry film thickness for this system shall be a minimum of 15 mils.
- b. Sherwin Williams: Prime coat shall consist of Macropoxy 646 NSF Fast Cure Epoxy to a minimum dry film thickness of 4 to 6 mils. Finish coat shall consist of Sherwin Williams Hi-Solids Polyurethane for a minimum dry film thickness of 5 mils. The total dry film thickness of this system shall be 10 mils.

B. Ferrous Metal - Exposure to Moisture and Fumes

- 1. Surface Preparation: All metal surfaces shall be sandblasted according to SSPC-SP-10 (Near-White Blast Cleaning). Where metal is galvanized, pretreat in accordance with Paint System "D" (Metal-Galvanized, Aluminum, Copper, Brass).

2. Coatings:

- a. Ameron: Amerlock 400 epoxy - two coats at 5 to 6 mils per coat, minimum 10 mils dry film thickness.
- b. Sherwin-Williams: Prime coat shall consist of Macroproxy 646 B58-600 to a dry film thickness of 5 mils. Finish coat shall consist of one or more coats of Macroproxy 646 B58-600 to a dry film thickness of 5 mils. Total dry film thickness for this system shall be a minimum of 10 mils.
- c. Tnemec: Prime coat shall consist of Tnemec N69-1211 HB Epoxoline to a minimum dry film thickness of 5.0 mils on new substrate. On previously painted surfaces Tnemec Series 135 Chembuild at 5.0 mils minimum dry film thickness shall be used. Finish coat shall consist of one or more coats of Series N69-Color Epoxoline II, to a minimum dry film thickness of 5.0 mils. Total dry film thickness for this system shall be a minimum of 10.0 mils.
- d. ICI/Devoe Coatings: Bar-Rust 235 epoxy – two coats at 4 to 8 mils per coat, dry film thickness. Total dry film thickness of this system shall be a minimum of 10 mils.

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- e. Carboline: Carboguard 890 – two coats at 5 to 8 mils per coat. Total dry film thickness for this system shall be a minimum of 10 mils.

C. Ferrous Metal - Interior and Exterior - Normal Exposure

- 1. General: The Contractor shall paint all exposed steel work, exposed pipe work, fittings, all mechanical equipment with this coating system.

All metal work previously given a shop prime coat approved by the District shall be touched up as required in the field with primers specified below.

- 2. Surface Preparations: All metal surfaces shall be cleaned according to SSPC-SP-6. Where metal is galvanized, pretreat with Paint System “D” after Brush Blasting per SSPC-SP-7.
- 3. Coatings
  - a. Ameron: Prime coat shall consist of Amercoat 385 polyamide epoxy one coat at 4 to 6 mils dry film thickness. Finish coat shall consist of Amercoat 450HS polyurethane applied to a dry film thickness of 3 mils. Total dry film thickness of this system shall be a minimum of 7 mils.
  - b. Sherwin-Williams: Prime coat shall consist of one coat of Macropoxy 646 Epoxy at a minimum dry film thickness of 4 to 6 mils. Finish coat shall consist of Hi-Solids Polyurethane to a dry film thickness of 3 mils. The total dry film thickness for this system shall be a minimum of 7 mils.
  - c. Tnemec: Prime coat or spot coat as required shall be Series N69 Epoxoline II applied to a minimum film thickness of 4.0 to 6.0 mils. Apply one finish coat of Series 1074 at 3.0 to 4.0 mils dry film thickness. Total dry film thickness of this system shall be a minimum of 7.0 mils.
  - d. ICI/Devoe Coatings: Prime coat shall consist of Bar Rust 235 at 4 to 6 mils dry film thickness. One finish coat of Dexithane 379 at 2 to 3 mils dry film thickness. Total dry film thickness of this system shall be a minimum of 7 mils.
  - e. Carboline: Prime coat shall consist of Carboguard 890 applied at 4 to 6 mils dry film thickness. Finish coat shall consist of Carbothane 134HG applied at 2 to 2.5 mils dry film thickness. Total dry film thickness for this system shall be 7 mils.

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D. Metal - Galvanized, Aluminum, Copper, Brass

1. General: All galvanized metal, aluminum, copper and brass to be painted shall be pretreated in accordance with this system.
2. Surface Preparation: Surfaces shall be solvent cleaned in accordance with Steel Structures Painting Council Specification SSPC-SP-1 (Solvent Cleaning).
3. Coatings:
  - a. Sherwin Williams: Apply one pretreatment coat of Sherwin – Williams Industrial Wash Primer Green P60G2, to a dry film thickness of ½ mil (.0005).
  - b. Tnemec: Apply one pretreatment coat of Tnemec N27 at 2 mil.
  - c. Finish coating of galvanized metals shall conform to the requirements and recommendations of the galvanized metal supplier. Finish coating must be applied by qualified personnel. Improper application could damage the galvanizing treatment. In general, manufacturer’s recommend application of 1 to 2 mils of epoxy based coating after pretreatment.

E. Concrete and Masonry – Interior and Exterior - Normal Exposure

1. General: All interior and exterior concrete and masonry surfaces subject to normal exposure shall be painted with this system.
2. Surface Preparation: Surfaces shall be free of dirt, grease, or other deleterious matter before coating. All cracks and voids shall be filled with a caulking material compatible with the specified coating. Surface preparation and applications (including block filler) shall be in accordance with manufacturer's instructions.
3. Coating: Apply two coats of an acrylic masonry water repellent, 1 to 2 mils minimum dry film thickness, per coat. Coating shall be Glidden Heavy-Duty Water Repellent No. 20537, Thoro Thoro-glaze, or equal.

F. Concrete Masonry – Interior – Subject to Chemical Service Exposure (Chemical Rooms)

1. General: Interior surfaces of concrete floor and masonry walls within the sodium hypochlorite and sodium bisulfite rooms.
2. Surface Preparation: surface shall be smooth to obtain a “pin hole” free surface after coating. Block filler shall be used on masonry, trowel smooth. Concrete shall

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be troweled or sacked prior to coating. Filler shall be Tnemec Series 201+Carbosisl, Semstone 800 Primed +Cabosisl, or equal.

3. Coating: Apply one coat, each, of the following alternative vinyl ester coatings; Tnemec Series 291, Carboline Semstone 80 (6.0 mils DFT) or equal, Tnemec Series 275, Carboline Semstone ED (30 mils DFI) or equal, or Tnemec Series 120 (15 mils DFT) or equal.

#### G. Gypsum Wallboard

1. General: The Gypsum Wallboard placed in the ceilings of the MCC Room and Chemical Room shall be coated with this system.
2. Surface Preparation: Surfaces shall be clean and dry.
3. Coatings:
  - a. Sherwin Williams (or approved equal): Apply one coat of interior primer, Sherwin Williams PrepRite Problock or equal; 2 mils DFT. Apply 1 coat of Sherwin Williams Acrylic, Semi-gloss Duration Interior or equal; 3 mils DFT.

#### H. Underground Metal Piping Appurtenances

1. General: Buried metal pipeline items, such as valves, couplings and bolts, shall be coated with this system.
2. Surface Preparation: Apply only to clean, dry surfaces. Remove rust, paint and other foreign matter by sand blasting (SSPC-SP-6), wire brushing, or scraping.
3. Coatings:
  - a. Ameron: Apply two coats of Amercoat 78HB coal tar epoxy applied at 8 to 10 mils dry film thickness per coat. Total dry film thickness of this system shall be a minimum of 20 mils.
  - b. Sherwin-Williams: Apply two coats of TarGuard Epoxy B69B60/B69V60 9 to 16 mils each coat. Total dry film thickness of this system shall be a minimum of 20 mils.
  - c. Tnemec: Apply two coats of 46H413 Tnemec-Tar Coal Tar Epoxy at 10 mils dry film thickness per coat. Minimum dry film thickness for this system shall be 20 mils.
  - d. ICI/Devoe Coatings: Apply two coats of Devtar 247 at 10 to 13 mils dry film thickness per coat. Total dry film thickness of this system shall be a minimum of 20 mils.

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- e. Carboline: Apply two coats of Bitumastic 300M at 10 to 12 mils dry film thickness per coat. Total dry film thickness of this system shall be a minimum 20 mils.
  4. Coatings: Polyethylene Encasement: As an alternative to the above Specified coatings, Contractors may wrap the appurtenance with 6 mil polyethylene encasement and tape the encasement tightly closed to the pipe. The placement and taping of the polyethylene encasement shall be conducted with review and approval of the District.
  - I. Repair Coatings – Exterior: The prime coat for exterior coating shall be solventless, 100% solids, corrosion resistant epoxy coating similar to the interior repair coating specified above. Prime coat shall be applied immediately after surface preparation. Finish coats shall be water based, low VOC, high dispersion acrylic polymer coating.
    1. Primer: Apply one coat of Aquatapoxy A-6 epoxy coating at 10 to 20 mils DFT or one coat of Tnemec Potapox Plus Series 20 V140F at 5 to 7 mils DFT.
    2. Finish: Apply two complete coats of semi-gloss, water based, acrylic polymer coating. Coating shall be suitable for application with brush or roller. Finish coats shall be Tnemec Series 1029, 2 to 3 mils per coat or equal product as furnished by ICI/Devoe Coatings, Carboline or Sherwin Williams.

### 3.08 - SURFACES NOT TO BE PAINTED

- A. Except as otherwise required or directed, do not paint the following surfaces:
  1. Exposed surfaces of aluminum (except galvanized aluminum).
  2. Polished or finished stainless steel.
  3. Nickel or chromium.
  4. Factory galvanized surfaces, except piping, conduit, ductwork, and other items specifically noted.
  5. Piping concealed in inaccessible plumbing chases.
  6. Rubber and plastics, including fiberglass reinforced plastics.
  7. Surfaces specified to be factory finished.
  8. PVC pipelines and PVC coated rigid conduit.

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### 3.09 – CLEANUP

Upon completion of coating, the Contractor shall remove surplus materials, protective coverings, and accumulated rubbish, and thoroughly clean all surfaces and repair any overspray or other paint related damage.

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

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SECTION 11000

**GENERAL REQUIREMENTS FOR EQUIPMENT**

**PART 1 – GENERAL**

**1.01 SCOPE**

This section specifies general requirements which are applicable to Project mechanical equipment. The Contractor is responsible for ensuring that all mechanical equipment meets the requirements of this section in addition to the specific requirements of the individual equipment specification section.

**1.02 GENERAL REQUIREMENTS**

All equipment shall be of new sturdy construction of ample strength for all stresses which may occur during fabrication, transportation, erection and during continuous or intermittent operations and shall be adequately stayed, or braced and anchored, and shall be installed in a neat and workmanlike manner. Appearance as well as utility shall be given consideration in the design of details.

All equipment shall include all production line improvements made up to the delivery or contract date.

The furnishing and installation of equipment shall include testing, painting, checking levels and alignment, furnishing and placing of lubricants of whatever type, and furnishing of factory trained service mechanics or engineers where called for. All equipment when finally installed shall be complete and ready for operation without binding or overloading of critical components or motors. The Contractor shall furnish, at no extra cost to the District, all appurtenances, piping, valves, fittings, wiring, supports, hangers, etc. as are required to place the equipment in first class operating condition and in a neat and workmanlike manner.

All fasteners for aluminum shall be stainless steel. All steel, other than stainless steel, shall be isolated from aluminum with stainless steel, neoprene, or other approved material.

**1.03 ARRANGEMENT**

The arrangement of equipment shown on the Plans is based upon information available to the Design Engineer at the time of design and is not intended to show exact dimensions peculiar to a specific manufacturer. The Plans are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual equipment installation requirements. Structural supports, foundations, connected piping and valves shown may need to be altered to accommodate the equipment provided. No additional payment will be made

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for such revisions and alterations which shall be accomplished by the Contractor and approved by the District.

#### **1.04 CONTROL DEVICES AND COMPONENTS**

Control devices, wiring, starters, and other electrical items provided with mechanical equipment shall be as specified in Division 16 of these Technical Specifications and the particular equipment section of this Division.

#### **1.05 SUBMITTALS**

Submittals shall be made as specified for each equipment item or group of related equipment items. Submittals shall be in accordance with Section 01300 of these Technical Specifications and shall identify the equipment as to the specification section, manufacturer and type designation.

#### **1.06 OPERATION AND MAINTENANCE MANUALS**

The Contractor shall furnish operation and maintenance manuals for each equipment system in accordance with Section 01730 "Operating and Maintenance Instructions".

#### **1.07 PROTECTION DURING SHIPMENT**

Equipment shall be shipped in sealed, weathertight, enclosed conveyances and protected against damaging stresses during transport and handling.

Bearing housings shall be wrapped or otherwise sealed to prevent contamination by grit and dirt; and ventilation and other types of openings shall be taped closed.

Damage shall be corrected to conform to the requirements of the contract before the assembly is incorporated into the Work. The Contractor shall bear the costs arising out of dismantling, inspection, repair and reassembly.

### **PART 2 - PRODUCTS**

#### **2.01 FLANGES AND PIPE THREADS**

Unless otherwise specified, flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1, Class 125. Pipe threads shall conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.

Threaded flanges shall have a standard taper pipe thread conforming to ANSI B1.20.1. Unless otherwise specified, flanges shall be flat faced.

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Flange assembly bolts shall be heavy pattern, hexagonal head carbon steel machine bolts with heavy pattern, hot pressed hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Equipment located outdoors shall have Type 316 stainless steel, ASTM A193, Grade B8M bolts and Type 316 stainless steel ASTM A194 hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Threads shall be Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

## 2.02 BEARINGS

Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified. Each bearing shall be rated in accordance with the latest revisions of AFBMA Methods of Evaluating Load Ratings of Ball and Roller Bearings. Unless otherwise specified, equipment bearings shall have a minimum L-10 rating life of 50,000 hours. The rating life shall be determined using the maximum equipment operating speed.

Grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic Alemite type.

Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60°C and shall be equipped with a filler pipe and an external level indicator gage.

## 2.03 SEALS

### A. Mechanical

Unless otherwise specified, rotating shafts shall be provided with mechanical seals and stuffing boxes tapped for flushing seal faces. Seals shall be factory installed. Seals shall be internal, single or double as specified, and unbalanced; except balanced seals shall be provided when shaft speed is greater than 3600 rpm or when pressures are greater than shown in the following:

Seal Inside Diameter (inches)	Shaft Speed (rpm)	Sealing Pressure (psig)
1/2" to 2"	Up to 1800	100
	1801 to 3600	50
Over 2" up to 4"	Up to 1800	50
	1801 to 3600	25

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Single unbalanced seals shall be Crane 8-1, Durametallc RO, or equal. Single balanced seals shall be Chesterton 880, Crane 8B-1, or equal. Double seals shall be Chesterton 241, Durametallc RO/RD, or equal.

To maintain the necessary minimum or necessary pressure across the seal faces, spring pressure shall be uniformly distributed to the sealing faces by a coil spring or multiple springs. The rotating seal element shall be clamped to the shaft and provided with an O-ring seal. The stationary seal element shall be sealed with O-ring or gasket material.

Seal faces shall be either tungsten carbide, carbon, silicon carbide or ceramic. Elastomeric materials shall be Viton. Metal parts shall be Type 316 stainless steel.

**B. Shaft Packing**

Where shaft packing is specified, stuffing boxes shall be tapped to permit introduction of seal liquid and shall hold a minimum of five rows of packing and a bronze lantern ring. Packing shall be die-moulded packing rings of material suitable for the intended service and as recommended by the manufacturer. Lantern rings shall be two piece construction and shall be provided with tapped holes to facilitate removal.

**2.04 COUPLINGS**

Unless otherwise specified in the particular equipment sections, equipment with a driver greater than 1/2 hp, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a tire with synthetic tension member bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub shaft by means of taperlock bushings which shall give the equivalent of a shrunk-on fit. There shall be no metal-to-metal contact between the driver and the driven unit. Each coupling shall be sized and provided as recommended by the coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.

Where torque or horsepower capacities of couplings of the foregoing type are exceeded, Thomas-Rex, Falk Steel Flex, or equal, couplings will be acceptable provided they are sized in accordance with the equipment manufacturer's recommendations, and provided sizing data are submitted. They shall be installed in conformance with the coupling manufacturer's instructions.

The use of mechanical couplings as specified above shall not relieve the Contractor of his responsibility for precise alignment of all driver and driven units.

All metal parts shall be Type 316 stainless steel.

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## 2.05 GUARDS

Exposed moving parts shall be provided with guards which meet the requirements of OSHA. Guards shall be fabricated of 14 gauge steel, expanded metal screen to provide visual inspection of moving parts without removal of the guard. Guards shall be galvanized after fabrication and painted with the equipment. Guards shall be designed to be readily removable to facilitate maintenance of moving parts. Provisions shall be made to extend lube fittings through guards. Any holes in the guards shall be reinforced.

## 2.06 CAUTION SIGNS

Equipment with guarded moving parts which operate automatically or by remote control and shall be identified by signs reading "CAUTION AUTOMATIC EQUIPMENT MAY START AT ANY TIME".

Signs shall be constructed of corrosion proof material with a heavy duty porcelain enamel finish. Signs shall be installed near guarded moving parts.

## 2.07 PRESSURE TAPS, TEST PLUGS AND GAGES

Pressure taps shall be provided on the suction and discharge sides of pumps and blowers. Pressure and vacuum test plugs and gages shall be provided where specified.

## 2.08 NAMEPLATES

Nameplates shall be provided on each item of equipment and shall contain the specified equipment name or abbreviation and equipment number. Equipment nameplates shall be engraved or stamped on stainless steel and fastened to the equipment in an accessible location with stainless steel screws or drive pins.

## 2.09 LUBRICANTS

The Contractor shall provide for each item of mechanical equipment a supply of the lubricant required for the commissioning period. Lubricants shall be of the type recommended by the equipment manufacturer. The Contractor shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. Not less than 90 days before the date shown in his construction schedule for starting, testing and adjusting equipment, the Contractor shall provide the District with 3 copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

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## 2.10 SPARE PARTS

Where spare parts are required by these Specifications, the spare parts for each separate piece of equipment shall be packed in a heavily constructed painted wood, aluminum or stainless steel box with hinged cover and locking clasp. The top of the cover shall be painted with the words "SPARE PARTS" followed by the name and number of the piece of equipment involved.

Each part shall be individually wrapped in a waterproof container and tagged. Spare bearings shall be encapsulated in airtight plastic film.

Spare parts shall not be used by the contractor during the startup and commissioning of equipment.

## 2.11 SPECIAL TOOLS AND ACCESSORIES

Any and all tools, instruments or accessories of a special nature which are required to assemble, disassemble, maintain or repair any item of equipment shall be furnished by the Contractor with that piece of equipment. Special tools shall be tagged and well marked indicating their service and the piece of equipment for which their use is intended. Operation and maintenance manuals shall contain a list and description or pictorial representation of all special tools required for a given piece of equipment.

## 2.12 - LIFTING EYES

Lifting eyes shall be provided on all equipment weighing over 80 lbs.

## PART 3 - EXECUTION

### 3.01 - General

Equipment shall be provided and tested within the tolerances recommended by the equipment manufacturer. The Contractor shall cause each item of equipment to be installed, aligned and tested under the direction of installation engineers who have been factory trained by the equipment manufacturer. Upon completion of the project and as a condition precedent to final acceptance, the Contractor shall furnish written certification from the equipment manufacturers that each item has been installed, aligned and tested correctly and that the installation meets all of the manufacturer's requirements for efficient, trouble-free operation. This provision, however, shall not be construed as relieving the Contractor of his responsibility for this portion of the work. The Contractor shall furnish all fuel, lubricants, and other required materials for testing and shall perform all work, all in accordance with manufacturer's recommendations.

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

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SECTION 11200

**WATER WELL PUMP AND MOTOR**

**PART 1 – GENERAL**

**1.01 SCOPE**

The Contractor shall install one, District furnished, water (product) lubricated, multistage, electric motor-driven vertical turbine pump in the 18 in. I.D. New York Well as shown on the Contract Plans.

The Contractor shall install, one District furnished, 350 hp vertical turbine motor at the well head as shown on the Contract Plans.

Refer to Section 11000, General Requirements for Equipment for additional requirements.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

The pump furnished by the District for this Project manufactured by Floway (Trillium) Pumps, Model 14 DKH, 7 stage.

**2.02 SERVICE CONDITIONS**

Liquid pumped	Groundwater
Liquid temperature	Avg. ± 68°F

**2.03 PERFORMANCE CHARACTERISTICS**

The pump furnished has the following characteristics:

Discharge Diameter	12 in.
Design Capacity	2,200 gpm (min 2000 gpm)
Design Head (TDH)	450.0 ft
Nominal Bowl Diameter	14 in.
Minimum Design Bowl Efficiency	83%
Minimum Runout Capacity	2800 gpm
Minimum Shutoff Head	840 ft
Nominal Pump Speed	1770 rpm
Maximum Column Size (nominal)	10 in.
Column Length (top of well) to bottom of pump bowls)	296 ft, 10 inches
Total Column Length (base of head to bottom of cone)	310 ft

- A. The pump furnished will be tested by the manufacturer to deliver the specified flow at the specified total dynamic head and at a total brake horsepower, including line shaft and thrust bearing losses, which does not exceed the specified nominal motor horsepower.
- B. Under the conditions hereinbefore specified and at any point the manufacturer's published curve, the pump furnished is designed and rated to operate continuously and perform smoothly without undue vibration. In no case does the pump exceed the nameplate horsepower rating of the drive motor at any point on the published pump curve.

## 2.04 PUMP CONSTRUCTION DETAILS

- A. The complete pump assembly is certified to NSF / ANSI standard 61. This certification covers all wetted components of the pump, including but not limited to, the bowl assembly, column assembly and discharge head assembly. Written documentation demonstrating full compliance to NSF61 has been provided. The pump discharge head shall be fitted with a separate nameplate displaying the NSF61 logo.

### B. Materials

DISCHARGE HEAD:	Fabricated Steel Type "F" (ASTM A181 Flanges, ASTM A53 Grade B Body, ASTM A36 Steel Plate)
PACKING BOX:	Cast Iron (ASTM A48 CL 30)
SHAFT PACKING:	JC C1056
SOLE PLATE:	Steel
COLUMN PIPE:	Steel (ASTM A36), Pipe (ASTM A53)
BEARING RETAINER:	Ductile Iron (ASTM A536 GR 60-40-18)
LINESHAFT BEARING:	Styrene Butadiene Rubber (SBR)
LINESHAFT:	416SS (ASTM A582 Type 416)
BOWL SHAFT:	416SS Cast Iron A582 Type 416
BOWL:	Ductile Iron (ASTM A48, 6630), Epoxy coated, Enamel Lined
IMPELLER:	316SS (ASTM A743 Gr. CF-8M)
IMPELLER WEAR RING:	Al Bronze (ASTM B505 Alloy 952)
BOWL BEARING:	Bismuth Tin Bronze (UNS C89835)
BOWL WEAR RING:	Al Bronze (ASTM B505 Alloy 954)
CONE & STRAINER:	316 SS
BOWL BOLTING:	304 SS
PUMP	
HEAD TYPE:	Cast Iron
SEAL ARRANGEMENT:	HP Pkg box
HEAD SIZE:	12" X 20" – "A" Head
LINESHAFT DIAMETER:	1.94 in
COLUMN SIZE:	10.00 in (Nominal)
LUBRICATION TYPE:	Product (Water)
SUCTION CASE:	Ductile Iron (ASTM A48, CI30) Epoxy Coated
SUCTION STRAINER:	416SS (ASTM A 582, Type 416) Cone Type
SAND COLLAR:	416SS (ASTM A582 Type 416)

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C. Coatings

BOWLS: Carboguard 891 Epoxy - Exterior

COLUMN: Carboguard 891 Epoxy – Interior and Exterior

DISCHARGE HEAD: Carboline Hydroplate 1086 Epoxy Coating – Interior; Exterior  
Carboline 635 Primer)

SOLEPLATE: Carboline 635 VOC Primer with Carboline 3359 top Coat – Top Side Only

BEARING RETAINER: Carboline Hydroplate 1086.

D. Pump Stages

1. Seven stage pump assembly
2. Pump Bowl Length = 101.75 inches

E. Discharge Flange

12 inch diameter flange, 300 FF, ANSI Flange, furnish with ½ inch diameter holes;  
bolt circle, 17.75 inch diameter.

F. Pump Manufacturer has furnished pump bowls to meet potential water hammer pressure  
from the ASR valve as well as the weight and the thrust of the valve.

G. Install Fabricated Type “F”. Discharge head flange shall accommodate ASR hydraulic lines  
as shown on the plans.

H. Install line shaft prelubrication system to lubricate line shaft bearings at pump start up and  
shut down.

2.05 **MOTOR**

Drive motors, furnished by the District, conforms to Section 16010 and the following:

Mounting	Vertical, Weather Protected
Type	WP-1 hollow shaft premium efficiency
Horsepower	350 HP; The motor nameplate horsepower rating is not exceeded at any point on the pump curve.
Synchronous Speed	1800 rpm
Voltage/Phase/Frequency	460/3/60
Service Factor	1.15
Manufacturer	Nidec-US Motor.

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The pump manufacturer is responsible for the coordination of motor features with the pump.

## 2.06 SPECIAL TOOLS AND ACCESSORIES

The District shall be furnished with all special tools, instruments and accessories required for proper maintenance of pump and motor.

## PART 3 - EXECUTION

### 3.01 PAINTING

The pump, baseplate, and all other above ground ferrous metal (except stainless steel) will be factory primed and field finish painted as specified in Section 09900, Coating Systems. The interior and the exterior of the column pipe shall be epoxy coated.

### 3.02 PREPARATION FOR SHIPMENT

Insofar as is practical, the equipment specified herein shall be factory assembled. The pump, parts, and assemblies that are of necessity shipped unassembled shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate the final assembly in the field. Generally, machined and unpainted parts shall be protected from damage by the elements with the application of strippable, protective coatings. Provide all lubricant required for initial lubrication.

### 3.03 INSTALLATION

The pump and motor shall be installed in strict accordance with the manufacturer's recommendations and as shown on the plans. The base plate shall be machined flat and shall bear evenly without the use of shims. Pump and motor alignment shall be checked according to the *Hydraulic Institute Standards*.

All strain from attached piping shall be eliminated from the pumps and any evidence of pump or driver misalignment, noisy operation, or other signs of improper setting shall be corrected by the Contractor.

Adjust pump assembly such that the driving unit is properly aligned per factory standards and recommendations and shall be plumb and level with the driven unit and all interconnecting shafts and couplings. Flexible couplings shall not be considered to compensate for misalignment. No alignment shims are to be installed between the pump and the discharge heads.

The pump shall be properly aligned and rigidly bolted in place so that operation is vibrationless and quiet. Pump and motor shall be realigned by the Contractor, according to the *Hydraulic Institute Standards*, after grouting of base and connection of piping.

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The pump and motor are to be mounted on reinforced concrete wellheads as shown on the Drawings and must be attached in such a manner to assure that the pumps, motors and connecting piping remain in position and alignment under all operating conditions.

The Contractor shall make all necessary electrical, mechanical and structural connections to the pumps to insure its proper operation.

### 3.04 TESTS

#### A. Factory Test

1. General: The pump manufacturer shall test each pump in accordance with Section A6 of AWWA/ANSI E101-88 and as described below.

All testing equipment used shall have an accuracy and precision at least equivalent to the limits of accuracy of measuring devices listed in Appendix A of ANSI/AWWA E101-88.

Dated copies of the most recent calibration curves for all instruments and laboratory motors used shall be furnished to the District's Representative prior to the start of the tests.

After completion of manufacture and assembly, and before shipment, tests shall be performed as follows:

- a. The pump bowl assembly and the discharge head shall be tested in accordance with Section A6 of ANSI/AWWA E101-88, as modified below and excluding all of Section A6.9.

Tests shall include standard running test, shop inspection, and hydrostatic test of discharge head and bowl assembly. For the purpose of the discharge head hydrostatic test, the test pressure shall be 200 psi.

In the test, pump discharge pressure shall be measured at the discharge nozzle or ten diameters downstream from the discharge elbow. Input horsepower shall be measured using a calibrated laboratory motor. The use of dynamometers is prohibited since dynamometer tests give consistently low input horsepowers which cannot be duplicated in normal service. Tests using a dynamometer will be rejected.

- b. The motor manufacturer has provided reed critical frequency data for the motors to the pump manufacturer including the motor weight and the height of the center of gravity above pump base and the displacement of the center of gravity in mils and the frequency in cycles per minute. With this information,

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the pump manufacturer has certified that the reed critical frequency on the system shall be at least 25 percent above or 25 percent below the operating speed range on the motor and pump system.

2. Submittal of Test Data: The following shall be submitted for approval on the pump/motor assembly:

a. Certified and guaranteed pump test data, including:

Speed, in rpm  
Flow, in gpm  
Total head, in feet  
Input electrical horsepower to motor  
Overall efficiency  
Total Indicator Reading (TIR) headshaft at the packing box

b. Certified and guaranteed curves showing pump performance characteristics based on the laboratory test:

Total head (feet) versus flow (gpm)  
Brake horsepower versus flow  
Bowl efficiency versus flow  
Overall efficiency versus flow (may be calculated from the bowl efficiency and motor efficiency curves)

3. Acceptance: Acceptance of the pump assembly will be subject to the following:

a. Proof that it will operate at or above the specified efficiency.

b. Capacity at design head shall not be less than rated.

c. Capacity at design head shall be not more than 110 percent of rated. Straightline interpolation shall be used to determine head capacity at the design point.

d. Notwithstanding b and c above, the guaranteed minimum bowl efficiency shall be determined from the actual test flow at a test head within  $\pm 2$  percent of the rated design head. The overall efficiency calculations shall be carried to within  $\pm 0.1$  percent.

e. The nameplate horsepower of the motor shall not be exceeded at any point on the curve.

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## B. Field Testing

Field testing shall demonstrate proper operation of the equipment and compliance with the Drawings, these Technical Specifications, and the Standards of the Hydraulic Institute. All equipment that fails field tests shall be rejected, and complete retesting shall be required at the Contractor's expense after the Contractor makes corrections or modifications to equipment installation which has previously failed any test. All field tests shall be witnessed by the District's Engineer.

Installation of the pump and motor shall be complete and the units shall be serviced, tested, adjusted and ready for use before the field tests are scheduled.

Written notice of the scheduled dates for the field tests shall be given to the District's Representative at least ten (10) days prior to the field test dates. The notice shall include a written test schedule listing the tests, the test procedure, the criteria for a satisfactory test and special measurement equipment to be employed.

Minor repairs and adjustments shall be made by the Contractor as required to achieve satisfactory performance of the pump drive units. If minor repairs or adjustments are made during the tests, additional testing shall be performed as required by the District's Representative.

Written records of the test shall be made by the Contractor and within ten (10) days and three (3) copies of the test records shall be submitted to the District's Representative. The test record shall indicate the test criteria and arrangement, the time of the test, the results, and pertinent data such as voltage, frequency, load current, ambient temperature, pump discharge and total head. Pertinent data shall be recorded for each test and at least every thirty (30) minutes when the test requires more than thirty minutes.

The pump shall be test operated by its motor for a minimum of one hour. Vibration measurements shall be made on the pump and drive system under running conditions ( $\pm 10$  percent of rated capacity) and shall be within the limits specified by the Hydraulic Institute for all specified operating conditions.

### 3.05 MANUFACTURER'S REPRESENTATIVE SERVICES

The equipment manufacturer or his/her representative shall inspect the installation of the equipment prior to startup and shall make the necessary adjustments to the equipment for satisfactory operation. The manufacturer shall also be responsible for instructing the District personnel in the operation and maintenance of the equipment. The manufacturer of his/her representative shall certify the correctness of the installation.

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3.06 **WARRANTY**

The equipment manufacturers shall warrant the well pump and motor equipment being supplied to the District against defects in workmanship and material for a period of 2 years from the date of completion of the New York Well Phase 2 Construction, New York Well Equipping and Site Improvements, not to exceed 30 months from the date of shipment. In the event that equipment fails to perform as specified, the equipment manufacturers shall promptly repair or replace the defective equipment without cost to the District, including handling and shipping costs.

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

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SECTION 11250

**CHEMICAL FEED AND CONTROL SYSTEMS**

**PART 1 – GENERAL**

**1.01 SCOPE**

The scope of these improvements shall include sodium hypochlorite feed pumps, sodium bisulfite feed pumps, sodium hypochlorite and sodium bisulfite controllers / analyzers, flow cell assemblies, diffusers and associated sodium hypochlorite and sodium bisulfite tubing and appurtenances as shown on the Contract Plans and as specified herein.

The sodium hypochlorite and sodium bisulphite feed pumps shall be installed on HDPE shelves in the chemical rooms. The chlorine residual analyzers, and flow cell assemblies shall be wall mounted, as shown on the Contract Plans, in the New York Well Building wellhead room. The chemical feed pumps together with the chemical storage tanks, tank stands and containment basins shall be furnished and installed, as shown on the Contract Plans in the chemical rooms.

Sodium hypochlorite shall be injected into the wellhead piping, as show on the Contract Plans, when the New York Well is operating in well discharge mode. Sodium bisulfite shall be injected into the wellhead piping, as shown on the Contract Plans when the New York Well is operating in ASR mode.

The sodium hypochlorite disinfection feed rates shall be controlled by flow signals from the New York Well flow meter, the operator set dosage disinfection level and the chlorine residual analyzer. The sodium bisulfite dechlorination feed rate shall be controlled by flow signals from the New York Well flow meter and a chlorine residual set point of zero for the ASR return flow. Chemical dosing and flow pacing control of the feed pumps shall be controllable via the SCADA system.

**1.02 SUBMITTALS**

Submittals shall be in accordance with Section 01300 of these Technical Specifications, to demonstrate full compliance with all aspects of this specification.

- A. Product Data Sheets
- B. Produce cut sheets indicating selected size and application and materials of construction.
- C. O & M information per Section 01730, Operating and Maintenance Information of these Technical Specifications.

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## 1.03 RELATED WORK SPECIFIED IN OTHER SECTIONS

Section 16940 - Instrumentation

## PART 2 - PRODUCTS

### 2.01 SYSTEM COMPONENTS

#### A. Sodium Hypochlorite and Sodium Bisulfite Feed Pumps

New sodium hypochlorite and sodium bisulfite feed pumps shall be Iwaki Metering Pump Model EWN-C2IVCURA capable of providing a dosage in the range of 0.5 mg/l to 2.0 mg/l. The discharge pressure for the sodium hypochlorite feed pump shall be 60 to 110 psi. The discharge pressure for the sodium bisulfite feed pumps shall be 0 to 40 psi. Furnish and install a total of 4 chemical feed pumps. Two pumps shall be installed for the sodium hypochlorite feed system. Two pumps shall be installed for the sodium bisulfite feed system.

#### B. Residual Chlorine and Residual Sulfite Monitors / Analyzers

Furnish one ATI Model Q 46H/62-63 Residual Chlorine Monitor and one AT1 Model Q 46S/66 Residual Sulfite Monitor

One monitor will be used to measure the chlorine residual in the groundwater supplied to the Fair Oaks Water District Distribution System. One monitor shall be used to measure the sulfite residual to be returned to the groundwater aquifer via the ASR improvements.

Refer also to Specification Section 16940, Instrumentation

#### C. Flow Cell Assemblies

Furnish two ATI flow cell assemblies compatible with the ATI Model Q 46H/62-63 Chlorine Residual Monitor and the ATI Model Q 46S/ 66 Sulfite Residual Monitor.

#### D. Sodium Hypochlorite and Sodium Bisulfite Diffusers

Furnish diffusers as shown on the Contract Plans complete with 3/4" corporation stops, spring loaded ball check valves and 3/8" diameter polyethylene tubing. As shown in the Diffuser Details the sodium hypochlorite and sodium bisulfite solution tubing shall be placed in a 1 1/2" diameter Schedule 80 PVC conduit.

#### E. Chemical Storage Tanks

Furnish two, 200 gallon capacity chemical storage tanks. Tanks shall be XLPE (cross linked polyethylene), heavy duty construction, with molded in calibrations. Tanks shall be suitable for top fill and furnished with bottom discharge connection foot valve and antisiphon valve.

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Tanks shall typically be 34 inches in diameter and 61 inches in height. Chemical storage tanks shall be ProChem Process Chemical Tanks, or approved equal. Tanks shall be suitable for storage of sodium hypochlorite, 12½% concentration and suitable for sodium bisulfite, 40% solution.

F. Chemical Storage Stands and Secondary Containment

Chemical storage tanks shall be furnished and installed with ProChem Tank Stands and ProChem Containment Basins, or approved equal, compatible with the 200 gallon capacity chemical storage tanks.

The containment berms shall provide secondary containment in conformance with EPA 40 CFR regulations.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

The Contractor shall be responsible for the installation of all manufacturer-supplied chemical feed and control equipment and materials and all required additional equipment and material not supplied by the manufacturer.

Installation of each equipment item shall be in strict accordance with the manufacturer's instructions.

**3.02 FIELD TESTING**

The Contractor shall submit a Field Test for Acceptance program for the District's approval per Section 01660, Installation, Testing, And Commissioning, of the Technical Specifications. The program shall include the name of manufacturer's staff who will be conducting the test, test objective, test description, test procedures, sampling procedures and frequency. Testing costs shall be borne by the Contractor.

After all equipment has been completely installed according to the direction of the Manufacturer and conducted in the presence of the District, all equipment shall be inspected for discrepancies. After all discrepancies have been properly adjusted, tests shall be performed to indicate that the system operates satisfactorily. The field test shall demonstrate correct mechanical operation after system start-up. Field tests shall include all equipment included under this section.

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**3.03 MANUFACTURER’S REPRESENTATIVE SERVICES**

At the discretion of the District, and per Section 01660, Installation, Testing, And Commissioning, of these Technical Specifications, the manufacturer shall be responsible for instructing the District’s personnel in the operation and maintenance of the equipment.

The manufacturer or its representative shall certify the correctness of the installation in accordance with Section 01640, Supplier’s / Manufacturer’s Services, of these Technical Specifications.

**3.04 WARRANTY**

The manufacturer shall guarantee in writing that the chemical feed and control systems operated in accordance with written instructions given and accepted by the District, will perform in complete accord with the specifications. All components will be warranted against manufacturers’ defects for 2 years from its original installation date or thirty months from its shipment date, whichever first occurs.

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

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SECTION 15040

**PIPING**

**PART 1 – GENERAL**

**1.01 SUMMARY**

Provide all piping and piping accessories as shown on the Contract Plans, described in the Specifications and as required to completely interconnect piping segments for a complete and operable, domestic well and ASR well systems. Furnish and install piping improvements as shown on the Contract Plans.

**1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS**

Fair Oaks Water District Standard Specifications  
Section 02300, Structural Excavation and Backfill; Excavation, Backfill  
and Compaction for Utilities, Pipelines and Structures  
Section 03400, Precast Concrete Vaults and Valve Boxes  
Section 15100, Manual, Self Activating and Automatic Control Valves and Appurtenances

**1.03 SUBMITTALS**

The Contractor shall submit information and shop drawings in accordance with Section 01300 of these Technical Specifications, indicating compliance with material specifications and showing dimensional layout. Specific submittals shall include the following:

- A. Verify by excavation, inspection and measurement all installation conditions for buried pipe before preparation of shop drawings. Submit field measurements and / or photos with shop drawings where exposed conditions are significantly different than indicated on the Drawings.
- B. Submit data to show the following items:
  - 1. Pipe fittings and accessories.
  - 2. Pipe couplings and connections.
  - 3. Valves and accessories.

**1.04 QUALITY ASSURANCE**

- A. Materials and equipment furnished under this Section shall be of manufacturers who have been regularly engaged in the design and manufacture of piping and piping materials for a period of at least 5 years. Demonstrate to the satisfaction of the District that the quality

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is equal to the materials and equipment made by the manufacturers specifically named herein, if alternate manufacturer is proposed.

- B. Factory quality control: The Contractor shall test all piping and piping products as noted herein and by the reference specifications.
- C. All piping materials and piping products shall comply with AWA Standard Design and Construction Specifications for Treated Water Systems.
- D. All piping and piping accessories furnished and installed as part of this Section of these Specifications shall be tested in accordance with Fair Oaks Water District Standards. Any piping that fails to perform as specified in these Standards shall be reconstructed or repaired, as necessary, and retested. The cost to reconstruct, or repair and to retest piping systems to comply with District Standards shall be borne by the Contractor.

#### 1.05 PIPING SYSTEMS

The various piping systems are identified on the Plans. Unless otherwise shown on the Plans, each system shall be constructed using the materials indicated for that system.

#### 1.06 APPURTENANCES

Furnish and install all necessary guides, inserts, anchors and assembly bolts, washers and nuts, hangers, supports, gaskets, couplings and flanges; all other appurtenant items shown on the Plans, specified or required for the proper installation and operation of the piping; devices included in or on the piping equipment; and piping accessories.

#### 1.07 PIPE SUPPORTS

##### A. General

1. Piping 6 inches and larger: pipe supports are shown on the Plans for piping 6 inches and larger in diameter, where the piping is shown on layout drawings. Where piping is shown schematically only, it shall be the Contractor's responsibility to support all such piping in accordance with the design criteria stated herein and using support details shown on the Plans. Pipe supports have been designed assuming flanged joints on Ductile Iron Pipe unless otherwise indicated on the Plans. If groove type mechanical couplings are used as an alternative, provide additional supports where required, particularly to resist rotation. Shop Drawings of these additional supports shall be reviewed by the District prior to installation.
2. Piping less than 6 inches: Pipe supports are generally not shown for piping less than 6 inches in diameter. Where supports are not shown, it shall be the Contractor's responsibility to support all such piping in accordance with the design criteria stated hereinafter and the support details shown on the Plans. Piping 2 ½ inches and larger shall be supported with pipe supports designed to resist seismic loads.

3. Shop Drawings: Submit layout drawings, schematics, and design calculations to demonstrate that support systems that are not as shown on the Plans are in accordance with the design criteria.
4. Where not detailed or otherwise indicated, pipe support types and spacing shall be in accordance with the Manufacturer's Standardization Society (MSS) Standard Practice No. SP-58 and No. SP-69, except as superseded by the requirements of these Technical Specifications. Submit drawings of pipe supports that are not as detailed on the Plans.

B. Pipe support system design:

1. Design loads: Pipe suspension shall be such as to prevent excessive stress or excessive variation in support force while system is in operation. Pipe supports shall support the sum of the weight of the pipe, fittings, appurtenances, and contents. In addition, the pipe shall be anchored to resist internal pressure forces tending to separate any unrestrained joint at pressures 1-1/2 times the maximum working pressure for the applicable service.
2. Seismic loads: Seismic loads, expressed as a percentage of the weight of the contributing length of pipe, fittings, appurtenances, and contents, are 50% in any direction within the horizontal plane of the pipe, and 50% up or down within the vertical plane of the pipe.
3. Location: All piping shall be supported in a manner which will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, at all nonrigid joints, at hose bibbs, and where otherwise shown. Where piping connects to equipment, it shall be supported by a pipe support and not by the equipment.
  - a. Maximum support spacing shall conform to the following table:

Pipe Size Inches	Pipe Material	Maximum Spacing Feet
1" & smaller	Steel or Copper	6
	Plastic	4-1/2
1-1/4" to 2"	Steel or Copper	8
	Plastic	5
2-1/2" to 4"	Iron or Steel	10
	Copper or Plastic	6

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6" to 8"	Iron or Steel	12
	Plastic	8
8" to 12"	Iron or Steel	8
	Plastic	6

**PART 2 – PRODUCTS**

**2.01 SCHEDULE**

- A. Buried Pump to Waste Main;
  - Ductile Iron Pipe (DIP) CL50 or CL53 350 psi rated or
  - AWWA C900 Class 165 or better, PVC Pressure Pipe
- B. Above Ground Pump Discharge, Pump to Waste and ASR Water Mains
  - Ductile Iron Pipe (DIP), CL50 or CL53, 350 psi Rated
- C. Buried Pump Discharge Water Main, Water Main to Future Filtration System
  - Ductile Iron Pipe (DIP) CL50 or CL53, 350 psi rated
- D. Meter Vault Piping
  - Ductile Iron Pipe (DIP), CL50 or CL53, 350 psi rated
- E. Water Service Piping
  - Type “K” Soft Copper Tubing
- F. Above Ground Piping, Pump to Waste Discharge at Drain Box,
  - Ductile Iron Pipe (DIP), CL50 or CL53, 350 psi rated
- G. Storm Drain Pipe
  - AWWA C900 Class 165 or better
- H. Sample Water Line
  - 3/8” Diameter Sample Line Polyethylene Tubing in Schedule 80 PVC Pipe.
  - Furnish and install SDR 11, 200 psi, HDPE pipe, or equal with no 90, 45 or 22.5 degree fittings.

**2.02 GENERAL**

- A. Pipe sizes are nominal inside diameter unless otherwise noted.
- B. All materials delivered to the job site shall be new, free from defects, and marked to identify the material, class, and other appropriate data such as thickness for piping.
- C. Acceptance of materials shall be subject to strength and quality testing in addition to inspection of the completed product. Acceptance of installed piping systems shall be based on inspection and leakage tests as specified hereinafter.

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## 2.03 GENERAL MATERIAL REQUIREMENTS

- A. Gaskets: Suitable for potable water, NSF 61.
- 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. Exposed: Electroplated zinc or cadmium steel.
  - 2. Submerged: Type 316 stainless steel, minimum tensile strength: 60,000 psi.
  - 3. Concrete encased: Steel
  - 4. Buried: Type 316 stainless steel, minimum tensile strength: 60,000 psi.
  - 5. Apply an anti-seize compound to the threads of stainless steel bolts.
- C. Flexible sealant: Flexible sealant for pipe joints, where shown on the Plans, shall be a two-compound polysulfide, non-sag; Sikaflex 412, Dualthane, or equal.

## 2.04 PIPING MATERIALS

- A. Buried PVC Pump to Waste Main and Storm Drain Pipe.

Pipe material, joints and fittings shall be summarized below. A detailed specification of each pipe type follows:

<u>Pipe Material</u>	<u>Field Joints</u>	<u>Fittings</u>
PVC C900-07	Bell & Spigot (B&S), Conforming to ASTM F4777	Mechanical Joint (MJ), Conforming to AWWA C111 or Slip On

- 1. PVC AWWA C900-07
  - a. Joints: Locked in flexible elastomeric gasket coupling with bell and spigot configuration. The bell shall consist of an integral wall section with a District approved locked-in, triple edge, elastomeric gasket rings per ASTM F477.
  - b. Fittings: AWWA C111.
  - c. Pipe taps:

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1) Direct threaded taps are not acceptable. Pipe branch line connections shall be made using service saddles for tapping, by using reducing flanges on tees, or by tapping blind flanges on tees.

2) Service saddles:

Materials: Stainless steel or ductile iron saddle with electro-galvanized straps and hardware, and neoprene gaskets.

Type: For pipe 4 inches in diameter and less, single strap saddles may be used. For pipe greater than 4-inch, double strap saddles shall be used.

d. District Standards: PVC Pressure Pipe shall conform to applicable Fair Oaks Water District Standard Specifications.

e. PVC Pipe, General: Polyvinyl Chloride (PVC) Pressure Pipe in sizes eight inches (8") through twelve (12"), shall conform to current AWWA C900-07 and have Underwriters' Laboratories, Factory Mutual and NSF approval. PVC pipe shall be dimension ratio (DR) twenty-five (25), PC165.

Lengths of PVC shall be joined by a locked-in flexible elastomeric gasket coupling with bell and spigot configuration. Lubricants intended for use with PVC pipe shall be compatible with the plastic material and not adversely affect the potable quality of the water being transported.

Joints between PVC pipe and fittings shall be slip-on type or mechanical type as noted on the plans. Slip-on type joints shall be sealed by means of rubber rings designated for use with the type of pipe being installed.

Joints between PVC pipe and other types of pipe shall be made by means of proper sized compression type adapter. Mechanical joint fittings conforming to AWWA C153 shall be used. Fittings shall be cement-mortar lined cast or ductile iron fittings or fusion bonded epoxy lined and coated fabricated steel fittings. Star Pipe Products fittings shall not be allowed. With approval of the District Engineer, fittings conforming to AWWA C110 Standard with a minimum pressure rating of 250 psi may be used.

B. Buried and Above Ground Pump Discharge, ASR Water Main, Pump to Waste Mains, and Ductile Iron Pipe Installed in Meter Vault

1. Pipe: Ductile Iron, AWWA C151

a. Minimum pressure Class 350 psi. Minimum thickness Class 50 or Class 53 per FOWD Standard Specifications.

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- b. Joints: Restrained Push-on, or mechanical joints per AWWA C111 potable water. Flanged joints required to connect pipe to valves, meters and other equipment.
  - c. Fittings: Ductile iron or cast iron push-on joints, AWWA C110 with minimum pressure rating of 250 psi or AWWA C153 mechanical joint fittings for buried pipelines. Flanged joints conforming to AWWA C111 for above grade pipeline.
  - d. Lining; Buried, standard thickness cement mortar lining for pipe and fittings, AWWA C104.
  - e. Lining; Above ground, standard thickness cement mortar lining for pipe and fittings, AWWA C104.
  - f. Protection: Buried, Polyethylene encasement, AWWA C105. Double wrap flanged fittings, mechanical joints, or other appurtenances with significantly different outside diameters from the pipe, for buried pipe.
  - g. Gaskets: Potable water, Rubber gasket joint for ductile iron pressure pipe and fittings per AWWA C111. Where shown on the Plans, Field Lok 350 gaskets per AWWA C111.
  - h. Coating: Buried, asphaltic, AWWA C151. Encase with polyethylene wrap conforming to AWWA C105 Standards.
  - i. Coating; Above ground, fusion bonded epoxy, AWWA C116 with UV resistant polyurethane top coat. Refer to Section 09900, Coating Specifications.
  - j. Flange bolts: AWWA C115.
  - k. Joint restraint: When Joint restraint is required or indicated on the Plans, restrained push-on joint and fittings utilizing ductile iron components shall be provided.

Restrained joint pipe shall be ductile iron manufactured in accordance with the requirements of ANSI/AWWA C151/A21.51. Push-on joints for such pipe shall be in accordance with ANSI/AWWA C111/A21.11 "Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings". Pipe thickness shall be designed in accordance with ANSI/AWWA C150/A21.50 "Thickness Design of Ductile-Iron Pipe", and shall be based on laying conditions and internal pressures as stated in the project plans and specifications.

Restrained joint fittings and the restraining components shall be ductile iron in accordance with applicable requirements of ANSI/AWWA C110/A21.0

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and/or C153/A21.53 with the exception of the manufacturer's proprietary design dimensions. Push-on joints for such fittings shall be in accordance with ANSI/AWWA C111/A21.11.

Restrained joint and pipe fittings shall be U.S. Pipe's TR FLEX pipe and fittings or approved equal. Restraint of field cut pipe shall be provided with U.S. Pipe's TR FLEX GRIPPER ring, TR FLEX pipe field weldments or approved equal. Star Pipe products shall not be permitted.

Restrained push-on joints for pipe and fittings shall be designed for internal working pressures of 350 psi.

Restrained push-on joint pipe and fittings shall be capable of being deflected after assembly.

l. Standards: Ductile Iron Pipe shall conform to applicable Fair Oaks Water District Standard Specifications.

m. Ductile Iron Pipe: General

Ductile iron water pipe shall conform to current AWWA C151 specifications, and shall be cement lined per AWWA C104. Ductile iron pipe shall be thickness Class 50 or Class 53 unless otherwise required by the pressure, loading or as specified on the plans.

Joints that are aboveground, submerged, or located in vaults and structures shall be flanged. Joints in buried piping shall be of the restrained, slip-on or mechanical-joint type per AWWA C111 except where flanged joints are required to connect to valves, meters and other equipment. Restrained joints shall consist of a follower gland having a seal gasket and individually actuated wedges that increase their resistance to pullout as pressure or external forces increase. The system manufacturer shall provide all the components (follower ring, wedges and gaskets) for the restraining device. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. Dimensions of the gland shall be such that it can be used with mechanical joint bells conforming to AWWA C111 and AWWA C153. Minimum rated pressure shall be 350 psi for sizes 15 inches and smaller. Furnish Megalug Series 1100 as manufactured by EBAA Iron, Inc., or approved equal.

Assembly of pipe and joints shall follow the manufacturer's instruction. After assembly of each slip-on joint, the final location of rubber rings within each joint shall be checked by gauge as recommended by the manufacturer.

Joints between ductile iron pipe and other types of pipe shall be made by means of the proper sized and type compression adaptor.

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Fittings shall conform to AWWA C110 with a minimum pressure rating of 250 psi. Mechanical joint fittings conforming to AWWA C153 may be used in lieu of AWWA C110 fittings. Mechanical joint fittings shall have a minimum pressure rating of 250 psi. Fittings shall be cement mortar lined per AWWA C104 and shall be protected with bituminous coating. Star Pipe Products fittings shall not be allowed.

Flanges shall be solid back, Class 125 per AWWA C115. Flanges on pipe shall be either cast or threaded flanged pipe and fitting shall be shop fabricated, not field fabricated. Threaded flanges shall comply with AWWA C115. Flanges shall be individually fitted and machine tightened in the shop, then machined flat and perpendicular to the pipe barrel. Flanges shall be backfaced parallel to the face of the flange. Prior to assembly of the flange onto the pipe, apply a thread compound to the threads to provide a leak-free connection. There shall be zero leakage through the threads at a hydrostatic test pressure of 250 psi without the use of the gasket. Material for blind flanges shall be cast or ductile iron. Restrained flange adapters may be used in lieu of cast or threaded spool pieces.

## **PART 3 – EXECUTION**

### **3.01 PIPING INSTALLATION**

#### **A. General handling and placing:**

1. 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 the pipe on the coating. Any damaged pipe sections, specials, or fittings shall be repaired or replaced at the expense of the Contractor as satisfactory to the District.
2. Carefully inspect each pipe fitting, valve and accessory before installation. Inspect the interior and exterior protective coatings and patch all damaged areas in the field or replace to the satisfaction of the District.
3. Place or erect all piping to accurate line and grade and backfill, support, hang, or brace against movement as specified as 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.
4. 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.

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5. Cast all metallic pipes and sleeves 6-inch and larger into new concrete walls without blockout. Pipes 5 inches and smaller may be cast in place or installed in a smooth core drilled hole using a link type seal at the Contractor's option. Maintain at least ½-inch clearance between reinforcing steel and metal pipe in penetrations.
  6. Cover polyvinyl chloride (PVC) pipe stored outside for more than two months with canvas or other opaque material. Provide for air circulation under the covering.

B. General buried piping installation:

1. Trenching, bedding, and backfill for buried piping shall be as shown on the Plans and as specified in Section 02300 and conform to Fair Oaks Water District Standard Specifications.
2. Where pipe grade elevations are shown on the Plans, install the pipe with straight grades between the indicated elevations.
3. Where no pipe grade elevations are shown on the Plans, install buried piping with at least 3 feet of cover to finished grade. Provide 12 inches minimum separation between the buried water pipes and other buried utilities.
4. Provide each pipe with a firm, uniform bearing for its full length in the trench except at field joints. Do not lay pipe in water or when trench conditions or weather are unsuitable for such work.
5. Protect buried piping against thrust by use of mechanically restrained pipe joints welded or flanged fittings. All exposed free pipe ends shall be securely braced. Cap or plug pipe ends that are left for future connections as shown on the Contract Plans and in a manner favorably reviewed by the District.
6. Where piping leaves a structure or concrete encasement, provide a joint capable of angular deflection within 12 inches of the structure for pipes 12-inch or smaller. Conform to details on the Plans.
7. Snake buried PVC pressure pipe from side to side in the trench in long sweeps.
8. Do not pull bell and spigot, gasketed joints more than 50% of the maximum deflection permitted by the pipe manufacturer.
9. Coat bolts on buried flanges or other buried appurtenances as directed by the District.

C. General exposed piping installation:

1. Unless shown otherwise, install piping parallel to structure, tank or vault.
2. Install piping without springing or forcing the pipe in a manner which would set up stresses in the pipe, valves, or connected equipment.

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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 for all piping connections to equipment and where otherwise shown on the Plans. The Contractor may install additional flexible couplings at favorably reviewed locations to facilitate piping installation, provided that they submit complete details describing location, pipe supports, and hydraulic thrust protection.
  5. Install unions or flexible connections where shown on the Plans, and at all equipment to facilitate removal of the equipment.

#### D. Connections to Existing Pipelines

All connections to existing pipelines shall be made as shown on the Plans and in accordance with these Specifications.

Where the existing main is provided with fittings for connecting to a new main, the face of the connection shall be clean and free of all foreign materials. The Contractor shall remove the plug, cap or blind flange, clean the ends and make the new joint.

Where the existing main is not provided with fittings for connecting to the new main, connections shall be made either by hot tap or by cutting and inserting sections of pipe and fittings, as shown on the Plans or as directed by the District.

For hot tap installations, the tapping saddle shall have a test plug and shall be air tested at fifty (50) PSI for five (5) minutes. Allowable pressure loss during test period shall be 1 psi. Tapping valves shall be flange by flange. All hot taps shall be witnessed by the District.

When deemed necessary by the District, shutdowns of existing in-service pipeline and other distribution facilities shall be made by the District as required to complete pipeline connections. A shutdown shall be for as short a period as amount of lead time necessary for shutdown and connection to existing mains shutdown times vary with each job and must be planned accordingly. Unless dictated by water system consideration, or emergencies, in no case will a shutdown and/or connection be scheduled with less than seven (7) days notice. Interference with the operation of the District's system shall be kept at a minimum. While an existing pipeline is shut down, the connection work shall be performed without interruption, continuing after regular working hours if necessary, until completed, unless otherwise directed by the District. In some cases, shutdowns must occur at times other than normal working hours and/or days. All cost for labor, equipment and meals shall be the responsibility of the Contractor.

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In all cases, shutdowns shall be made under the direction of the District. The District shall close all valves in making a shutdown and shall open all valves to restore pressure to the existing main, as well as initiate pressure to the new installation.

The District Engineer shall be notified at least seven (7) working days prior to any connection operations so that advance preparation on the part of the District can be made, and shall confirm such advance notice in writing. In no case shall any connection operations occur prior to passing pressure and bacteria tests.

### 3.02 PIPING INSTALLATION IN VAULTS

- A. Connect valves and accessories such that all parts are easily accessible for maintenance and operation.
- B. Connections between ferrous and non-ferrous piping, valves, accessories or pipe supports shall be made using a dielectric coupling, union, or flange.
- C. 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.
- D. Use reducing fittings where any change in pipe size occurs. Do not use bushings unless specifically noted on the Plans. Use eccentric reducing fittings wherever necessary to provide free drainage of lines. Each piece of pipe and each fitting shall be carefully inspected to see that there is no defective workmanship on pipe, or obstructions in pipes and fittings. 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.
- E. Refer also to Section 15100 of these Technical Specifications, Valves and Appurtenances.

### 3.03 LOCATING CABLE & LOCATOR TAPE

Direct burial copper wire solid, Soft Drawn No. 10 insulated, shall be taped to the top of every section of buried pipe every ten (10) feet, before backfilling. The wire shall be procured from the vendor complete with an approved splice and insulation kit and cable joints shall be spliced in accordance with the manufacturer's instruction to form a set of continuous electrical conductors throughout the pipe system. Where pipe branches occur, the wire shall be branched also so that wire is provided to each valve, all other appurtenances and to the locating wire of the branch if the existing branch has one.

All water supply and distribution pipe shall be marked with a 3" wide metallic locator tape, located 12" directly above the pipe and bedding material. The tape shall be marked with 1 -

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1½” black “CAUTION – WATER LINE BURIED BELOW” lettering and be placed face up in the trench.

### 3.04 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 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.

### 3.05 FIELD TESTING

- A. General: Perform leakage test on all pipe installed in this project. Furnish all equipment, material, personnel and supplies to perform the test and make all taps and other necessary temporary connections. The test pressure, allowable leakage and test medium shall be as specified and as shown in the following paragraphs. Test pressure shall be measured at the highest point on the line unless specifically noted otherwise. Leakage tests shall be performed on all piping at a time agreed upon and in the presence of the District.
- B. Buried piping: The leakage test for buried piping shall be made after all pipe is installed and backfilled. However, the Contractor may conduct preliminary tests prior to backfill. If the Contractor elects to conduct preliminary tests, provide any necessary temporary thrust restraint.
- C. Exposed piping: All supports, anchors and blocks shall be installed prior to the leakage test. No temporary supports or blocking shall be installed for final test.
- D. Encased piping: The leakage test for encased piping shall be made after all pipe is installed and encased, and before any structures are constructed above it. However, the Contractor may conduct preliminary tests, prior to encasement. If the Contractor elects to conduct preliminary tests, provide any necessary temporary thrust restraint.
- E. Accessories: It shall be the responsibility of the Contractor to block off or remove valves, gauges, etc., which are not designed to withstand the full test pressure.
- F. Testing apparatus: Provide pipe taps, nozzles and connections as necessary in piping to permit testing including valves to isolate the new system, addition of test media, and draining lines and disposal of water, as is necessary. These openings shall be plugged in a manner favorably reviewed by the District after use. Provide all required temporary bulkheads.

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- G. 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.
- H. Reports: The Contractor shall keep records of each piping test, including:
1. Description and identification of piping tested.
    - a. Test pressure.
    - b. Date of test.
    - c. Witnessing by Contractor and District.
    - d. Test evaluation.
    - e. Remarks, to include such items as:
      - 1) Leaks (type, location).
      - 2) Repairs made on leaks.
  2. Test reports shall be submitted to the District.

I. Testing Procedures

Testing procedures shall conform to Fair Oaks Water District Standards.

The District Engineer shall be notified forty-eight (48) hours prior to testing and must approve any water placement in any portion of the pipeline. The pipeline shall be filled with water and all air evacuated.

The pressure shall be slowly increased to two hundred (200) PSI or one hundred fifty percent (150%) of working pressure, whichever is greater. The test pressure shall be maintained for measuring the quantity of water required to maintain full pressure in the line for the test period of two (2) hours.

The maximum make-up water allowance shall be per the pipe manufacturer's recommendations, AWWA, or as directed by the District Engineer, whichever is more stringent.

All leaks shall be repaired, regardless of the amount of leakage.

All or part of the pipeline may be drained as necessary to repair leaks. All leaks shall be repaired in a manner approved by the District and retested before acceptance by

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the District. The Contractor shall provide all labor, equipment and materials required for filling and testing the pipelines. After successful completion of the hydrostatic test, the chlorination flushing, bacteriological test and high velocity flushing may be completed per the specifications.

Make-up water allowance for pipe shall be determined from the following equation:

$$M = \frac{SD(P^{1/2})}{148000}$$

Where: M = Make-up Water allowance (gal/hr)  
S = Length of Pipe Tested (ft)  
D = Nominal Diameter of Pipe (in)  
P = Average Test Pressure (PSI)

Allowable leakage shall conform to Fair Oaks Water District Standard Specifications.

- J. Venting: Where not shown on the Plans, the Contractor may install valved “tees” at high points on piping to permit venting of air. Valves shall be capped after testing is completed.

### 3.06 DISINFECTION OF POTABLE WATER SYSTEMS

After successful completion of the hydrostatic test, the Contractor shall disinfect the pump discharge pipeline per methods included in the latest edition of AWWA C651. Disinfection shall be supervised and approved by the District. The District shall approve which method is most suitable for each situation considering length and diameter of pipeline, type of joints present, availability of materials and safety considerations. The interior of all pipe and fittings used in making final connections shall be swabbed or sprayed with 1% hypochlorite solution.

For the tablet method or the continuous feed method the chlorinated water shall be retained in the main for at least twenty-four (24) hours hold time, or per AWWA C651, whichever is greater. At the end of this hold time the treated water in all portions of the main and appurtenances shall have a residual of not less than ten parts per million (10 ppm). During the hold time, new valves shall be exercised to promote disinfection of the appurtenances.

After chlorination, the pipeline shall be flushed and de-chlorinated per AWWA C651 Section 4.9 and Fair Oaks Water District Standard Specifications. Flushing shall continue until the chlorine residual in the water leaving the main is no higher than that of the existing distribution system or 0.3 ppm. The water shall then remain unmoved for a minimum of

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twenty-four (24) hours after which the District shall collect bacteriological samples which shall be tested by an independent laboratory. Bacteriological testing shall be per AWA Standards or AWWA C651, Section 5.1, whichever is more stringent. The number and location of samples shall be per AWWA C651, Section 5.1 or as directed by the District, and shall be approved by the District prior to sampling. If emergency work is under way, disinfection is to be per AWWA C651 Section 4.11, or as directed by the District.

The Contactor shall make the necessary piping connections and furnish and install all necessary equipment required for the high velocity flushing operations. The Contractor shall provide for safe and legal disposal of water from such flushing. The Contractor shall remove all temporary flushing facilities. All costs for chlorination bacteriological testing and flushing shall be paid by the Contractor.

### 3.07 CONTINUITY TESTING

The Contractor shall test the continuity of the locating wire at time of final walk- thru. The Contractor shall provide all labor, equipment and materials required for testing the continuity of the locating wire at the meter and valve vaults. Should continuity not be present and / or observed, the Contractor shall repair, replace and retest as necessary, entirely at Contractor's expense.

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

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SECTION 15100

**MANUAL, SELF ACTIVATED AND ELECTRICALLY CONTROLLED VALVES  
AND PIPE APPURTENANCES**

**PART 1 – GENERAL**

**1.01 SCOPE**

This section of the specifications covers the work necessary to furnish and install valves and pipeline appurtenances. All valves and appurtenances are to be furnished and installed in accordance with the Fair Oaks Water District Standard Specifications. The locations and size of valves and appurtenances to be placed as part of this Project are shown on the Plans.

**1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS**

Fair Oaks Water District Standard Specifications  
Section 03400 – Precast Concrete Vaults and Valve Boxes  
Section 15040 – Piping

**1.03 SUBMITTALS**

Submittals shall include data sheets and catalog cuts and sufficient information to ensure conformance with the specifications. Furnish installation instructions and spare parts lists for valves 4 inches and larger.

Submittals shall comply with Section 01300 of these Technical Specifications.

**1.04 OPERATING AND MAINTENANCE INSTRUCTION**

Operating and maintenance manuals shall be furnished for the gate valves, check valves, automatic control valves and combination air and vacuum release valves specified in this section in accordance with Section 01730 “Operating and Maintenance Instructions” of these Technical Specifications.

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## **PART 2 - PRODUCTS**

### **2.01 GENERAL**

Valves shall be furnished full line size unless specifically called out to be of reduced size. Unless otherwise specified, valves and pipeline appurtenance shall be rated for not less than 150 psi working pressure minimum.

All valves shall be complete with all necessary operating extension stems, operating nuts, and wrenches which are required for the proper completion of the work included under this section. The direction of wrench nut to open the valve shall be to the left (counterclockwise). Each valve body or operator shall have cast thereon the word "OPEN" and an arrow indicating the direction to open. Flanges shall meet the requirements of ANSI B16.

Extend stems to within 18" of finished grade for all buried valves.

### **2.02 Manually Operated Valves**

#### **A. Gate Valves**

Gate valves, eight inches (8") to twelve inches (12") in diameter shall be resilient seated wedge type, two hundred (200) PSI WOG rated, and conform to AWWA specification C509. All interior ferrous surfaces shall be protected against corrosion by factory applied fusion-bonded epoxy coating, which shall be a minimum of eight (8) mils thick and applied per AWWA C550. Ferrous metal exterior valve surfaces shall receive factory applied fusion bonded epoxy coating, two coats, with a minimum dry film thickness of seven (7) mils. Valves shall have a smooth inside bore on the bottom half so that sediment cannot accumulate. Valves shall open counterclockwise. Valves installed underground shall have a non-rising stem and a two inch (2") square operating nut that is accessible through a valve box. Valves installed above ground shall have outside stem and yolk (OS&Y), rising stem, and be hand wheel operated. All gate valves 8" to 12" in diameter supplied for this Project shall be products of the same manufacturer.

Stems shall be Type 304 or 316 stainless steel or cast, forged, or rolled bronze. Stem nuts shall be made of solid bronze. Bronze shall conform to ASTM B 62 or ASTM B 584 (Alloy C83600).

End connections for exposed gate valves 4" and larger shall be flanged. End connections for buried gate valves 4" and larger shall be mechanical joint, flanged, or mechanical joint by flanged as required. Gate valves shall be Mueller A-2360RS Gate Valve, American Darling – CRS-80, American AVK-Series 25, US Pipe Meteroseal 250 or approved equal.

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B. Butterfly Valves

Butterfly valves shall comply with the requirements of AWWA C504 and requirements as specified hereinafter.

<u>Component</u>	<u>Material</u>
Shaft	Type 316 Stainless Steel, ASTM 276
Disc	Ductile Iron, ASTM A-536 Grade 65-45-12
Disc Edge - Seat Surface	Type 316, Stainless Steel, ASTM 276
Rubber Seat	Neoprene or Buna-N
Body	Cast Iron, ASTM A126, Class B

Valves shall be through-shaft design. Wafer type ends are not acceptable. Butterfly valves shall be rated at 150 psig and provide driptight shutoff up to the full valve rating. Seat shall be mechanically held in place and shall be field replaceable. Valve ends shall be as shown on the Plans.

Butterfly valve interiors shall be factory coated per AWWA C550, Ferrous metal exterior valve surfaces shall receive factory applied fusion bonded epoxy coating, two coats, with a minimum dry film thickness of seven (7) mils.

Manual operators shall be designed in accordance with AWWA C504 and shall have a disc position indicator designating the open and closed position of the valve.

Operators for butterfly valves, 12" diameter and smaller, shall permit locking the valves in any position between fully open and fully closed.

All butterfly valves furnished shall be manufactured by Henry Pratt Ground Hog, Mueller Linesal III, or approved equal. All butterfly valves supplied for this Project shall be products of the same manufacturer.

C. Ball Valves

1. Type 1 - PVC Ball Valves: PVC ball valves 3 in. and smaller shall be full port, rated 150 psi at a temperature of 73°F, with ASTM D1784, Class 12454-B chlorinated polyvinyl chloride (PVC) body, ball, and stem. Valves shall be of double union design with solvent weld socket ends (125 lb. ANSI B16.1 flanged ends shall be provided where shown). Valves shall have replaceable Teflon

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seats and Viton or Teflon O-ring stem seals. Valves shall have handle for manual operation. Valves shall be Asahi America, Nibco, or approved equal.

2. Type 2 - Ball Valves - 2 Inches and Smaller (General Service): Ball valves 2 in. and smaller, for general water and air service, shall be bronze body and trim, internal entry type, with screwed ends, full bore ports, Teflon seats, and hand lever operators, rated 400 psi and 400°F. Valves shall be Jamesbury 11-1100TT, or approved equal.
3. Type 3 Polypropylene Ball Valves: True union style with body and ball of polypropylene, teflon seats, and EDPM o-rings. Valves shall be Asahi America, or approved equal.

## 2.03 SELF-ACTUATED VALVES

### A. Combination Air and Vacuum Release Valves

Air and vacuum release valves shall be combination air and vacuum release valves as manufactured by Crispin UL10, 20, bronze or stainless steel trim. Size shall be as specified herein, as shown on the plans and FOWD Standard Drawing No. 2-1.

Air and Vacuum Release Valve enclosure shall conform to Fair Oaks Water District Standard Drawing 2-1.

Provide one inch (1") AVRV with a minimum air release orifice diameter of 5/64" on line sizes up to twelve inches (12").

### B. Check Valves

Swing check valves shall be NSF / ANSI 61 Drinking Water Certified. Valves shall be cast iron (ASTM A 48, Class 30, or ASTM A 126, Class B) body and cover. Flapper shall consist of a steel disk insert and a steel bar hinge covered with Buna-N vulcanized to the metal pieces. Provide O-ring seal vulcanized onto the disk. Valve shall be designed for a working pressure of not less than one hundred seventy-five (175) PSI and tested at three hundred fifty (350) PSI. They shall be of the balanced, swing gate type with a clear opening at least equal to that of the connecting pipe. Valve interior and exterior shall be coated with an NSF / ANSI 61 certified fusion bonded epoxy in accordance with AWWA C550. Valve shall be suitable for horizontal or vertical pipe installations

### C. Elastomeric Check Valve

Check Valves shall be all rubber and the flow operated check type with slip-in cuff or flange connection. The entire valve shall be ply reinforced throughout the body, disc and bill, which is cured and vulcanized into a one-piece unibody

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construction. A separate valve body or pipe used as the housing is not acceptable. The valve shall be manufactured with no metal, mechanical hinges or fasteners, which would be used to secure the disc or bill to the valve housing. The port area of the disc shall contour down, which shall allow passage of flow in one direction while preventing reverse flow. The entire valve shall fit within the pipe I.D. Once installed, the valve shall not protrude beyond the face of the manhole or end of the pipe.

The slip-in style valves will be furnished with a set of stainless steel expansion clamps. The clamps, which will secure the valve in place, shall be installed inside the cuff portion of the valve, based on installation orientation and shall expand outwards by means of a turnbuckle. Each clamp shall be pre-drilled allowing for the valve to be pinned and secured into position in accordance with the manufacturer's installation instructions.

D. Pump Column Check Valve

The pump column check valve, Techno 10 inch Model 500 2F 316, to be installed below the pump bowls shall be furnished by the District for installation by the Contractor.

## 2.04 AUTOMATIC CONTROL VALVES

A. Well Pump Control Valve

The well pump control valve shall be a diaphragm-actuated, single-seated, hydraulically operated 8-in. globe type valve. The valve shall utilize line pressure for operation. It shall have two operating chambers sealed from each other by a flexible fully supported and reinforced Buna-N synthetic rubber diaphragm suitable for groundwater dechlorinated with sodium bisulfite. The lower diaphragm chamber shall be separated from the main flow passage. The valve disc shall have a rectangular cross-section and shall be retained on three sides. All internal metal parts shall be bronze or stainless steel. The valve shall be satisfactory for operation with a 350-hp motor and pressures up to 175 psi.

Pressure from the system side of the check valve (estimated 55-85 psi) shall be used for pilot valve operation.

Control of the valve shall be by an externally mounted 4-way 120 VAC solenoid pilot valve housed in a NEMA 4 enclosure. Solenoid pilot valve shall be CSM11. Both the suction and the discharge lines to the solenoid pilot valve shall be equipped with strainers and check valves. Flow control valves shall also be provided on the liner to both sides of the diaphragm to regulate the rate of valve opening and closing. A limit switch in a NEMA 4 enclosure shall be installed on the valve that is adjustable over the entire length of travel and serves as an interlock between the valve and pump. The pump control valve shall be wide open when the pump is stopped. When the pump is started, the solenoid shall be energized

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after a time-delay and the valve shall begin to slowly close. As the valve closes, pump discharge shall be diverted into the main line as the main line check valve gradually opens. Upon shutdown of the pumping unit, the solenoid valve shall be de-energized and the pump control valve shall slowly open. As the valve opens, pump discharge shall be diverted to the waste discharge pipeline. As pump pressure gradually decreases, the main line check valve shall close slowly in order to prevent shock or slam.

The valve body, cover and flanges shall be constructed of cast iron ASTM A-48. Flat face flange drilling shall be in conformance with ANSI B16.1 125 lb standard for cast iron flanges. The main valve trim shall be bronze or 303 stainless steel. Pilot system shall be cast brass, ASTM 862 with 303 stainless steel trim. Seat and diaphragm shall be Buna-N.

Valve shall be globe style, Cla-Val 61-02. A manufacturer's field representative shall be present at the project site to witness and assist in the adjustment and startup, and to instruct operating personnel in the operation of the valve.

**B. Solenoid Valves**

1. Description: Solenoid valves furnished under this specification shall be encapsulated coil, direct or pilot operated, suitable for 2, 3, or 4 way service.
2. Performance, Service and Design Requirements: Solenoid valves furnished under this section shall be suitable for continuous (24 hr/day, 7 days/week) service at 120°F ambient temperature, outdoor environment with high humidity.

Service voltage, connection size and number of ports shall be as indicated on the Project Plans. Unless otherwise specified or noted, solenoid valves shall be normally closed; that is, designed to seal the pressurized (supply) port upon de-energization.

All valves shall be combination NEMA 4X, 7 and 9 enclosures and shall be listed by Underwriters Laboratories Inc., in accordance with UL429 and UL1002. Solenoid valves for gas service shall also be approved by Factory Mutual Engineering Corporation. The maximum acceptable operating pressure differential for full valve operation of pilot operated valves shall be 5 psi.

3. **Materials and Construction**

<u>Component</u>	<u>Material</u>
Body	Bronze
Seat	Teflon or Buna-N
Coil Tube	Epoxy/Fiberglass
Core	A1-220 or HNL Magnet 220C Class, Epoxy Encapsulation

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Shell	Silicon Varnish Impregnated Glass Thread
Fasteners	Type 316 Stainless Steel

Valve bodies shall be threaded or flanged in accordance with the Project Plans. Valves with piping connections 1-1/2 in. diameter and greater shall be external pilot operated globe body type with adjustable operating time control.

Coils shall be fully encapsulated, Class H, suitable for 180°C operating temperature.

Valves shall be 120V AC.

## 2.05 VALVE APPURTENANCES

### A. Valve Boxes

Valve boxes shall be provided for all underground valves and shall be pre-cast concrete, Christy G5 Traffic Valves boxes. Lids shall be cast iron traffic type G5C and marked "WATER."

### B. Valve Riser Extensions

Eight inch (8") diameter PVC conforming to AWWA Section C900 water pipe or SDR35 sewer pipe shall be used and installed as shown on FOWD Standard Drawing 4.

### C. Plastic Film Wrap

Plastic film wrap shall be furnished and installed to encase all ductile iron buried valves, bolted flanges, ductile iron pipe and other fittings. The polyethylene film shall be of virgin polyethylene as produced by DuPont Alathon resin and shall meet the requirements of ASTM Designation D1248 for Type 1, Class A, Grade E-1 and shall have a flow rate or nominal melt index of 0.4 g/min maximum. Polyethylene encasement shall conform to AWWA C105 Standards.

The polyethylene film shall be minimum six (6) mils in thickness. The length shall be sufficient to firmly attach the film to the pipe on either side of the valve, valve flange or fitting with ten (10) mil tape or duct tape.

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## 2.06 ELECTRIC (MOTOR) VALVE ACTUATORS

Electric motor valve operators are to be installed on 8 inch and 12 inch diameter disc edge, rubber seated butterfly valves at the wellhead piping locations shown on the Plans.

The electric valve operators shall be Rotork IQS-Multi-train single phase operators or approved equal, capable of providing not less than 225 ft/lbs of torque for valve closure.

Electric valve actuators shall include direct drive and gear handwheels for effective manual operation. Handwheel drive shall be independent of the motor drive. The valve actuators shall include a local display which will show position of the valves.

Valve actuators shall include local open/close and local/stop/remote selectors. Each actuator shall be furnished with a battery to support the local display and remote indication when no main power is available.

All of the electric valve actuators installed for the New York Well Phase 2 Project shall be furnished by the same manufacturer.

## 2.07 WATER PIPE APPURTENANCES

### A. Flexible Couplings

Flexible couplings shall have a minimum pressure rating equal to the pipe class. Care shall be taken to see that smooth surfaces have been provided on the pipe so that the coupling can be properly fitted. Flexible couplings for cast iron, ductile iron, PVC or AC Pipe shall be Smith-Blair Model 411, 437, 441 or equal. Transition coupling shall be Smith-Blair Model 413, 437, 441 or equal. Reducing couplings shall only be used where approved of by the District Engineer and shall be Smith-Blair Model 415, R441, or equal.

### B. Flange Coupling Adapters

Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with AWWA C115.15. For PVC pipe, the flange adapter shall have a pressure rating equal to or greater than the pipe. For Ductile Iron Pipe, the flange adapter shall have a minimum safety factor of 2:1. The flange adapter shall be Series 2100 Megaflange adapter by EBAA Iron, Inc., or approved equal.

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## 2.08 SERVICE PIPE APPURTENANCES

### A. Service Saddles

Service saddles shall be 85-5-5-5- bronze construction with wide strap and female NPT (aka FIPT, FIP or female “iron pipe”) threads. Service saddles shall be NSF 61 certified. One inch (1”) and smaller services shall be Jones J996 or Ford S91 for PVC C900 mains or, Jones J979, Ford F202, Mueller BR2B, or Romac 101B for ductile iron pipe mains.

### B. Corporation Stops

Corporation Stop components that are in contact with the water shall be made of lead-free brass alloy (e.g. UNS C89833, C89550 or C28500). Components not in contact with the water may be 85-5-5-5 bronze (UNS C83600) as manufactured by the James Jones Company, Mueller Company or Ford. Corporation stops must comply with AWWA C800.

Inlet threads shall be male iron pipe (MIP) threads. Outlet shall be copper tube size compression, or Mueller “Insta-tite

## 2.09 MISCELLANEOUS APPURTENANCES

### A. Pressure Gauges

Unless otherwise noted, pressure gauges shall be stainless steel bourdon type with a two and a half inch (2 ½”) diameter dial and black alumalite cases suitable for mounting as required. Pressure range and calibrations shall be as required and the dial shall be engraved with the units in which the gauge is calibrated. All pressure gauges shall be glycerin filled.

### B. Meter Vault Wall Penetration Seals

Pipe connections cored through the Meter Vaults shall be sealed with link-seal, modular, elastomeric seals. The link seals shall be pressure resistant up to 20 psi. Seal shall be stainless steel construction with EPDM seal elements, reinforced nylon reinforced polymer pressure plates and stainless steel nuts and bolts. Wall penetration seals shall be Thunderline Link-Seal Model C Modular Seals, or approved equal.

### C. Adjustable Floor Mounted Pipe Support

Adjustable floor mounted pipe supports to be furnished and installed as shown on the Contract Plans and as required to provide above ground pipe support shall include threaded base stand, TOLCO Figure 316T, or approved equal with 8 inch x 8 inch

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floor plate and Adjustable Pipe Support Saddle, TOLCO Figure 317 A, ANVIL International #264 or approved equal. The adjustable pipe support shall be furnished with minimum 2 ½ inch diameter stand pipe suitable to support 8 inch to 12 inch diameter AWWA DIP. The adjusted floor mounted pipe supports shall be designed to support horizontal pipe from floor stand or where vertical adjustment is required. Floor mounted pipe supports shall be bolted to concrete well pad. Floor supports shall conform to Federal Specification WW-H-171E and AA 1192A, Type 39 and ANSI/MSS SP-69 and SP-58, Type 38. Furnish with galvanized finish.

D. Static Mixer

Static mixer furnished and installed for the ASR piping shall be 8 inch diameter, flanged, ductile iron or stainless steel, 2 element mixer with one chemical injection port. The maximum lay length for the static mixer shall be 32 inches. Static mixer shall be manufactured by Koflo Corporation or approved equal.

### **PART 3 – EXECUTION**

#### **3.01 – Installation**

- A. Valves and appurtenances specified herein shall be installed according to FOWD Standard Specifications, the details shown on the Plans and as specified by the manufacturer.
- B. Install valves and accessories such that all parts are easily accessible for maintenance and operation.
- C. Where valve handwheels are shown on the Plans, 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 meters in a position to permit reading them from a point approximately 3 to 5 feet above floor level.
- E. Install a union adjacent to each screwed end valve and accessory with additional unions as necessary to facilitate removal.
- F. Install a ball valve between each pressure gauge and pipe saddle.
- G. Connections between ferrous and non-ferrous piping, valves, accessories or pipe supports shall be made using a dielectric coupling, union, or flange.

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- H. 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.
  - I. Install a suitable chrome plated escutcheon on pipes passing through slabs or walls in finished areas.
  - J. Use reducing fittings where any change in pipe size occurs. Do not use bushings unless specifically noted on the Plans. Use eccentric reducing fittings wherever necessary to provide free drainage of lines. Each piece of pipe and each fitting shall be carefully inspected to see that there is no defective workmanship on pipe, or obstructions in pipes and fittings. 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.

### 3.02 **WARRANTY AND GUARANTEES**

The valve and pipe appurtenance equipment manufacturers shall warrant the valve and pipe appurtenances and associated equipment being supplied to the District against defects in workmanship and material for a period of 2 year from the date of completion of the FOWD New York Well Phase 2 Construction, New York Well Equipping and Site Improvements Project, not to exceed 30 months from date of shipment. In the event that a valve or pipe appurtenance fail to perform as specified, the manufacturer shall promptly repair or replace the defective equipment without any cost to the District, including handling and shipping costs.

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

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SECTION 15200

**AQUIFER STORAGE AND RECOVERY VALVES**

**PART 1 – GENERAL**

**1.01 SCOPE**

A. Work consists of installing one (1) Aquifer Storage and Recovery (ASR) downhole control valve as furnished by the District. Installation shall be complete, as shown on the Contract Plans and/or specified herein, including the downhole control valve, aboveground control components, the hydraulic control lines connecting the aboveground control components to the downhole control valve components, and other appurtenances, and accessories as necessary for a complete ASR system.

B. Related Requirements:

1. Section 11200 – Water Well Pump and Motor

**1.02 RELATED WORK SPECIFIED IN OTHER**

Section 15040: Piping

Section 15100: Manual, Self Actuated and Electrically Controlled Valves

**PART 2 - PRODUCTS**

**2.01 DOWNHOLE VALVE**

A. Materials: All metal parts for the downhole control valve are stainless steel. All other downhole components are made of corrosion resistant materials.

B. Performance: The downhole control valve will provide cavitation free control of the recharge rate under the operating conditions described herein and shown on the plans. The downhole control valve shall close tight during pumping of the well (recovery) to prevent any recycling of water within the well during pumping. Coordinate with technical submittal for the vertical turbine pump for the internal pressure against which the downhole control valve shall remain closed.

C. Valve operating conditions

Install in 10 inch diameter vertical turbine pump column.

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<b>Parameter</b>	<b>ASR</b>
Maximum well recharge flow rate, gpm	1000
Maximum flow through valve during recovery, gpm	2200
Maximum residual pressure at the ground surface at the well head during recharge, psi	20
Minimum residual pressure at the ground surface at the well head during recharge, psi	0
Static water level (without recharge), ft bgs <sup>(1)</sup>	159
Maximum water level during recharge, ft bgs <sup>(1)</sup>	100
Minimum water level during recovery, ft bgs <sup>(1)</sup>	217

(1) Below ground surface.

## 2.02 VALVE CONTROLS

- A. The aboveground components for control of the downhole control valve shall be supplied and warranted by the manufacturer of the downhole control valve. Aboveground control components shall interface with a programmable logic controller (PLC) main control panel specified elsewhere in these Contract Documents. The main controller shall direct the downhole control valve to open or close by starting a hydraulic pump and energizing the appropriate solenoid valve. The valve control panel shall provide a means for bypassing or overriding the PLC main controller to allow for local, manual control of the valve.
- B. Position indicators and limit switches shall be supplied for indicating when the valve is in the closed position and for generating an alarm if the valve has lost hydraulic pressure. The position indicators/alarms shall interface with the PLC main control panel.
- C. Two (2) hydraulic control lines shall extend from the valve control components located above ground to the downhole control valve. The control lines shall be supplied and warranted by the manufacturer of the downhole valve. Hydraulic fluid shall be food grade mineral oil, NSF certified for potable water.
- D. In the event of system failure the downhole valve shall fail in the “closed” position so that the well can still be pumped.
- E. All electrical components for control of the downhole control valve, including solenoid valves and pump motors, shall comply with the requirements of Division 16.

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- F. Aboveground components shall be protected against corrosion. Coatings shall comply with Section 09900 - Coatings.

## 2.03 MANUFACTURER

3R Valve of Echo, OR

## PART 3 – EXECUTION

### 3.01 INSTALLATION

- A. Aboveground and downhole components of the downhole control valve shall be installed in accordance with the manufacturer's written instructions and as shown and specified in the Contract Documents.
- B. The downhole control valve and the control conduits within the well casing shall be installed above vertically suspended submersible pump as specified in Section 11200.

### 3.02 TESTING

- A. The hydraulic control conduits shall be tested for leakage after installation. A written procedure for the leakage test shall be prepared by the downhole control valve manufacturer and presented to the District for approval at least one week prior to the testing.
- B. The downhole control valve shall be functionally tested after installation. A written procedure for the functional testing shall be prepared by the Contractor in conjunction with the downhole control valve manufacturer, the vertical turbine pump supplier and the Systems Integrator. The proposed testing procedure shall be presented to the District for approval at least one week prior to the testing.

### 3.03 SERVICES PROVIDED BY MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall provide the services of the downhole control valve manufacturer's representative. The manufacturer's representative shall observe and verify the proper installation of the downhole control valve and control lines within the well and coordinate installation of the downhole valve with the installation of the submersible pump specified in Section 11200.
- B. The downhole control valve manufacturer's representative, having observed the installation of the downhole control valve, shall submit a written report indicating whether the installation was done in accordance with the manufacturer's written

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instructions and detailing any reservations or shortcomings that the manufacturer's representative may have regarding the installation of the downhole control valve and control conduits. The Certificate of Substantial Completion shall not be issued prior to receipt of the report from the downhole control valve manufacturer's representative.

- C. Inspection, Startup and Field Adjustment - The downhole control valve manufacturer's representative shall be present at the site for not less than 3 work days, in addition to those days provided in the previous paragraphs, to furnish the following services.
1. Inspect, check, adjust if necessary and approve the installation of all the downhole control valve components.
  2. Start-up and field-test the downhole control valve for proper operation.
  3. Perform necessary field adjustments during the test period until the downhole control valve installation and operation are satisfactory to the District.
  4. Instruct the District's personnel in the operation and maintenance of the downhole control valve. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.
- D. The costs of all inspection, startup, testing, adjustment and instruction work performed by the downhole control valve manufacturer's representatives shall be borne by the Contractor.
- E. For the purposes of this paragraph, a work day is defined as an 8 hour period at the site, excluding travel time.

### 3.04 WARRANTY

The equipment manufacturers shall warrant the Aquifer Storage and Recovery Valve equipment being supplied to the District against defects in workmanship and material for a period of 2 years from the date of completion of the New York Well Phase 2 Construction, New York Well Equipping and Site Improvements, not to exceed 30 months from the date of shipment. In the event that equipment fails to perform as specified, the equipment manufacturers shall promptly repair or replace the defective equipment without cost to the District, including handling and shipping costs.

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

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SECTION 15400

**PLUMBING AND PLUMBING APPURTENANCES**

**PART 1 – GENERAL**

**1.01 SCOPE**

Furnish and install floor drains, mud valves, drain pipe, emergency shower, eye / face wash station and hose bibs together with appurtenant fixtures and above grade and below grade piping for plumbing fixtures as shown on the Contract Plans and as specified herein.

**1.02 STANDARDS, QUALITY ASSURANCE**

All work, including equipment, materials and installation shall conform to California Administrative Code, Title 24, Building Standards (CAC Title 24), County Building Code Standards.

**1.03 RELATED WORK SPECIFIED IN OTHER SECTIONS**

Section 15040 - Piping

**1.04 SUBMITTALS**

- A. Submit all required data for approval prior to start of fabrication and in accordance with Section 01300 of these Technical Specifications.
  - 1. Submit dimensioned shop drawings.
  - 2. Submit manufacturer's installation recommendations

**1.05 PRODUCT HANDLING AND DELIVERY**

- A. All equipment shall be enclosed in such a manner that they shall be protected against damage from dust, moisture, or striking by external objects.
- B. Prepare, ship and store plumbing equipment to prevent warping or damage.

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## **PART 2 – PRODUCTS**

### **2.01 DRAIN PIPE**

- A. Inside building and within 5' of building line: Service weight cast iron soil pipe and fittings conforming to Cast Iron Soil Pipe Institute's Standard HS-67 and 301-67T, with bell and spigot joints or hubless pipe with stainless steel shields and clamps or ABS Schedule 80 pipe conforming to the requirements of ASTM D1527 Standards. Underground installation procedures for ABS pipe shall conform to the requirements of ASTM D2321 and ASTM D2751, drain pipe and fittings.
- B. More than 5' outside building line: PVC, ASTM 3034, SDR 35, drain pipe.

### **2.02 WATER LINES**

- A. Buried piping 5 feet outside of building line 2" and smaller: PVC ASTM D1784, Schedule 80.
- B. Buried piping 2" and smaller within 2' of building line and / or beneath concrete shall be copper type "L" hard.
- C. Exposed piping within buildings shall be Copper Type L, hard. Hose bib risers inside buildings may be PVC ASTM D1784, Schedule 80.

### **2.03 VALVES AND ACCESSORIES**

- A. Gate Valves: Stockham, Crane, Mueller, or approved equal.

### **2.04 EMERGENCY SHOWER**

- A. Suitable for indoor or outdoor installation. Equipment shall meet or exceed current ANSI Z358.1 standards.
- B. Emergency Shower, Eye / Face Wash Station furnished and installed at New York Well Building shall be Haws Axion Series 8300, or approved equal. Emergency Shower, Eye / face wash station shall be floor mounted and constructed of 1 ¼ inch IPS Schedule 40 hot dipped galvanized steel pipe, powered coated cast iron floor flange and 11" diameter stainless steel receptor. Wrap exposed water supply pipe with heat trace tape.

### **2.05 FLOOR DRAINS**

Floor drains shall be Wade, Jay R. Smith Model 2020 or Model 2030, Josam Model 30000-E or equal, 4 inch diameter cast iron drain with nickel bronze strainer. Floor drains in chemical rooms shall be furnished with tapped flange for installation of mud valves.

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## 2.06 MUD VALVES

All parts and hardware shall be fabricated from 310 stainless steel. Finish suitable for flanged end connection to floor drains in chemical rooms.

Furnish with 2-inch square operating nut and stem extension to the top of all structures or 14-inch handwheel as shown on the Contract Plans. The extension stems, pedestal lifts, covers, stem guides, levers and brackets will be designed and furnished by the manufacturer of the mud valve to make a complete and operable unit.

Mud valves shall be Waterman, M & H Style 140; Trumboll; Waterman Industries Model MV-11, Fontaine, Model C-85, Whipps, Inc., Model 706, or equal.

## 2.07 HOSE BIB

¾" Hose bib shall be bronze body and trim, composition disc. Furnish with ¾" NPT pipe hose thread outlet.

Nibco No. T-113-HC, Grinnel 3000 HC, or equal.

## 2.08 HOSE AND HOSE RACK

Furnish hose bib with 50 foot long industrial hose same size (¾") as hose valve. Hose shall be oil resistant, reinforced two ply, modified nitrile tube and cover. Versigard synthetic rubber, RMA Class C. Reinforced with spiral synthetic yarn. Rated between -40°F and 190°F. Minimum pressure rating of 100 psi. Provided with threaded end connections and spray nozzle. GoodYear, Model 569-049 Sureline, or equal. Wall Mount Hung Up On Dixon, Model DHR1 hose rack, or equal, adjacent to the hose bib.

## PART 3 - EXECUTION

### 3.01 PIPE JOINTS AND PLUMBING CONNECTIONS

- A. Work shall be performed by competent tradesmen specially trained in type of work required and using tools and equipment recommended by manufacturers of pipe, fittings or equipment. Mating joint surfaces shall be wiped clean before assembling.
- B. Make joints with best quality, paste carefully and smoothly placed on male threads only. Tighten with tongs and wrenches and remake leaky joints with new material. Use of thread cement or caulking to make joints tight will not be permitted. Ream all cut ends to full bore before assembly.

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- C. Make flanged joints square, with even pressure on gaskets using full face or ring type gaskets to suit flange facings. Gaskets shall be rubber at least 1/6" thick or approved metallic packing. Use best quality refined iron or mild steel bolts and nuts with well fitting and hexagonal chamfered heads. Underside of bolt heads and nuts shall be true surface at right angles to axis bolts.
  - D. Install rubber joints in accordance with pipe or fitting manufacturer's instructions for pressure service requirements.
  - E. Provide unions, whether shown or not, on all threaded piping to permit easy disassembly for removal of equipment, tanks or valves.
  - F. Wrought copper adapters shall be used wherever it is necessary to connect copper tubing to a valve or "Tee" having threaded connections.

### 3.02 **DISINFECTION**

- A. All domestic water piping and facilities shall be flushed and chlorinated by disinfecting solutions in accordance with AWWA Standard C653. Contractor shall arrange for sampling and testing for bacteriologic quality to show absence of coliform organisms. Calcium hypochlorite granules or tables, if used, shall not be applied in the dry form, but shall first be dissolved into a solution before application.
- B. The Contractor shall take adequate precautions in handling chlorine not to endanger workmen or damage materials. All pipes and fittings shall be completely filled with water containing a minimum of 50 ppm available chlorine. Each outlet in the system shall be obtained. The line shall then be closed and the chlorine solution allowed to remain in the system for a minimum of 24 hours so that the line shall contain no less than 25 mg/l chlorine throughout. After the retention period, the system shall be drained, flushed and refilled with freshwater.

### 3.03 **TESTING**

- A. Testing shall comply with the provisions of UBC and UPC. Refer also to testing requirements included in Section 15040 of these Specifications.

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

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## SECTION 15800

### AIR VENTILATION AND CONDITIONING EQUIPMENT

#### PART 1 – GENERAL

##### 1.01 SCOPE

This section includes the furnishing and installation of wall mounted sidewall exhaust fans at the chemical rooms and at the wellhead room of the New York Well Building, a roof mounted turbine ventilator for the wellhead room and an air conditioning unit to be installed in the New York Well Building MCC Room. The exhaust fans installed at the well building chemical rooms shall be activated with the entrance door switch. The sidewall exhaust fan in the wellhead room will be activated by a room thermostat. The roof mounted turbine ventilator shall be wind or head convection operated to dissipate heat in the wellhead room. The air conditioning unit at the MCC Room will be thermostat controlled.

##### 1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

Section 08910 – Metal Wall Louvers  
Section 11250 – Chemical Feed and Control Systems  
Section 16010 – General Electrical Requirements

##### 1.03 SUBMITTALS

The Contractor shall submit information necessary to demonstrate compliance with these Specifications, all in accordance with Section 01300. The following specific information shall be provided.

- A. The Contractor shall submit shop drawings, technical product data and installation instructions to substantiate compliance with these Specifications.
- B. The equipment in this section shall be installed by the Contractor under the guidance of the manufacturer and shall be subject to field performance tests. Upon completion of installation, the Contractor shall submit a written certifications from the manufacturers that installation is in accordance with the manufacturer's recommendations.
- C. Operation and Maintenance Manuals shall be furnished for the ventilating equipment specified herein in accordance with Section 01730 "Operating and Maintenance Instructions".

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## **PART 2 - PRODUCTS**

### **2.01 EXHAUST FAN SCHEDULE**

<b>Location</b>	<b>Mounting</b>	<b>Capacity</b>	<b>Motor (HP volts)</b>	<b>Fan RPM</b>
Sodium Bisulfite Room	Side Wall	600 cfm	1/10	1550
Sodium Hypochlorite Room	Side Wall	600 cfm	1/10	1550
Wellhead Room	Side Wall	1500 cfm	1/4	1160

### **2.02 SIDEWALL DIRECT DRIVE FANS**

Provide sidewall direct drive fans of the type, size and capacity as specified herein. Unless otherwise approved by the District, all of the sidewall direct drive fans shall be products of the same manufacturer. The chemical room fans shall, each, be Greenheck Sidewall Exhaust Fan Model SE1-12-426-D. The wellhead room exhaust fan shall be Greenheck Sidewall Exhaust Fan Model SE1-16-428-B, or approved equal, as manufactured by Penn Ventilator Company.

Fans shall be fabricated of corrosion resistant materials. Fans shall be furnished with corrosion resistant blade propellers. The heavy gauge welded wire motor supports and fan guards shall be zinc plated and coated for chemical room applications. Motors shall be mounted to support guard with neoprene isolators. Furnish and install fans with corrosion resistant fasteners.

All fans shall be exhaust flow. Dampers shall be gravity operated.

Fans installed for ventilation of chemical rooms shall not be furnished with aluminum components.

Disconnect switches shall be NEMA-4X, Toggle Type.

Exhaust dampers shall be vertical mounted and constructed of corrosion resistant material. Weatherhoods shall be fiberglass or reinforced plastic construction with 0.5 inch welded wire bird screens.

### **2.03 AIR CONDITIONING UNIT**

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The sidewall mounted air conditioning unit to be furnished and installed in the MCC room shall be 1 ton capacity, 11,800 BTU Cool, 13,000 BTU heat unit. The air conditioning unit shall be suitable for 120 volt A.C. single phase service.

Air conditioning unit shall be Toshiba – Carrier GV Preferred Series Model, or approved equal.

## **2.04 ROOF MOUNTED TURBINE VENTILATOR**

The roof mounted turbine ventilator furnished and installed above the wellhead room shall be 12 inch diameter with a 20 inch by 20 inch base. Ventilator shall be galvanized with weathered wood finish construction with variable pitch base suitable for installation on standing seam metal roof with roof pitch up to 4 over 12. Roof ventilator shall be Lomanco Model GT-12 turbine ventilator, or approved equal.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

Install exhaust fan and air conditioning equipment where indicated on the Contract Plans, in accordance with equipment manufacturer's installation instructions, and with recognized industry practices, to ensure that equipment complies with requirements and serves intended purposes.

Provide motors so that they cannot be overloaded above nameplate rating throughout the full speed range.

Provide drives and guards conforming to the requirements hereinbefore specified.

### **3.02 ELECTRICAL CONNECTIONS**

Ensure air exhaust and air conditioning equipment is wired properly, with rotation in direction indicated and intended for proper performance.

### **3.03 WARRANTY AND GUARANTEES**

The equipment manufacturer shall warrant the exhaust fan and air conditioning equipment being supplied to the District against defects in workmanship and materials for a period of 2 years from the date of completion of the New York Well Phase 2 Construction, New York Well Equipping and Site Improvements Project, not to exceed 30 months from date of shipment. In the event that the equipment fails to perform as specified, the equipment

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manufacturer shall promptly repair or replace the defective equipment without any cost to the District (including handling and shipping costs).

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

## SECTION 16010 – ELECTRICAL GENERAL

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. The following list of components and areas of work is a summary of the work required in the drawings and specifications. The list is not comprehensive of the total work required nor is it in any specific order. It is merely being provided as an aid to the bidder. Work not listed herein, but described in the plans or specifications, is also part of the overall scope of work.
1. Switchboard with the following features:
    - a. Utility Metering with Main Disconnect and Generator Breaker.
    - b. Automatic Transfer Switch and Distribution Panelboard.
    - c. Low voltage panelboard, and transformer.
    - d. Power monitoring equipment.
    - e. Circuit breakers with electronic trip units for those breakers above a specified voltage and current trip level.
  2. Portable Generator Connection Panel
  3. Motor Controls:
    - a. Well pump control panel VFD.
    - b. Custom motor controls for extraction/injection well with VFD.
    - c. Miscellaneous equipment as shown on Contract Drawings.
  4. Aquifer Storage and Recovery (ASR) Control Panel.
  5. PLC Control Panel.
  6. Control panel(s):
    - a. Systems Integrator to design, furnish, assemble, wire, test, and complete all test forms pertaining to control panels as part of their scope of work.
    - b. Contractor shall remove and transmit PLC and Operator Interface to Application Programmer upon conclusion of factory testing. Purpose is for Application Programmer to complete PLC and OI programming and bench testing.
    - c. Application programmer will return the PLC and OI to the System Integrator for insertion into the control panel at the beginning of Field Testing. Contractor shall re-install the PLC and OI into the Control Panel.
    - d. System Integrator to perform factory and field testing as required for this project. Instrumentation calibrations and I/O checkout must be complete prior to Operational Testing.
    - e. System Integrator to coordinate, configure, and place communications system(s) into operation during pre-operational testing of system hardware.
  7. PLC, OI, and SCADA Applications Programming:

- a. Configuration and Programming of the Programmable Logic Controller (PLC), and Operator Interface (OI), and SCADA System is by Application Programmer. Application programmer is defined in this specification section [Qualifications].
  - b. Application Programmer work is limited to programming and testing (labor only) of the PLC, OI, and SCADA. All other material, assembly, and installation is by Contractor.
  - c. Pre-energization and pre-operational testing must be complete prior to Application Programmer arrival for start-up services. Instrumentation calibrations and I/O checkout must be complete.
  - d. Application Programmer will be available to startup systems as they become available. The Contractor shall notify the Application programmer of start-up and testing dates 2 weeks minimum in advance of requirement.
8. Instrumentation
    - a. Systems Integrator to design, furnish, assemble, wire, test, and complete all test forms pertaining to instrumentation as part of their scope of work.
    - b. Furnish NSF/ANSI 61 certified products that have undergone testing for any device, valve, instrument, or assembly that will come into contact with drinking water.
    - c. Furnish mounting supports or other accessories as detailed and as recommended by the instrument manufacturer for the application.
  9. Communications system. Contractor to coordinate, configure, test, and place communications system(s) into operation.
  10. Automated gate control system utilizing card readers. Contractor shall install, configure, and test per gate system manufacturer's requirements.
  11. Coordination and timely installation of critical path equipment and services such that construction may be facilitated. The Electrical Contractor and System Integrator should not assume that submittals, manufacturing, installation, start-up will be based on their own schedule. The Electrical Contractor and System Integrator scope of work is part of a much larger project and will need to be coordinated. Expect that additional cost in time and labor will be required beyond normal optimistic projections.
  12. Conduit – support systems, wire, and grounding system, for equipment interconnection, and operation.
  13. All necessary process piping, shut off, sample and calibration valves, drains, pressure reducers and calibration equipment for connection of instrumentation.
  14. Trenching, backfilling, compaction and resurfacing for all new underground conduit routes, concrete pads, and pull boxes.
  15. Coordination and equipment for connection of power utility and telephone services per utility drawings and standards.
  16. Site electrical devices, lights and receptacles.
  17. Seismic Anchorage Design Calculations and conforming installation.
  18. System startup, calibration, testing and documentation.

- B. Electro-mechanical equipment to be installed in this project may be specified in other divisions but will interface to equipment provided under Electrical Specifications. Obtain submittals for those devices, review, coordinate and provide all interfacing equipment, software, communications, I/O, and testing to integrate the equipment to the extent possible and as intended.
- C. Install electrical and control portion of electro-mechanical equipment specified in other sections. Reference those specifications, pertinent details, and follow all manufacturer instructions to erect, install and commission equipment. Furnish all electrical equipment, interconnecting wire, and make connections to place equipment in operation.
- D. All electrical equipment and materials, and methods - including installation, calibration, and testing - shall conform to the applicable codes and standards listed in this and other Sections. All electrical materials and work shall conform to published standards of the National Electric Code (NEC) current issue, Institute of Electrical and Electronic Engineers (IEEE), and Underwriters Laboratories Inc (UL).

1.02 RELATED SPECIFICATIONS

- A. The following specification sections are part of the [Electrical Specifications].

Section	Description
16110	Conduit and Boxes
16120	Low Voltage Wire and Data Cable
16250	Automatic Transfer Switch
16430	Low Voltage Switchboard
16450	Grounding
16470	Panelboard and Power Transformer
16481	Variable Frequency Drive
16600	Factory and Field Testing
16630	Electrical System Analysis
16905	Control Panels
16910	PLC & OI Hardware
16940	Instrumentation

- B. Owner, Engineer, Construction Manager, and City are used within Electrical Specifications and are interchangeable. They are all representatives of the Owner, in this case, the Fair Oaks Water District.

## 1.03 QUALIFICATIONS AND REQUIRED WORK SCOPE

### A. Electrical Contractor

1. Management and installation of the entire electrical and control system (including stand-by generator) required for this project shall be by an Electrical Contractor meeting qualifications as defined herein.
  - a. Contractor shall be capable of looking at electrical equipment submittals, prior to installation, comparing hookup requirements to the drawings, and noting any deficiencies.
2. Electrical Contractor shall select, furnish, and install all commodity electrical materials (conduit, wire, supports, fittings, ductbanks, etc) that are generally not “custom” or uniquely manufactured for this project. Custom electrical panels, controls, and instrumentation shall be furnished by Systems Integrator.
3. Shall be competent in and familiar with management and subcontracting of specialty electrical and instrumentation supply and engineering work as requires of a Systems Integrator as described herein.
4. Electrical Contractor must be competent in performance, supervision and coordination of work required and performed by equipment suppliers and Systems Integrator (Subcontractors).
5. The Electrical Contractor (EC) shall meet the following minimum qualifications:
  - a. Has a current C10 Electrical Contractor’s License issued by the State of California Department of Consumer Affairs.
  - b. EC shall be regularly engaged in similar industrial power and controls electrical contracting for the Water and Wastewater Industry.
  - c. EC shall have successfully performed work of similar or greater complexity (as measured in contract value on industrial power and controls projects) on at least three (3) previous projects.
  - d. EC shall carry all insurances as defined and required by the special provisions and as required by law.
  - e. EC shall be competent in methods and materials execution and selection associated in the type of electrical and instrumentation work specified in this Division.
    - 1) EC shall be familiar with and understand codes and requirements from NFPA70, NFPA110, and all other governing national or local codes as required for work scope as described in the drawings and specifications.
    - 2) EC shall know and understand common terms and abbreviations used in this Industry. Not all terms and abbreviations will be defined in the drawings and specifications.
  - f. EC shall comply with State law which requires that all personnel installing electrical components are certified by the State of California as “Electrician” or “Electrician Trainee.” Apprentices may install electrical components only under direct supervision of a certified Electrician.

## B. System Integrator

1. Systems Integrator shall be a supplier to the Electrical Contractor and must be competent in performance, supervision and coordination of work required in this contract.
2. This includes, but is not limited to, all work necessary to select, furnish, construct, supervise installation, configure, calibrate, test, and place into operation all transmitters, instruments, programmable controllers, control panels, motor controls, alarm equipment, communications, monitoring equipment, and accessories.
3. The System Integrator shall have on staff a Project Engineer with three years prior experience on similar sized projects. This Project Engineer shall coordinate the technical aspects of this project and prepare the submittals and drawings. The Project Engineer shall attend all coordination meetings when specifically requested by the Engineer.
4. The System Integrator (SI) shall meet the following minimum qualifications:
  - a. SI shall be regularly engaged providing electrical and control systems for the Municipal Water and Wastewater Industry.
  - b. SI shall have an Electrical Engineer on staff registered in the State of California as a Professional Engineer.
  - c. SI shall be capable of labeling all electrical panels as manufactured or customized by the System Integrator with appropriate Underwriters Laboratories (UL) label prior to factory testing or shipment to project site.
  - d. SI shall have successfully completed work of similar or greater complexity and on similar facilities on at least ten previous projects under the present company name.
  - e. SI shall be actively engaged in the following disciplines for the last 5 consecutive years.
    - 1) Design and manufacturing of custom Control Panels, Motor Controls Centers, and associated devices and equipment as specified in this division.
    - 2) Programming and commissioning of SCADA, PLC and Operator Interface hardware.
    - 3) Instrumentation - selection, purchase, calibration, start-up and commissioning.
    - 4) Testing, calibration, start-up, and commissioning of control systems as applied to the Water and Wastewater industry.
  - f. SI shall employ personnel on this project who have successfully completed ISA or equal training courses on general purpose instrumentation.
  - g. SI shall have a permanent, fully staffed and equipped service facility within 200 miles of the project site for a minimum of 1 year prior to bid date with personnel and equipment required to maintain, repair and calibrate the instrumentation system.

### C. Application Programmer

1. The Applications Programmer will be a part of the Construction Management team and their work is not in contract.
2. The Application Programmer work is limited to programming and configuration, and associated startup and testing services of the PLC, Operator Interface, and SCADA. All other work is by Contractor.

## 1.04 CONTRACT DOCUMENTS

- A. The resolution of conflicting information within the contract electrical documents shall put precedence on electrical drawings over that of electrical specifications.
- B. The Drawings and specifications are intended to be descriptive of the type of electrical system to be provided with sufficient detail to construct. Minor omission of detail shall not relieve a qualified contractor from the obligation to provide a complete operational system if it can be determined that the particular detail is usual and customary for similar systems.
- C. The following specifications may incorporate specific equipment or materials that do not have equal equipment listed. These items are standards because of their familiarity, serviceability, and/or spare parts inventory. However, equal alternate equipment or materials (noted in the submittal cover letter) will be considered for use on this project if submitted. The Engineer may reject said equipment for the purpose of adherence to standards.
- D. Contract drawings are diagrammatic and indicate general arrangement of systems and equipment.
  1. Exact locations and layouts of electrical products shall be defined during submittal, assembly, or field fit during construction. Field measurements take precedence over dimensioned drawings. Drawing intent is to show initial size, capacity, approximate location, orientation, and general relationship of equipment in area shown but may not show exact detail or arrangement.
  2. However, when materials, locations, sizes, or methods are specifically dimensioned, detailed or noted, the drawings shall take precedence over electrical specifications in the event of conflict. In no case, is NEC, UL, or other applicable governing standards to be overridden.
- E. The Contractor shall examine the architectural, mechanical, structural, and electrical and instrumentation submittals and equipment furnished under other specifications divisions in order to determine conduit routing, stub-up locations, and final terminations for all conduits and cables. Conduits shall be stubbed up as near as possible to equipment electrical terminals. The exact locations and routing of cables and conduits shall be governed by structural conditions, physical interferences, and the physical location of wire terminations on equipment.

- F. All equipment shall be installed and located so that it can be readily accessed for operation and maintenance. If accessibility appears to be compromised, the location of equipment or stub ups shall be modified to the extent possible.
- G. Where conduits are shown on the Drawings, or stated to be furnished but not explicitly shown, as part of the scope of work; the Contractor shall provide all fittings, boxes, wiring, etc. as required for completion of the raceway system in compliance with the NEC and the applicable specifications in this Section.
- H. No changes from the Drawings or specifications shall be made without written approval of the Engineer. Should there be a need to deviate from the Contract documents, submit written details and reasons for all changes to the Engineer for review.
- I. The Contractor shall maintain a neatly and accurately marked full size set of Contract Drawings recording the as built locations and layout of all electrical and instrumentation equipment, routing of raceways, junction and pull boxes, and other diagram or drawing changes. Drawings shall be kept current weekly, with all "change orders", submittal modifications, and construction changes shown. Drawings shall be subject to the inspection by the Engineer at all times, progress payments or portions thereof may be withheld if drawings are not accurate or current.
- J. When documents are changed, they shall be marked with erasable colored pencils using the following coloring scheme:
  - 1. Additions - red
  - 2. Deletions - green
  - 3. Comments - blue
  - 4. Dimensions - black
- K. Prior to acceptance of the work, the Contractor shall deliver to the Engineer one set of record full size drawings neatly marked accurately showing the information required above.

#### 1.05 UTILITY COORDINATION AND FEES

- A. All fees and charges of the Power Utility, Sacramento Municipal Utility District (SMUD) for design and final connection will be paid by others.
- B. Coordinate all work with the Utility for the work shown on Contract Drawings.
  - 1. Unless already completed, apply for electric service within 10 working days from Notice to Proceed.
  - 2. Coordinate and meet with the Utility's Representative at the project site(s) within 30 days after award of contract.
  - 3. Discuss specific installation and comply with Utility requirements. Contact Engineer in the event that Utility requirements far exceed allowances in the plans and specifications. Provide an itemized list of deviations and potential costs or credits.

4. Coordinate and obtain required inspections prior to backfill. Make corrections to installation as required.
  5. Coordinate connection and date of service with Utility. Utility back-charges due to mis-coordination or installation problems will be Contractor responsibility to pay and correct.
- C. Furnish and install electric service in accordance with the serving Utility's requirements.
1. The contract plans show the preliminary design for the Utility installation. Slight changes required by the Utility do not constitute extra work unless cost impacts in material and labor exceed \$5000. In that event, the agreed excess amount will be allowed as a contract change.
  2. The Contractor shall provide and install service entrance equipment, all material, conduits, wiring, pull ropes, pole risers, transformer pads, bollards, etc. as shown on Utility design drawings and standards for new power service. Utility standards are available upon request from the Utility or for download from the Utility's website.
  3. The Utility will provide and install primary wire, transformer, meter, and connections.
- D. Following award of Contract, schedule all service installations and connections with utilities. Construction or start-up delays as a consequence to lack of documented effort by the Contractor which delay the project completion due to lack of Utility services will not be considered valid and Contract liquidated damages may be assessed.

#### 1.06 PROJECT COORDINATION

- A. Prior to submittal, the Electrical Contractor shall coordinate with equipment suppliers to verify sizes, mounting, connections, storage, and delivery of equipment. If there are any issues whereby the solution will be in conflict with plans and specifications, or that are undefined and need direction, they shall be brought to the attention of the Engineer or Construction Manager via the RFI process.
- B. Where connections must be made to existing or new operational facilities, the Contractor shall schedule all the required work with Engineer, including the power shutdown period. Carry out each shutdown so as to cause the least disruption to the operation of the installation.
1. The Contractor shall limit all unscheduled shutdown periods to less than 15 minutes and only with prior approval of the Station operator.
  2. Carry out shut downs of durations greater than 15 minutes only after the time and date schedule and sequence of work proposed to be accomplished during shutdown has been favorably reviewed by the Engineer. Submit shutdown plans at least 2 days in advance of when the scheduled shutdown is to occur.
  3. Provide temporary power to all existing facilities utilizing a portable generator. The generator shall be utilized for all shutdowns that exceed 15 minutes and run

continuously for the duration of the primary power shutdown. All cost for operating the generator including equipment, fuel and labor shall be provided.

4. The Engineer reserves the right to delay, change, or modify any scheduled shutdown at any time, at no additional cost to the Owner, when the risk of such a shutdown would jeopardize the operation of the water distribution system and/or water plant operation.

#### 1.07 SUPERVISION

- A. The Contractor shall schedule all activities, manage all technical aspects of the project, coordinate submittals and drawings, and attend all project meetings associated with this Section. The Contractor shall coordinate and confirm that the project schedule is being adhered to and all work is being completed within the scheduled time frames.
- B. The Contractor shall supervise all work in this Section, including the electrical system general construction work, from the beginning to completion and final acceptance.
- C. The Contractor shall coordinate, obtain, prepare, and/or complete the documentation required within this division. All documentation shall be complete and delivered prior to final acceptance.

#### 1.08 INSPECTIONS

- A. General
  1. Contract work or materials shall be subject to inspection at any time by the Engineer. If equipment, material, or installation method does not conform to the Contract documents, or does not have a favorably reviewed submittal status and has been determined to be unsatisfactory by the Engineer, then the Contractor shall remove said material from the premises; and if said material has been installed, the entire expense of removing and replacing same, including any cutting and patching that may be necessary, shall be borne by the Contractor.
  2. The Engineer may inspect and test the fabricated equipment at the factory before shipment to job site. See Electrical Specifications [Factory and Field Testing] for requirements.
  3. Work shall not be closed in or covered over before inspection and approval by the Engineer. All costs associated with uncovering and making repairs where non-inspected work has been performed shall be borne by the Contractor.
  4. The Contractor shall cooperate with the Engineer and provide assistance at all times for the inspection of the electrical system under this Contract. The Contractor shall remove covers, provide access, operate equipment, and perform other reasonable work which, in the opinion of the Engineer, will be necessary to determine the quality of the work.
- B. Milestones requiring inspection and signoff.

1. Underground conduit and grounding system complete. Do not cover any portion of conduit prior to inspection. Conduits must be labeled with temporary tags per Electrical Specifications [Conduit and Boxes] and [Grounding].
2. Factory testing. Coordinate test date with Engineer 2 weeks prior to test scheduled date.
3. Installation of electrical equipment. Equipment is anchored in place, conduit connections are complete, no wire is yet pulled into conduit. Permanent conduit tags must be in place per Electrical Specifications [Conduit and Boxes] and [Grounding].
4. Wire termination complete. Do not energize equipment. All wire tags must be installed and wires terminated per Electrical Specifications [Low Voltage Wire and Data Cable]. Pre-energization testing to commence after inspection.
5. Testing per Electrical Specifications [Factory and Field Testing]. All testing per Electrical Specifications [Factory and Field Testing] shall be witnessed unless specifically declined by the Engineer. Schedule tests with Engineer 2 weeks prior to test date.
6. Start-up per Electrical Specifications [Factory and Field Testing]. Schedule tests with Engineer 2 weeks prior to test date.
7. Punch list – final inspection. Schedule final walkthrough with Engineer one week prior to intended project completion date. All items on punchlist must be complete prior to scheduling walk-through.

#### 1.09 JOB CONDITIONS

- A. Construction Power and Telephone Service
  1. The Contractor shall coordinate, furnish and install, temporary utility services required during construction of the project, such as temporary electrical power and telephone service. Temporary services shall be installed in accordance with the applicable codes and regulations of the serving utilities.
  2. Upon completion of the project, remove temporary services. All equipment and material shall be the property of the Contractor.
  
- B. Equipment Storage
  1. The Contractor shall provide adequate protection for all equipment and materials during shipment, storage and construction.
  2. Equipment and materials shall be completely and sufficiently sealed and covered and set on a pallet above grade so that they are protected from weather, wind, dust, water, or construction operations.
  3. Equipment shall not be stored outdoors. Where equipment is stored or installed in an area with susceptibility to moisture, such as unheated buildings, untested piping, etc., provide an acceptable means to prevent moisture damage, such as plastic cover and a uniformly distributed heat source to prevent condensation.
  
- C. The project site is located where outside temperatures vary between 10 deg F. to 110 deg F. Humidity in this area will range from 10% to 100%.

## 1.10 AREA CLASSIFICATIONS

- A. Area classifications are shown on the site electrical plans. The area enclosed by walls or the entire drawing area shall be classified as shown unless otherwise described in notes.
- B. All electrical equipment, enclosures, conduit, and supports shall be formally rated for or, at minimum, meet the intent of the rating as interpreted by Engineer.
- C. If no area classification rating is shown on the drawings, classification shall default to a NEMA 12 rating for indoors, and NEMA 4 rating for outdoors (non corrosive) and NEMA 4X for corrosive areas both indoors and outdoors.

## 1.11 SUBMITTAL REQUIREMENTS

- A. General
  - 1. Requirements described herein are specific to electrical submittals and are secondary to those described in other general specifications sections. Any additional requirements described here that are beyond those described in those sections shall be provided as described. Conflicts shall be resolved by giving priority to general specifications.
  - 2. The Contractor shall ensure that the System Integrator and/or equipment suppliers provide the submittal documentation required in this section. Submittals shall be neat, orderly, complete (without un-needed parsing), and indexed.
  - 3. The Contractor shall coordinate submittals with the work so that project will not be delayed. This coordination shall include scheduling the different categories of submittals, so that one will not be delayed for lack of coordination with another. Time extensions will not be allowed due to failure to properly schedule submittals.
  - 4. No material or equipment shall be delivered to the job site until the submittal for such items has been reviewed by the Engineer and marked "no exceptions noted" or "make corrections noted".
  - 5. The equipment specifications have been prepared on the basis of the equipment first named in the Specifications. The Contractor shall note that the second named equipment, if given, is considered acceptable and equal equipment, but in some cases additional design, options, or modifications may be required to meet Specifications or functional installation.
  - 6. Exceptions to the Specifications or Drawings or equipment or procedures submitted as "equal" to specified equipment shall be clearly identified in a letter at the front of the submittal. Submittal data for "equal" equipment or procedures shall contain sufficient details so a proper evaluation may be made by the Engineer. The Contractor is responsible for verifying proper application/operation of substituted equipment.

7. The opinion of the Engineer will be the final determination whether a substitution request meets the design intent.
8. Deviations from the Contract documents shall not be incorporated into the work without prior written approval of the Engineer. A "Change Order" directive from the Engineer is required prior to incorporating any deviation from the Contract documents that has costs associated. The cost differential associated with this change order must be negotiated with the Owner to amend the Contract to reflect the costs or savings.

**B. Submittal Procedures**

1. Identify all submittals by submittal number on letter of transmittal. Submittals shall be numbered consecutively and resubmittals shall have a letter suffix. For example:
  - a. 1st submittal: 1
  - b. 1st resubmittal: 1A
  - c. 2nd resubmittal: 1B, etc.
2. The reviewed submittals will be annotated "Make Corrections Noted", "No Exceptions Noted", "Revise and Resubmit Noted Items", or "Rejected without Review." The following actions shall then be taken by the Contractor:
  - a. "No Exceptions Noted" - The Contractor may proceed with the work covered in this submittal. No resubmission is necessary.
  - b. "Make Corrections Noted" - The Contractor may proceed with the work covered in this submittal incorporating the changes noted. However, the Contractor shall revise the submittal in accord with the changes noted and resubmit six (6) copies of drawings, bill of materials, and catalog data denoting changes within 14 calendar days when requested by the Engineer for record keeping purposes.
  - c. "Revise and Resubmit Noted Items" - The Contractor shall not proceed with the work covered in this submittal. The Contractor shall revise and correct the submittal in accordance with the comments and resubmit six (6) copies within 14 calendar days for approval.
  - d. "Rejected without Review" submittal - The Contractor shall not proceed with the work covered in this submittal. The submittal did not address the work scope as defined by the submittal's title or the previous submittal comments have not been addressed in full. The Contractor shall revise and correct the submittal in accordance with the specifications, and resubmit six (6) copies within calendar 14 days for approval.
3. Resubmittals shall address all comments by the Engineer. A submittal response letter shall be submitted that addresses each comment by the Engineer with a standardized response of "revised" or with a written explanation. Partial resubmittals (that do not address all comments) may be returned without review at the discretion of the Engineer.

4. The Contractor shall be responsible for the Engineer's review cost for each resubmittal in excess of the second resubmittal. These costs will be back-charged to the Contractor and will be deducted from his progress payments.
- C. Electrical Equipment -- Submittal data shall be grouped by equipment type. Each submittal shall be as complete as possible covering the entire project and scope of supply. Drawings or equipment submitted individually that are not on the critical path will not be accepted for individual review. The electrical submittals shall include (as a minimum):
1. Table of Contents
  2. Comment Letter: The Project Engineer of the System Integrator shall note all deviations from Contract Documents and the reason(s) for the deviation. They may use this forum to inform the Engineer or installing Contractor of important information related to the project. RFIs must be submitted separately. Re-submittals shall include written responses to every comment provided by the Engineer during the previous review.
  3. Bill of Materials: The Contractor and System Integrator each shall provide Bill of Material for electrical components formatted as shown below. Generic names or part numbers as defined by a distributor or Integrator are not acceptable. Only the originating manufacturer's name and part number shall be listed. Provide separate bill of materials for each panel, MCC, instrument list, etc.

Bill of Material

Item #	Qty	Tag#	Description	Manufacturer	Part #

4. Shop Drawings:
  - a. Equipment elevations with enclosure details drawn to scale or dimensioned with relative scale.
  - b. Electrical One-line, Elementary, and wiring diagrams
  - c. PLC I/O wiring diagrams
5. Catalog Data shall include the following: (features and options shall be highlighted, circled, or "arrowed.")
  - a. Instrumentation data summary sheets (by Contractor)
  - b. Manufacturer's technical information brochure
  - c. Physical size and mounting details and illustrations
  - d. Calibration Range
  - e. Input/output signals
  - f. Electric power, air, and/or water supply requirements.
  - g. Options selected and available (Cross out items not included)
  - h. Materials of construction of components
6. Program Software Documentation
  - a. Programming documentation

- b. Programming code native files
- D. Shop Drawings Shop drawings shall be furnished for each electrical panel even if one was not shown explicitly on the Drawings. Shop drawings shall be numbered in sequence. Blank drawings or drawings that contain no specific project data will not be accepted for review.
- E. All drawings shall be generated with a computer utilizing AutoCAD or similar drafting program. Drawings shall be no smaller than 11" x 17". The lettering shall be legible and no smaller than 0.75 inch in height.
- F. Drawings shall be custom prepared for this project and shall have borders and a title block identifying the project, manufacturer, system or location, drawing number, drawing title, AutoCAD file name, project engineer, date, revisions, and type of drawing. Diagrams shall carry a uniform and coordinated set of wire colors, wire numbers, and terminal block numbers. The shop drawings shall include the following as a minimum:
- 1. Electrical one-line diagrams detailing all devices associated with the power distribution system. The following applicable information or data shall be shown on the one- or three- line diagram: location, size and amperage rating of bus; size and amperage rating of wire or cable; breaker ratings, number of poles, and frame sizes; power fail and other protective devices; fuse size and type.
  - 2. Detailed analog and digital I/O diagrams showing the wiring requirements for each instrument or device connection. Reference the Drawings for an example of each I/O card drawing requirements. If one is not included in the Drawings, then one may be obtained from the Engineer upon request.
  - 3. Elementary (wiring) diagrams shall be provided for all relay logic, programmable logic controls, motor controls, power supplies, and other wiring. All elementary (wiring) diagrams shall be drawn in JIC EMP/EGP format and standards showing ladder rung numbers and coil and contact cross referencing numbers.
  - 4. Equipment exterior and interior scaled drawings of front, side, elevation, deadfront, front panel devices, and backpan components. Show fabrication methods and details; including material of construction, paint color, door latch and lock, and ventilation system. Show shipping split locations and offloading information. Submit base plan showing allowed conduit entrance areas and bolt hole locations.
  - 5. Drawings shall show UL required information as needed to UL label the equipment in accordance with UL procedures for label applied.
  - 6. Submit full size drawing of all nameplates and tags, as specified herein, to be used on project. Submittal to include the following:
    - a. Dimensions of nameplate.
    - b. Exact lettering and font for each nameplate.
    - c. Color of nameplate.
    - d. Color of lettering.

- e. Materials of construction.
- f. Method and materials for attachment.
- g. Drawing showing location of nameplates on each, panel and enclosure.

G. Seismic Anchor Design Calculations

- 1. All switchgear, motor controls centers, transformers, cabinets, raceways, supports, and electrical materials shall be so installed as to remain in a secure and captive position when subjected to a horizontal force in accordance with the current, applicable, and more stringent of California Building Code (CBC) or International Building Code (IBC) requirements. Method of securing shall constrain equipment against both vertical and horizontal forces and overturning forces.
- 2. Calculations as prepared by a structural engineer registered in the State of California shall be submitted in accordance with code requirements for earthquakes forces on all specified equipment. Calculations shall include wind loading forces for equipment installed outdoors.

1.12 OPERATING AND MAINTENANCE INFORMATION

A. Operational Training

- 1. At time of completion, the Contractor shall provide a period of not less than 6 hours training for instruction of operation and maintenance personnel in the use of systems. Instruct all personnel at one time in one session. Make necessary arrangements with manufacturer's representative. Provide product literature and application guides for user's reference during instruction.

B. Operations and Maintenance Manuals

- 1. Provide Operation and Maintenance manuals per specifications as described in "Submittal Requirements" in this section with the following additional requirements:
  - a. A comprehensive index.
  - b. A complete "Record" set of favorably reviewed electrical submittals as provided under subsection "Submittal Requirements" illustrating all components, piping, and electrical connections.
  - c. A complete list of the equipment supplied, including serial numbers, ranges, catalog cuts, and pertinent data.
  - d. Full specifications on each item.
  - e. Detailed service, maintenance and operation instructions for each item supplied. Schematic diagrams of all electronic devices shall be included. A complete parts list with stock numbers shall be provided for the components that make up the assembly. All of these shall be originals, no copies.
  - f. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

- g. Shop drawings in native file format and updated to reflect as-built conditions.
  - h. Application programs, configurations, calculations, documents or other computer electronic files prepared for this project. Provide all files in native file format such as .dwg, .rss, .xls, .doc, etc.
2. Submit electronic readable PDF file format (email with attachments or download links) of the proposed O&M manuals for review by the Engineer. Submittals shall be delivered timely to the Engineer to allow for review period, corrections, and re-submissions as necessary.
    - a. General Contractor supervision must not be circumvented by sending submittals direct to Engineer.
    - b. O&M Submittals shall be published 1st electronically and 2nd on hard copy paper stock.
    - c. Electronic Submittals shall be transmitted with the hard copy submittals and be viewable using a PDF reader.
    - d. Electronic submittals shall be assembled in accordance with the specifications for hard copy submittals with table of contents, bookmarks, tabs, subtabs, etc. utilizing the electronic bookmarks feature available in the PDF assembler.
    - e. Electronic (PDF) submittals must follow all applicable requirements for hard copy submittals including indexing, item selection indication, bookmarks, etc.
  3. Provide four (4) hard copy O&M manuals per specifications as described in SUBMITTALS REQUIREMENTS in this section.
    - a. Deliver approved hard-copy O&M manuals to the project site and Owner prior to pre-operational testing or equipment start-up.
- C. At the end of the project hard copy and soft copy electronic PDF files, shall be updated to "as-built" conditions.

## PART 2 PRODUCTS

### 2.01 QUALITY

- A. All equipment and materials shall be new, in current production, 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.
- B. Products specified that have become obsolete (out of current manufacturing, or have been superseded by another product) shall be cross-referenced to a replacement product(s) and provided in lieu of the specified product(s) for no additional cost. Under no conditions, shall products be submitted or furnished that are known (on manufacturer's list of obsolescence) and expected to be removed from current

production within 12 months after project submittal. Products found to have been furnished this way will be removed and replaced at Contractor's expense.

- C. 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 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. 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 questionable durability shall not be used.
- D. The Contractor should expect that there will be occasional freezing conditions at the project site in outdoor locations. Instrument valves, tubing, instrumentation, and other components, etc. which are outdoors and susceptible to damage if frozen, must be provided with internal or external protection. Freeze protection can consist of internal or external active heaters with thermostats and/or passive insulation systems. Active systems can be powered from a nearby receptacle or via the conduit intended for the device.
- E. Products that are specified and include a manufacturer, trade name or catalog number are intended to establish a standard of quality, performance, warranty and service. Products that are specified "or equal," do not prohibit the use of equal products of other manufacturers provided they are submitted, identified and promoted as equal, and favorably reviewed by the Engineer prior to procurement and installation.
- F. Products submitted as "equal" to the named products will be reviewed for conformance with the specifications and in comparison with the first named product. If the equal product meets specifications, but does not have a feature or performance characteristic that is available with the first named product, and that feature or performance is required for this project, then the submitted equal product may be rejected on those grounds.
- G. In the event that some claims of the manufacturer of submitted "equal" product are called into question by the Engineer, the Contractor, may be required to prove those claims either prior to installation or during startup of product. If the product does not meet the claims made or specifications, the product may be rejected by the Engineer and a replacement product must be submitted by the Contractor in its place. All cost for the rejected product, installation, testing, and removal will be the responsibility of the Contractor.
- H. Underwriters Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment. Extra parts, labor, panel space, power supplies, circuit breakers, and/or GFIC devices shall be provided as necessary for incorporation of specified non-UL components.

- I. When required herein or requested by the Engineer, the Contractor shall submit equipment or material samples for test or evaluation. The samples shall be furnished with information as to their source and prepared in such quantities and sizes as may be required for proper examination and tests, with all freight and charges prepaid. All samples shall be submitted before shipment of the equipment or material to the job site and in ample time to permit the making of proper tests, analyses, examinations, rejections, and resubmissions before incorporated into the work.

## 2.02 NAMEPLATES & TAGS

- A. Equipment exterior nameplates Nameplate material shall be rigid laminated black plastic with beveled edges and white lettering; except for caution, warning, and danger nameplates the color shall be red with white lettering. The size of the nameplate shall be as shown on the drawings. No letters are allowed smaller than 3/16". All nameplates located outdoors shall be UV resistant. Securely fasten nameplates in place using two stainless steel screws, type 316L, if the nameplate is not an integral part of the device. Epoxy cement or glued on nameplates will not be acceptable. Engrave the nameplates with the inscriptions as approved by the Engineer in the submittal.
  1. For each major piece of electrical equipment provide a manufacturer's nameplate showing the Contract specified name and number designation, and pertinent ratings such as voltage, # of phases, ratings, etc.
  2. For each device with a specific identity (pushbutton, indicator, instrument, etc.) mounted on the exterior or deadfront of a piece of equipment provide a nameplate with the inscription as shown on the Drawings and described herein.
  3. Where required by code, provide nameplates denoting information required. For example:
    - a. Transformers not in sight of disconnect, furnish nameplate denoting location of feeding circuit breaker or disconnect.
    - b. Motor controls without door interlock or disconnecting circuit breaker; furnish nameplate denoting location or feeding circuit breaker or disconnect.
  4. Where no inscription is indicated on the Drawings or described herein, furnish nameplates with an appropriate inscription providing the name and number of device.
  5. Install Safety Signs in accordance with the latest OSHA requirements.
    - a. Entrances to electrical rooms and stations: Danger Sign requirements, ELECTRICAL ROOM, HIGH VOLTAGE (define voltage, example 480 VAC) KEEP OUT, AUTHORIZED PERSONNEL ONLY.
    - b. Equipment enclosures, cable tray and wireway where 120 VAC or higher and 50 V DC and higher exist: Danger Sign requirements, HIGH VOLTAGE (define voltage, example 480 VAC) AUTHORIZED PERSONNEL ONLY.
    - c. Equipment such as motor control centers, control panels, etc., where more than one source may be present in an enclosure or cubicle: Danger Sign requirements, VOLTAGE (define voltage, example 120 VAC

control voltage or 480 VAC power) FROM MULTIPLE SOURCES IN THIS ENCLOSURE.

- d. Equipment such as switchboards, switchgear, panelboards and motor control centers: Warning Sign requirements, WARNING, SERVICE ENTRANCE DISCONNECT FOR 1 OF \_\_\_ (define quantity) SERVICES TO THIS BUILDING. OTHER SERVICE ENTRANCE DISCONNECTS ARE LOCATED AT (define locations).

6. Caution, warning and danger nameplates shall be red with white lettering

B. Equipment Interior Nameplates Nameplate material shall be clear plastic with black machine printed lettering as produced by a KROY or similar machine; except caution, warning, and danger nameplates shall have red lettering. The size of the nameplate tape shall be no smaller than 1/2" in height with 3/8" lettering unless otherwise approved by the Engineer. Securely fasten nameplates in place on a clean surface using the adhesion of the tape. For each device with a specific identity (relay, module, power supply, fuse, terminal block, etc.) mounted in the interior of a piece of equipment provide a nameplate with the inscription as shown on the Drawings and described herein. Where no inscription is indicated on the Drawings or described herein, furnish nameplates with an appropriate inscription providing the name and number of device used on the submittal drawings. Stamp the nameplates with the inscriptions as approved by the Engineer in the submittal.

C. Equipment Tags When there is no space or it is impractical to attach an engraved plastic nameplate with screws, as is the case with most field devices and instruments, the Contractor shall attach a tag to the equipment with the same inscriptions as specified above in paragraph A. The tag shall be made from stainless steel material and the size of the nameplate shall be no smaller than 3/8"h x 2"w with 3/16" machine printed or engraved lettering unless otherwise approved by the Engineer. The tag shall be attached to the equipment with stainless steel wire of the type normally used for this purpose.

## 2.03 FASTENERS

A. Fasteners for securing equipment to walls, floors, or ceilings, shall be stainless steel. The minimum size fastener shall be 3/8 inch diameter.

## 2.04 COMPONENTS

A. Switches and Pushbuttons

- 1. Switches (HS) and pushbuttons (HC) for general purpose applications shall be water and oil tight as defined by NEMA 4X, corrosion resistant as defined by NEMA ICS 6 110.58, U.L. listed, standard 30 mm diameter, with plastic holding nut.
- 2. Switches and pushbuttons shall have contacts rated NEMA A600 or 10 amperes continuous and 600 VAC. Provide NO and NC contacts as required.

3. Engraved black legend plates shall be provided to define each switch and pushbutton function.
4. Selector switch handles and pushbutton caps shall be black unless otherwise noted on drawing. Lock-out stop caps shall be red.
5. Selector switches for hand off auto (HOA) applications shall have the hand position to the left, off in center, and auto in the right position.
6. Pushbuttons and selector switches in hazardous locations shall have hermetically sealed contacts or explosion proof enclosures.
7. Lockout stop pushbuttons shall include padlocking attachment. Pushbutton type shall be coordinated with padlock attachment type.
8. Switches and pushbuttons shall be Allen-Bradley 800H, or equal.

**B. Indicating Lights**

1. Indicating Lights for general purpose applications shall be NEMA 4X, corrosion resistant as defined by NEMA ICS 6 110.58, U.L. listed, 30 mm diameter, with plastic lens, plastic holding nut, and miniature bayonet lamp base.
2. Lamp shall be full voltage 120 VAC with 28 chip (min) High Intensity LED.
3. Indicating lights shall have contacts rated NEMA A600 or 10 amperes continuous and 600 VAC. Provide NO and NC contacts as required.
4. Engraved black legend plates shall be provided to define each lights function.
5. Indicating light type and color of lens shall as follows or as otherwise shown on the Drawings:
  - a. Open/On                      Green
  - b. Closed/Off                    Red
  - c. Alarm                         Amber or Blue
  - d. Power On                      White
6. Indicating lights designated "PTT" on wiring diagram or shown with push-to-test wiring shall be provided with a push to test switch and wiring.
7. Indication lights shall be Allen-Bradley 800H, or equal.

**C. Relays and Timers**

1. General: Relays and timers shall be provided with N.O. or N.C. contacts as shown on the Drawings. All spare contacts shown shall be provided. Contacts shall be rated 10 amps minimum at 120 VAC, 60 Hz unless otherwise shown on the Drawings. Coil voltage shall be 120 VAC unless otherwise described or shown on the Drawings. Relays and timers shall be designed for continuous duty. All relays shall be U.L. listed. All relays and sockets shall be the product of a single manufacturer. The following is a summary of abbreviations associated with relays and timers:
  - a. CR                      – Control relay
  - b. TR                      – Timing relay
  - c. TDOE – Time delay on energization
  - d. TDOD                    – Time delay on de-energization
  - e. PR                        – Power Relay

- f. PFR – Phase Fail Relay
- 2. Sockets for plug in relays and timers shall be standard industrial type DIN rail mount with barrier type pressure plate screw terminals. Sockets shall be rated 300 VAC, 10 amps minimum.
  - a. Blade 8 or 11 pin for coil voltage above 90 volts AC or DC.
  - b. Octal 8 or 11 pin for coil voltage below 90 volts AC or DC.
- 3. Control relays (CR) shall be plug in type with neon indicating lights and clear see through sealed housing to exclude dust. Provide IDEC Type RR, or equal. Two form C contacts (minimum) shall be provided on each relay.
- 4. Time delay relays on energization (TR-TDOE) shall be solid state plug in relays with adjustable timer ranges from 1 second to 10 hours selectable unless other ranges are shown. Provide LED timer energized indicator lamp. Time delay relays shall be IDEC RTE, or equal.
- 5. Time Delay Relays (TR-TDOD)
  - a. Time delay relays on de-energization (TR-TDOD) (continuous power control input) shall be solid state plug in relays with a timer adjustable range from 1 second to 10 hours selectable unless other ranges are shown. Provide LED timer energized indicator lamp. Time delay relays shall be IDEC RTE, or equal.
  - b. Time delay relays on de-energization (TR-TDOD) (true off) shall be solid state plug in relays with a timer adjustable range from 1 second to 10 minutes unless other ranges are shown. True off time delay relays shall be IDEC GT3F-2, or equal.
- 6. Power relays (PR) shall be plug in ice cube type with clear sealed housing to exclude dust.
  - a. Applications requiring 3PDT contacts rated 20A or 0.5 HP at 120 VAC (minimum), furnish Magnecraft Type 389FXCXC-120A, or equal.
  - b. Applications requiring SPDT contacts rated 30A or 1.0 HP at 240 VAC, furnish Magnecraft Type 389FXHXC1-120A, or equal.
  - c. Furnish compatible blade type relay socket model 70-788EL11-1 or equal.
- 7. Voltage Sensor relay (VR) shall continuously monitor its input terminals nominally rated for 24 VDC. When nominal operating voltage with a value between the UPPER & LOWER setting is applied, the internal relay will energize (Pick-up). If the operating voltage falls outside the preset OVER trip point (adjustable 100-125% of nominal) or UNDER trip point (adjustable 75-100% of nominal) for a period longer than the drop-out time delay (T), the relay will de-energize (Drop-out). When the voltage returns to normal (within the preset OVER & UNDER trip points), the unit automatically resets and the relay energizes. The VR shall interface to the control circuit with to independent SPDT contacts rated for 10 Amps at 120 VAC. Set the trip points per contract drawings. Sensor Relay shall be Macromatic VWKP024D, or equal.

D. Voltage Monitor Relay (VMR)

1. The voltage monitor relay (VMR) shall continuously monitor the three phases for power loss, low voltage, phase loss, and phase reversal. The VMR shall interface to the control circuit with DPDT contacts rated for 4 Amps at 120 VAC. The VMR shall have a drop out voltage adjustment, time delay adjustment, and status indicating LEDs. Voltage monitor relay shall be Time Mark 2652, or equal.

## 2.05 MOLDED CASE CIRCUIT BREAKERS

### A. General

1. Circuit breakers and motor circuit protectors shall be manufactured by Eaton Cutler-Hammer, Square D, G.E., Siemens, or equal.
2. Circuit breakers shall be the bolt-on type.
3. Multiple pole circuit breakers shall be designed so that an overload on one pole automatically causes all poles to open. The use of tandem or dual circuit breakers in a normal single pole space to provide the number of poles or spaces specified are not acceptable.
4. Molded case circuit breakers shall be operated by a single toggle-type handle and shall have a quick-make, quick-break switching mechanism. An automatic trip of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and have flash reduction arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
5. Minimum interrupting capacity:
  - a. 480 volt circuit breaker shall have a minimum interrupting capacity of 22,000 amperes or as shown on drawings.
  - b. 120 or 208 or 240 volt breaker shall have a minimum interrupting capacity of 10,000 amperes or as shown on drawings.
6. Circuit breakers shall be UL listed for series application.
7. Where indicated circuit breakers shall be current limiting.
8. Where indicated on Drawings, provide UL listed circuit breakers for continuous duty at 100% of their ampere rating in the intended enclosure.
9. Furnish add-on features such as auxiliary position status contacts, trip indication contacts, zone interlocking, shunt trip coils, etc, as shown in the drawings.

### B. Trip Unit – Molded Case Circuit Breakers

1. Circuit Breakers over 400 volt and over 90A trip units as defined herein. All other circuit breakers shall have non-electronic thermal-magnetic (TM) trip units with inverse time-current characteristics.
2. The trip unit shall be Eaton type Power Expert Release (PXR) or equal.
  - a. Each circuit breaker trip unit shall have three (3) current sensors, voltage sensors, microprocessor, and flux transfer trip solenoid at minimum.
  - b. Trip units shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.

- c. Trip units shall be powered from the primary voltage connected to the circuit breaker. Current flow shall not be required for settings functions. Circuit breaker trip units shall be operable and adjustable with zero current flowing through the circuit breaker.
  - d. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current and voltage sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached.
  - e. Trip units shall be provided with a display panel. Trip units shall have an information system that provides LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip
  - f. Programming may be done via a keypad at the faceplate of the unit. Programming via the communication network if or as shown in drawings.
  - g. The trip unit shall offer a three-event trip log that will store the trip data, and shall time and date stamp the event.
  - h. The trip unit shall have the following advanced protective features integral to the trip unit:
    - 1) Adjustable undervoltage release (defeatable)
    - 2) Adjustable overvoltage release (defeatable)
    - 3) Reverse power and fault current
    - 4) Reverse sequence voltage
    - 5) Under-frequency
    - 6) Over-frequency
    - 7) Voltage phase unbalance and phase loss during current detection.
  - i. Although not preferred but if needed, furnish 24VDC redundant power supply with terminal blocks and 0.5A miniature circuit breakers to distribute control power to each circuit breaker trip unit that requires it for settings. The power supply shall be connected below the main breaker and transfer switch but above any feeder circuit breakers. Provide option for external power supply input.
3. System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:
- a. Adjustable long-time setting (set by adjusting the trip setting dial to an amount not to exceed rating plug)
  - b. Adjustable short-time setting and delay with selective flat or I<sup>2</sup>t curve shaping,
  - c. Adjustable instantaneous setting
  - d. Adjustable ground fault setting and delay with selective flat or I<sup>2</sup>t curve shaping.

4. The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.
5. Furnish internal ground fault protection with adjustable settings. Provide neutral ground fault sensor for four-wire loads. Bypass neutral sensor for 3 wire loads.
6. Include ARMS technology for all circuit breakers 400A and above or where shown on drawings.
  - a. Activation and deactivation of the ARMS technology and local indication shall be accessible from the face of the trip unit without opening the circuit breaker door or cover and exposing operators to energized parts.
  - b. Recalibration or adjustment of trip unit parameters shall not be required when enabling / disabling the ARMS technology.
7. Breakers shall have built-in test points for testing the long-time delay, instantaneous, and ground fault functions of the breaker by means of a test set.

C. Manual operators

1. Furnish door interlocked manual operators for mains and selected feeder circuit breakers as shown in the drawings.
2. Manually operated mechanisms designed to open, close and reset circuit breakers.
3. Operators shall be available in three basic configurations— flange mounted, through-the door rotating and direct handle through door to provide a variety of options for different applications and enclosure ratings.

## 2.06 MOTOR CONTROL ACCESSORIES

A. Control Power Transformer:

1. Control power transformer shall be epoxy encapsulated for dust and moisture protection. The internal wiring shall be copper and have 105 deg. C insulation rating. The unit shall feature barriered screw terminals for connection to electrical circuits. Provide with time-delay, slow-blow secondary fuse rated to protect the transformer and interrupt 10,000 amperes at 120VAC. Two primary fuses rated for 480 VAC and AIC as shown in the Drawings shall be provided. Transformer minimum size and voltage ratings shall be as shown on Contract drawings. Control power transformer shall be Micron Impervitran, Cutler Hammer MTE or equal.

## 2.07 DEVICES

A. Switches

1. General purpose commercial grade switches shall be manufactured in accordance with UL 20. Switches shall be one pole, brown, 20 amps at 277 VAC, 1HP at 120 VAC, 2 HP at 240 VAC. Switches shall have copper alloy contact arm with silver cadmium oxide contacts. Switches shall have slotted

terminal screws and a separate green grounding screw. Provide Leviton, Hubbel, or equal.

2. Wall mount commercial grade motion detector switches (denoted with M next to switch symbol in drawings) shall utilize passive infrared detection with 180 deg field of view to determine if the space is occupied by personnel. The device shall be capable of switching incandescent (800W at 120V) and fluorescent (1200VA at 120V) lamps with electronic ballasts. The device shall feature a manual-off-auto switch. A delay off time adjustment shall be settable from 30 seconds to 30 minutes. The device shall incorporate a photocell with light intensity adjustment to keep the switch from activating when light levels are above setting. Provide Leviton, Hubbel, Wattstopper, or equal.
3. Timer Switches (denoted with T next to switch symbol in drawings) shall provide a variable time range countdown of lighting circuit. Depressing touchplate turns lights on for the dial setting located behind the touchplate. Dial setting ranges of 1 minute to 18 hours shall be attainable. An illuminated LED indicates the load is on and blinking LED accompanied by annunciator sound indicates end of time cycle. Device shall be capable of switching incandescent (600W at 120V) and fluorescent (900W at 120V) lamps with electronic ballasts. Timer Switch shall be Leviton 6652, or equal.
4. Time Clock Switches (denoted with TC next to switch symbol in drawings) shall provide a programmable automatic time on/off of lighting circuit. Settings each 30 minutes for 24 hours shall be attainable by setting from front of switch. An illuminated LED indicates the load is on. Device shall be capable of switching incandescent (900W at 120V) and fluorescent (1200W at 120V) lamps with electronic ballasts. Timer Switch shall be Leviton 6124, or equal.
5. Thermostat Switches (T in circle on drawings) shall have a plastic NEMA 4X rated housing with stainless steel temperature sensing coil externally mounted. A face mounted dial shall allow temperature settings for heating and cooling from 40 to 104 deg F. The switch shall be rated for 120/240 volt at 10A inductive/16A resistive, SPDT. Temperature switch shall be Esapco TH15 or equal.
6. Special purpose switches shall be provided with the amperage, voltage, and configuration as shown on the Drawings. Switches used as motor disconnects for single phase motors shall be horsepower rated.

**B. Receptacles**

1. General purpose receptacles shall be commercial grade, duplex and rated 20 amps, 120 VAC, 2 pole, 3 wire grounding, NEMA 5-20R configuration, specification grade, and side wired to screw terminals. Face color shall be brown when paired with stainless steel covers. General purpose receptacles shall be specification grade Leviton, Hubbel, or equal.
2. Ground fault circuit interrupter receptacles shall be used where noted as GFI on plan or where in outdoor NEMA 3R locations. GFI receptacles shall be commercial grade, duplex, brown, 20A, 120V, back and side wired, with "test"

- and "reset" buttons. "Daisy Chain" connecting multiple receptacles from one GFI unit is not acceptable. GFI receptacles shall be Leviton, Hubbel, or equal.
3. Boxes shown in NEMA 3R environments and outdoor locations shall be weatherproof while in-use. Furnish in-use weatherproof covers and weatherproof boxes for these areas.
  4. Definite purpose receptacles and plugs in NEMA 4 or 4X environments where a receptacle is shown and a device is to be connected continuously, shall be listed as UL type 4, 4X, (Plug) and NEMA 3R (flip cover). Receptacles, plugs, and housings shall be fabricated of impact resistant plastic with o-rings and gaskets to prevent the entrance of water, vapors, and chemicals when unplugged or plugged. Circular plugs shall be retrofitted onto equipment so as to be compatible with the receptacles to maintain in-use ratings. Furnish Hubbel Watertight Wiring Devices and Accessories, or equal.

## 2.08 GENERATOR CONNECTION PANEL

- A. The Generator Connection Panel shall be a NEMA 3R rated enclosure, ANSI 61 gray and located as shown on Contract Drawings. The generator connection panel shall be 480 VAC, amperage as shown in Drawings, or main breaker size if not shown, and wall-mountable.
- B. The panel shall be provided with male cam-type receptacle assembly for connection of generator power phases (A, B, C), neutral and grounding conductors. All connections for phases, neutral, ground, etc., shall be clearly marked via color code and labeling.
- C. Each single pole male cam-type receptacle shall be rated for no less than 400 amps at 90 deg C. Multiple receptacles per phase, neutral, and ground shall be utilized when amperages over 400 are required.
- D. Cam-type receptacles must be suitable for use in outdoor environments.
- E. Single pole Cam-type receptacles shall be UL 498 listed for Attachment Plugs and Receptacles and UL 1691.
- F. Provide 400A, 480V rated, color coded power cables with female CAM connector installed on one end. The other end shall be suitable for mechanical connection to portable generator. Provide 25 feet of cable minimum.
- G. Provide Trystar Generator Docking Station (GDS-1) with manual disconnect, optional battery charger receptacle and optional 2 wire start, or approved equal.

## 2.09 SPARE PARTS

- A. The Contractor shall supply all spare parts prior to start of field tests. All parts shall be sealed in plastic bags and delivered to the site in a heavy duty plastic storage bag. Bag

shall be clearly labeled with part name & number and the corresponding equipment tagname.

- B. The Contractor shall make available any replacement parts that are not manufacturer's normal stock items for immediate service and repair of all the instrumentation equipment throughout the warranty period.
- C. The following spare parts shall be provided as part of this Contract:
  - 1. Ten fuses for each type of fuse below 31 amps, 3 of each type above
  - 2. Ten lamps for each type of light, two lamps per color if LED type.
  - 3. Two relays for each type of control, and time delay relay.
  - 4. One voltage monitoring relay or power fail relay.

## PART 3 EXECUTION

### 3.01 CONSTRUCTION METHODS

- A. Equipment shall be assembled and wired by the manufacturer prior to shipment. Field modifications or changes are not allowed without a written "change order" to the Contract. Field changes, however large or small, shall be executed using the components, materials, wiring, labeling, and assembly methods identical to that of the original supplied equipment.
- B. Electrical plugs, receptacles, cords, and connectors required to power or interface the equipment and panels shall be furnished and installed by the Contractor.
- C. Factory as-built drawings for each custom manufactured control panel or MCC shall be shipped with the equipment and placed inside in waterproof envelopes.

### 3.02 EQUIPMENT FABRICATION

- A. All electrical equipment, including custom manufactured equipment, shall meet the requirements of Underwriters Laboratories (UL) and bear the appropriate label. Panels shall be affixed with UL label prior to shipment and be built in accordance with the UL guidelines and procedure that corresponds to the UL label. Custom control panels shall bear a UL-508A label for general use, minimum, with additional UL labels as required per intended service.
  - 1. Design and furnish a Low Voltage Limited Energy Circuit for any device(s) not bearing a UL listing or registration that are required to be installed into a UL labeled panel.
  - 2. Revise voltages for any electrical parts and equipment that are specified that do not bear the UL listing or registration.
- B. Panel cutouts for devices (i.e. indicating lights, switches) shall be cut, punched, or drilled and smoothly finished with rounded edges. Exposed metal from cutouts that are

made after the final paint finish has been applied shall be touched up with a matching paint prior to installing device.

- C. Equipment doors shall swing freely and close and latch with proper alignment.
- D. Component within the electrical equipment shall be securely mounted on an interior subpanel or backpan and arranged for easy servicing. Mounting bolts and screws shall be front mounted for device removal without special tools or removal of entire mounting panel.
- E. A ground bus shall be provided in each enclosure or cabinet. It shall have provisions for connecting a minimum of ten grounding conductors. Screw type lugs shall be provided for connection of grounding conductors. All grounding conductors shall be sized as shown on plans or in accordance with NEC Table 250 95, whichever is larger.
- F. Bolts and screws for mounting devices on doors shall have a flush head which blends into the device or door surface. No fastening devices shall project through the outer surfaces of equipment.

### 3.03 WORKMANSHIP

- A. All work in this division shall conform to the codes and standards outlined herein.
- B. Installation shall be performed by qualified personnel providing first class workmanship per Electrical Specifications [Electrical General, Qualifications].
- C. Maintain equipment installed (or to be installed) in new condition. Protect equipment from damage while in Contractor care from dust, water, or mishaps that are typical to construction sites
- D. Confirm that equipment and materials are correct for their intended duty and will be installed per manufacturer guidelines. Equipment and components found to be installed inconsistent with manufacturer guidelines and/or these specifications will not be acceptable and subject to removal and replacement.
- E. Upon completion of daily work, remove excess materials, scraps, and debris from the work area and from the inside of equipment.
- F. Upon notification, stop work on any portion of the installation that is determined to be non-compliant with contract or being installed by unqualified personnel.
- G. Perform all work to correct improper installations at no additional cost to the owner.
- H. Equipment furnished under this contract or provided to Contractor for installation shall be installed in accordance with manufacturer's instructions, installation calculations, and contract documents.

### 3.04 EQUIPMENT SHIPMENT AND STORAGE

- A. Shipment -- Any equipment whose destination (jobsite) is more than 25 miles from the factory shall be carefully protected for shipping. All openings shall be protected by plywood securely fastened to the framework of the equipment. Equipment shall be adequately covered during local delivery.
- B. Storage -- From the time of receipt until the equipment is installed and energized, the equipment shall be considered in storage. While in storage, a 120V, 1 phase source of power shall be made available and connected to space heaters in all items of equipment so equipped. Equipment not provided with space heaters shall be provided with a light bulb or electric heater while in storage to prevent moisture condensation. Unless stored indoors, it shall be a least 1 foot above grade covered with at least 2 layers of heavy polyethylene plastic sheets and anchored to prevent damage by high winds. All equipment shall be protected from dust and moisture prior to and during construction.

### 3.05 DAMAGED PRODUCTS

- A. Damaged products that cannot be repaired to new condition shall be replaced with new products. All equipment and materials shall be in like-new condition at start-up and commissioning.
- B. Any equipment furnished outside of contract to the Contractor shall be repaired or replaced if damaged while in the Contractor's care. The Contractor shall pay for the parts and/or services of the original equipment manufacturer (OEM) to troubleshoot, asses, and repair damaged equipment.
- C. Minor cosmetic damage shall be repaired by spray painting, after properly preparing the surface, all scratches or defects in the finish of the equipment. Only identical paint furnished by the equipment manufacturer shall be used for such purposes.

### 3.06 INSTALLATION

- A. General
  1. Install all products per manufacturer's recommendations and the Drawings.
  2. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the electrical equipment provided under other Sections.
  3. Protect wiring insulation from wear by installing rubber cushions, bushings, or strip insulation, or by fastening the wiring to a rigid surface with zip ties and anchors.
  4. Provide additional devices, wiring, conduits, relays, signal converters, isolators to complete interfaces of the electrical and instrumentation system.
  5. Changing normally open contacts to normally closed contacts or vice versa
  6. Adding additional relays to provide more contacts as necessary.
  7. All programmable devices (not specifically excluded herein) shall be programmed, set-up and tested by the Contractor prior to startup. Programming

and set-up parameters shall be adjusted or changed as directed by the Engineer during start-up and throughout the warranty period.

8. Coordinate with the Engineer and setup all alarm, process, and operation setpoints.
  9. Keep a copy of the manufacturer's installation instructions on the jobsite available for review at all times prior to and during the installation of the associated equipment.
- B. Panels and enclosures:
1. Install panels and enclosures at the location shown on the Plans or approved by the Engineer.
  2. Install level and plumb.
  3. Seal all enclosure openings to prevent entrance of insects and rodents.
  4. Clearance about electrical equipment shall meet the minimum requirements of NEC 110.26
- C. Conduits and Ducts:
1. Install all conduits and ducts per Electrical Specifications [Conduit and Boxes] and [Grounding].
  2. Minimum wire bending space at terminals and minimum width of wiring gutters shall comply with NEC tables 312-6 (a) & (b).
- D. Wiring, Grounding, and Shielding:
1. Observe proper grounding and shielding practices as this application environment is generally noisy. The shield of shielded cables shall be terminated to ground at one end only, the origination end. The shield at the other end shall be encased in an insulated material to isolate it from ground.
- E. Cutting and Patching:
1. The Contractor shall do all cutting and patching required for installing his work. Any cutting which may impair the structure shall require prior approval by the Engineer. Cutting and patching shall be done only by skilled labor of the respective trades. All surfaces shall be restored to their original condition after cutting and patching.
- F. Cleaning and Touch up:
1. At the completion of the work, all parts of the installation, including all equipment, exposed conduit, and fittings, shall be thoroughly cleaned of grease and metal cuttings. Any discoloration or other damage to parts of the building, the finish, or the furnishings, due to the Contractor's failure to properly clean the system, shall be repaired by the Contractor.
  2. The Contractor shall thoroughly clean any of his exposed work requiring same.
  3. Vacuum and clean the inside of all electrical and instrumentation enclosures prior to applying power.

4. The Contractor shall paint scratched or blemished surfaces with the necessary coats of quick drying paint to match existing color, texture and thickness. This shall include all prime painted electrical equipment including but not limited to enclosures, poles, boxes, devices etc.

### 3.07 APPLICATION OF POWER

- A. The Engineer will direct the energization and de-energization of all existing and new equipment. The Contractor is not authorized to energize or de-energize any equipment unless they have been given written permission to do so or while in the presence of the Engineer.
  1. Any equipment that is under repair, demolition or installation shall be locked off and tagged out of service with Contractor supplied padlocks and tags.
  2. The Contractor is required to comply with NFPA 70E and specifically in regards to safety when working on live equipment. Obtain work permits when needed to do live work.
- B. The Contractor is responsible for grounding of high and medium voltage cabling and/or bus during installation and removal of equipment. The contractor is responsible for complying with all California Electrical Safety Orders (ESO) and Occupational Safety and Health Act (OSHA) safety requirements and procedures while working in or near medium voltage equipment.

### 3.08 WARRANTY

- A. The Contractor shall warrant all electrical and instrumentation equipment & software for a period of 1 year from date of final acceptance. Standard published warranties of equipment which exceed the preceding specified length of time shall be honored by the manufacturer or supplier.
- B. The Contractor shall have a staff of experienced personnel available to provide on-site warranty service on 2 working days notice during the warranty period. Such personnel shall be capable of fully testing and diagnosing hardware & software and implementing corrective measures.

### 3.09 FINAL ACCEPTANCE

- A. Final acceptance will be given by the Engineer after the equipment testing is complete, each deficiency has been corrected, final documentation has been provided, and all the requirements of Contract documents have been fulfilled.
- B. At the end of the project, following the completion of the field tests, and prior to final acceptance, the Contractor shall provide the following:
  1. Each "operation and maintenance" manual shall be modified or supplemented to reflect all field changes and as built conditions.
  2. Two (2) disk copies of all final documentation to reflect as-built conditions.

- C. Keys: Submit two sets of all keys for locks supplied on this project. Wire all keys for each lock securely together. Tag and plainly mark with lock number or equipment identification, and indicate physical location, such as panel or switch number.

END OF SECTION

## SECTION 16110 – CONDUIT AND BOXES

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. Labor, materials, equipment, tools, safety gear, test equipment, incidentals, services, and transportation for a complete electro-mechanical installation as shown on the Drawings, included in these Specifications, or as can be reasonably implied from project descriptions.
- B. The scope of work includes:
  - 1. Furnish and install conduits, wireways, raceways, cable trays, junction boxes, pull boxes, and associated hardware. Provide conduit, fittings, hardware, hangars, mounting channel, and other parts for a complete raceway installation.
  - 2. Furnish and install grounding system required by drawings, or if not shown or defined, as required by Article 250 of the NEC.
  - 3. Installations shall be designed and installed with components meeting the NEMA area designation.
- C. Work includes that specified in Electrical Specifications [Electrical General].

#### 1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Low Voltage Wire & Data Cable]
- C. Electrical Specifications [Grounding]
- D. Project Drawings

#### 1.03 QUALIFICATIONS

- A. Material furnished under this specification shall be installed by qualified installers meeting requirements specified in Electrical Specifications [Electrical General, Qualifications].

#### 1.04 SUBMITTAL REQUIREMENTS

- A. Provide submittals and drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].

### PART 2 PRODUCTS

2.01 CONDUIT, RACEWAYS AND WIREWAYS

- A. GENERAL - Conduit, raceways, and wireways, wiring methods, materials, installation shall meet all requirements of the NEC, be UL labeled for the application, and meet the minimum following specifications.
  - 1. All wiring shall be installed in conduits, raceways, or wireways when interconnecting equipment and devices.
    - a. The minimum size conduit shall be 3/4-inch unless indicated otherwise on the Drawings or for special connections to equipment.
    - b. Provide cords and cord seals for devices or instrumentation requiring waterproof seal to maintain NEMA 4 or 4X ratings. Example devices include lighting and pipe mounted instruments that are located below grade.
  - 2. Conduits may connect into junction boxes or wireways as shown in the drawings or as requested by Contractor and approved by Engineer. Junction boxes (circle with J in drawings) can be as simple as a condulet or JIC box, or larger box as determined by contractor and needed for the installation. Drawing may or may not depict junction box requirements that may be required by code. Wireways or junction boxes shall be rated for area (as noted in the Drawings), or furnish minimum NEMA 4 if not noted.
  - 3. The Contractor shall use conduit material types (SPEC per conduit schedule) as defined below or as otherwise shown in the contract drawings or as specifically called out in the conduit schedule.
    - a. Non-exposed underground portions of conduit run shall be PVC-40 for all signals and voltages unless otherwise shown in the conduit schedule.
    - b. Exposed conduit material (not underground and beyond transition) shall be per the following table unless specifically noted otherwise in the plan drawings. The conduit schedule denotes the conduit type for non-exposed (under-ground, in-concrete, etc.) and does not apply or coordinate with this table. Exposed condulets, elbows, fittings, device boxes, and hardware shall be of the same material and finish as the adjacent conduit.

<u>Location</u>	<u>Material</u>
NEMA 1 or 12	Galvanized rigid steel (GRS)
NEMA 3R	Galvanized rigid steel (GRS)
NEMA 4	PVC-Coated Steel (GRS-PVC)
NEMA4X	PVC-Coated Steel (GRS-PVC)
Class 1 Div 1 or 2 hazardous	PVC-Coated Steel (GRS-PVC)

- 4. Conduit stubs and transitions:
  - a. Conduit transitions shall be GRS-PVC for 6” on either side of the transition point (minimum) or as shown in drawing details. Conduit

transition is defined as conduit sections emerging from or through concrete or earth or from below to above grade or through walls or vaults, non-exposed to exposed.

- b. Beneath pad mounted electrical equipment, where not exposed, shall be installed or trimmed to 2” or less above slab and have bushing or end bell installed. Overall height of conduit entering into the base of equipment shall be enough for bushings/bells to be installed but be high enough for conduit tags to be installed.
- c. Uniform in height for each panel or section. Conduits end bushings/bells shall not vary in height above slab more than ½” from lowest to highest.
- d. Conduits shall be spaced apart such that bushings and end bells may be installed without interfering with the adjacent conduits.
- e. Transitions to PVC shall include PVC coated locknuts to shield exposed steel pipe threads.
- f. Through walls – shall protrude approximately 2” and include end bell or bushing. Pack space around conduit with non-shrink grout if the thru-hole was core drilled.
- g. From hazardous locations – shall include seal off and/or conduit cable seals as required per NEC.
- h. Conduits for future use shall be capped with coupling and plug. Identify each end with conduit labels.
- i. Existing conduits that are no longer able to be used due to removal of equipment or shown demolished, shall have flexible conduit removed, wires removed or pulled back to the nearest pullbox, coiled and labeled at each end. Disconnect wires at each end.

5. Conduit Tags

- a. All conduits listed in the “Conduit and Wire Routing Schedule” shall have conduit tags at both ends of each conduit run with tag number from schedule identified. This shall include ends within underground pull boxes.
- b. All conduits shall have temporary tags during construction. Temporary tags may be made from duct tape with hand written ink marking or suitable equivalent. Temporary tags shall be removed by Contractor at time of installation of permanent tags.
- c. Tag material shall be rigid laminated red plastic with white lettering. The size of the tag shall be ¼” thick by 1” round or ¾” x 1” rectangle minimum.
- d. Letter height shall be 3/8” minimum. Engrave the tags with the conduit number or acronym. Labeling shall be neatly installed for visibility and shall be clearly legible. Securely fasten tags in place using 20ga stainless steel tie wire through a pilot hole on the tag.
- e. Conduit tags shall be Custom manufactured per specification.

6. Supports

- a. Cross section of a single channel shall be 1-5/8" x 1-5/8" and cross-section of a double channel shall be 1-5/8" x 3-1/4". The channel wall thickness shall be 12 gauge as applicable.
- b. One-Hole clamps shall be intended for pipe mounting on support channels and equipped with clamp-backs. The clamps shall be Efcor, Thomas and Betts, Appleton or equal
- c. Spacers, provided to support underground conduits in concrete encasements, shall be plastic. The spacers shall be Carlon, Johns-Manville, Underground Products or equal
- d. Anchors shall be expansion type for securing equipment to concrete foundations, floors and walls. Anchors shall have length identification mark on the exposed end of the bolt. Provide Hilti Kwik Bolt 3, or equal.
- e. Stanchions shall be provided as needed to mount equipment and electrical components. Stanchions shall be shop fabricated from welded 4" c-channel, 12" x 12" x 1/4" steel base plate, coated with a rust inhibiting primer and top coat of gray polyurethane gloss paint. Attach equipment to the stanchion direct or on a 1/4" aluminum sheet sized for the equipment supported.
- f. Conduit Hangers shall be trapeze construction, with double channel, 3/8-inch rods and nuts. Suspend from suitable structural support.
- g. Support material and finish shall be per the following table unless otherwise noted in the drawings. Brackets, fittings and hardware shall be of the same material and finish.

<u>Location</u>	<u>Material</u>
Indoors NEMA 12	Galvanized steel
Outdoors NEMA 3R	Galvanized steel
Outdoors NEMA 4	Stainless Steel type 316
Corrosive areas NEMA4X	PVC bonded, 40 mil, factory applied

- h. Equipment mounting racks shall be designed by installer for rigid equipment and conduit mounting. Racks shall be bolted or welded construction and sized for equipment or as shown on the drawings.
- i. Strut channels shall be used for mounting equipment to walls and for supporting conduit runs. Double strut channel type shall be used for fabricating equipment mounting racks as required and/or as detailed on the drawings. Add additional supports to rigid mounting locations as needed to prevent wobbling and to meet seismic requirements. All field cut surfaces of the strut channels shall be deburred and coated to prevent rust.

B. Galvanized Rigid Steel Conduit - (GRS)

1. Manufactured from high-strength steel and hot dipped zinc galvanized inside and out. Conduit and fittings shall meet UL 514B, UL 6, and conform to NEMA RN 2. Conduit shall be capable of being used as an equipment grounding conductor per NEC 250.
2. Provide galvanized rigid steel factory sweeps and elbows for 90 degree transitions.
3. Cast fittings and device boxes shall be malleable iron or aluminum. Appleton type FS/FD or equal.
4. In hazardous locations, fittings shall meet and be listed UL 886.
5. All fittings, hubs, couplings, pulling elbows and connectors shall be threaded-type. Set-screw type and compression-type are not acceptable. All thread conduit is not allowed over 1/2" exposed length. Cover plates shall be cast iron with sealing gasket in NEMA 3R locations.
6. Conduits entering enclosures shall be fitted with insulated grounding bushing; O-Z "HBLG", Appleton "GIB", or approved equal. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC code.
7. Combination expansion-deflection fittings installed exposed shall be Type XD as manufactured by Crouse-Hinds Co.; Type DX as manufactured by O.Z. Gedney Co.; Type DF as manufactured by Appleton Electric Co., or equal

C. Galvanized Rigid and Coated Steel Conduit (GRS-PVC)

1. Galvanized Rigid Steel conduit with a 40-mil thick polyvinylchloride exterior coating and a 2-mil urethane interior coating meeting NEMA RN-1, UL-6 and ETL PVC-001. The bond of the PVC to the zinc coated pipe must be stronger than the tensile strength of the PVC.
2. Provide PVC coated galvanized rigid steel factory sweeps and elbows for 90 degree transitions.
3. Cast fittings and device boxes shall be malleable iron or aluminum with a 40-mil thick PVC coating meeting the same
4. In hazardous locations, fittings shall meet and be listed UL 886.
5. Provide PVC coated threaded-type fittings, hubs, pulling elbows, couplings, and connectors; set-screw type and compression-type are not acceptable. Form 8 conduit fittings, 1/2" through 4", must have a tongue-in-groove gasket to effectively seal out the corrosive elements. Covers shall be supplied with plastic encapsulated stainless steel cover screws. Form 8 fittings shall be UL and type 4X and IP69 listed.
6. A "PVC Coated Sealing Locknut" shall be used on all exposed male threads transitioning into female NPT threads which do not have sealing sleeves, including transitions from PVC couplings/female adapters to PVC Coated GRC elbows in direct burial applications. "PVC Coated Sealing Locknuts" are not to be used in place of a myers hub
7. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.

8. All junction and metal pull boxes shall be galvanized with exterior surfaces PVC coated to 40 mils thickness.
  9. Unistrut, strut clamps, pipe straps, and clamp back spacers, shall have 40 mil thick PVC coating. All mounting anchors shall be stainless steel.
  10. Conduits entering enclosures shall be fitted with insulated grounding bushing. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC code.
  11. Installers of PVC Coated Conduit must be certified by the manufacturer and be able to present a valid, unexpired certified installer card.
  12. GRS-PVC conduit to be Robroy Plasti-bond, Perma-Cote, KorKap, T&B OCAL or equal.
- D. PVC Conduit, Schedule 40 or 80 (PVC-40, PVC-80)
1. Shall be high impact schedule 40 or 80 polyvinylchloride suitable for use underground, direct burial and for use with 90 C wires, and shall conform to UL 651. Shall be UL listed and labeled for "direct" burial.
  2. A copper bonding conductor shall be pulled in each raceway and bonded to equipment at each end with approved lugs.
  3. Each underground run shall be placed in a trench with a five (5) inch sand bed evenly compacted on all sides, top and bottom unless otherwise noted.
  4. Elbows, and risers shall be per exposed conduit transition detail. PVC conduit is not allowed above ground except where specifically called out on the Drawings.
  5. PVC fittings shall have solvent-weld-type conduit connections. Fittings and device boxes shall be PVC with factory fabricated conduit connections. Provide Carlon or equal.
  6. Conduits entering enclosures shall be fitted with a glued male adapter, lock ring and bushing to prevent wire chafing. Conduits entering panels through concrete to an open bottom or entering a pull box shall have a glued end bell fitting.
  7. PVC conduit shall be stored on a flat surface and shielded from the sun.
- E. Liquid Tight Flexible Non-metallic Conduit (up to 2") - (FLEX)
1. Liquid tight flexible Nonmetallic Conduit shall be constructed of flexible PVC and have a smooth inner surface with integral crush resistant reinforcement within the conduit and be designated as a Type LFNC-B (for FNMC-B).
  2. Liquid tight Flexible Nonmetallic Conduit shall be sunlight, oil, and flame resistant and approved for the installation of electrical conductors in indoor and outdoor applications.
  3. Liquid tight Flexible Nonmetallic Conduit shall be listed to UL standard UL1660.
  4. Liquid tight flexible non-metallic conduit shall be installed in accordance with Article 351, Part B of the National Electrical Code (NEC) and other applicable sections of the NEC and/or local electrical codes.
  5. Liquid tight Fittings shall be listed for the use with Liquid tight Flexible Nonmetallic Conduit and shall be marked LFNC-B (FNMC-B).

6. Flexible Non-Metallic Conduit shall be Carlon Carflex or equal.
- F. Liquid Tight Flexible Metal Conduit (above 2-1/2") - (FLEX)
1. Liquid Tight Flexible Metal conduit shall be moisture and oil-proof with PVC jacket extruded over a galvanized flexible steel conduit.
  2. Liquid Tight Flexible Metallic Conduit shall be sunlight, oil, and flame resistant and approved for the installation of electrical conductors in indoor and outdoor applications.
  3. Liquid Tight Flexible Nonmetallic Conduit shall be listed to UL standard UL 360.
  4. Liquid Tight flexible metallic conduit shall be installed in accordance with Article 351, Part B of the National Electrical Code (NEC) and other applicable sections of the NEC and/or local electrical codes.
  5. Liquid Tight Fittings shall be listed for the use with Liquid tight Flexible Metallic Conduit and conform to UL514B.
    - a. Outdoors when extension of GRS-PVC: PVC coated galvanized steel with insulated bushings.
    - b. Outdoors when extension of GRS: Galvanized steel with insulated bushings.
    - c. Indoors or outdoors when extension of stainless steel: 316 stainless steel with sealing ring and insulated bushing.
    - d. Indoors: Galvanized steel with insulated bushings.
  6. Flexible Metallic Conduit shall be Amer-Tite type GP or equal.

## 2.02 DEVICE BOXES

### A. BOXES

1. Device boxes shall be of zinc-galvanized malleable iron or cast aluminum with shape and size best suited for the particular application, rated for the location installed, and shall be supported directly to structure by means of screws, anchors, or bolts.
2. Box dimensions shall be in accordance with size, quantity of conductors, and conduit clearances per NEC articles 314 requirements.
3. Boxes exposed to the weather or in moist locations shall be weatherproof (WP) by means of gasketing under a weatherproof cover.
4. Boxes connected to GRS-PVC conduit runs shall be PVC coated with 40 mil coating.

### B. DEVICE PLATES and COVERS

1. Indoor general purpose device plates and covers shall be stainless steel. Plates or covers shall be attached with stainless steel screws. An engraved plastic label denoting circuit breaker number and panelboard name shall be affixed to each cover with #4 stainless steel screws.
2. Weatherproof switch, outlet, and receptacle boxes shall be fitted with gasketed covers rated for wet locations. Each access cover shall have a padlockable

cover to maintain security and weatherproof integrity even when a plug is connected to the receptacle. Screws and hinge springs shall be stainless steel. Weatherproof access covers shall be Leviton 5977-CL, Cooper 4966, or equal.

## 2.03 PULL BOXES

### A. JUNCTION BOXES

1. Where required for best installation or where specifically called out in the Drawings, junction boxes shall have JIC type construction with hinged door, NEMA 4X rating, manufactured of type 304 stainless steel or as otherwise shown. Door shall be fastened with clamps and stainless steel screws. No devices, screws, rivets, or bolts shall protrude through the exterior surface unless specifically shown on the Drawings. Boxes shall be Hoffman, Circle AW, or equal.

### B. UNDERGROUND BOXES

1. Underground pull boxes shall be prefabricated "Christy Box" size and type as noted in the Drawings or equal. Size shall be as shown or dimensioned on the Drawings. Provide larger boxes as needed to meet code or as determined in field to allow for adequate pull area at Contractor discretion. Extension sections shall be provided as necessary to reach the depth of underground conduits with maximum depth of 48". All boxes shall have galvanized steel hold down bolts and hardware. Boxes shall be H/20 loading rated and have traffic rated covers. Steel covers or lids shall be galvanized and grounded with bonding jumper to the local grounding circuit per NEC. Pull box covers shall be labeled electrical, signal, utility, and telephone, whichever applies. Pull boxes shall be Christy Concrete Products, Brooks or equal.

### C. Pull Box and Vault Identification

1. Engrave or bead weld box covers with minimum thickness of 1/4" x 1" lettering with pullbox name (i.e. PBX-XXX) and purpose (electrical, signal, fiber, telephone, etc.). Provide an additional identifier "high voltage" for boxes with 600 volts or higher.
2. Utility pull boxes shall be labeled per Utility Company standards.

## PART 3 EXECUTION

### 3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

### 3.02 INSTALLATION

- A. System:

1. Install all products per Electrical Specifications [Electrical General, Installation].
- B. Rigid Conduits and Ducts:
1. Exposed conduits shall be neatly arranged with runs perpendicular or level and parallel to walls. Bends shall be concentric.
  2. Except as expressly indicated or approved, all conduits shall be surface mount on block walls, concealed behind gypsum walls, and buried to required depth below floor slabs.
  3. Pipe threads shall be treated with conductive thread compound.
  4. Installation of the GRS-PVC conduits must be in accordance with the manufacturer's installation procedures using recommended tools.
    - a. Apply touch up compound at each fitting sealing sleeve edge to improve watertight seal.
    - b. To ensure compliance, the installer(s) must be "manufacturer certified" before installation can proceed.
    - c. Certification available by contacting manufacturer's representative and attending a brief instructional course. Valid and unexpired certification card shall be available for review per installer.
  5. Repair GRS-PVC coating utilizing a touch-up compound as provided by the manufacturer of the conduit of the same material as the coating. Overlap beyond the damaged area to cover the PVC coating. Contact from touchup compound to PVC is required to maintain integrity. The entire conduit shall be replaced if the repair exceeds 1" combined length.
  6. A maximum of three equivalent 90 degree elbows are allowed in any continuous run. Install pull boxes where required to limit bends in conduit runs to not more than 270 degrees or where pulling tension would exceed the maximum allowable for the cable.
  7. Route all above grade conduits parallel or perpendicular to structure lines and/or piping. Conduits installed above grade shall be braced in place with stanchions. Expansion joints shall be installed every 100 feet. Bends shall be concentric.
    - a. Combination expansion-deflection fittings installed exposed shall be Type XD as manufactured by Crouse-Hinds Co.; Type DX as manufactured by O.Z. Gedney Co.; Type DF as manufactured by Appleton Electric Co., or equal
  8. Care shall be exercised to avoid interference with the work of other trades. This work shall be planned and coordinated with the other trades to prevent such interference. Process Pipe, mechanical and HVAC shall have precedence over conduits for routing and space requirements.
  9. Seal each bottom entrance conduit into the MCC and other electrical enclosures with plugging compound sealant to prevent the entrance of gasses, insects and rodents. Plugging compound sealant shall be Gardner Bender Duct Seal or equal.
  10. Seal conduits from wetwells within underground pullboxes with conduit cable seals. Furnish Roxtec RS UG, Crouse Hinds, or equal.

11. Exposed conduit stubs for future use shall be capped with coupling and plugged. Drill hole in plug for pull rope as necessary.
12. Explosion proof seal-off fittings shall be provided on all conduits that enter or leave hazardous areas per requirements of the National Electrical Code, Chapter 5 and UL 886. The seal-off fitting shall prevent hazardous gases and/or flames from passing from one type area to another through the conduit system. Ceramic or other non-asbestos fiber material and sealing compound shall be placed in the fitting to complete the seal.
13. Hazardous location conduit outlet boxes shall be used in hazardous locations for change in direction, access to conductors and as pull and splice boxes.
14. All spare conduits shall have 1/8" nylon pull ropes installed.

C. Flexible Conduit and Cords

1. Final connections to vibrating equipment such as motors, heaters and fans shall be made with liquid tight flexible conduit.
2. Flexible conduit lengths shall not be greater than 36 inches for sizes up to 2 ½" and 48 inches for 3" and larger conduit.
3. Flexible conduit shall include a ground conductor for equipment bonding in circuits over 30 VDC or as shown in the conduit schedule.
4. Flexible conduit shall only be installed in exposed or accessible locations.
5. Where equipment is cord connected, submersible rated, and conduit connections are not possible without modification, devices and equipment may be free-air cord connected in lieu of flexible conduit. Connection to adjacent rigid conduit shall be through liquid-tight cord connector fitting specifically designed for the purpose and sized appropriately for the cord. Cord connectors shall be rated similar to the adjacent conduit they are connected to: Stainless steel, galvanized or plastic.

D. Excavation and Back Filling:

1. Trenches for conduit below floor slabs and other underground electrical conduit shall be excavated to the required depths per utility requirements or specific detail. Conduits under floor slabs shall have minimum trench depth to contain bends without any portion of the radius visible at finished grade.
2. Underground conduits outside of structures, excluding utility conduits, shall have a minimum cover of 24 inches except under roadways where minimum cover shall be 30 inches or as otherwise shown in the Contract Drawings. Back filling shall be done only after conduits have been inspected. Excavation and back fill of conduits shall conform to the requirements of other applicable Specifications sections unless modified on plans, and to other entities (Utilities, etc.) as required.
3. Install spacers to support underground conduits. Horizontal and vertical separation shall be maintained by plastic spacers set every four feet. Spacers shall be Carlon Snap-Loc or equal.

4. At all times during the installation of the electrical system, the Contractor shall provide barricades, fences, guard rails, etc., to safeguard all personnel, including small children, from excavated trenches.
- E. Underground pullboxes:
1. Pullboxes shall be located in areas that will experience the least traffic loading and in the general vicinity as shown in the Drawings. Boxes in pavement shall be set at final grade and boxes in planter areas shall be set 1" above final grade. Boxes shall not be buried by landscape material.
  2. Steel pull box lids shall be grounded per NEC 250.4(A)(5) and 314.4.
  3. Boxes shall be set on compacted base and base rock to minimize settling of the box over time. If the box is located in a paved traffic area, a 6" x 6" concrete ring shall be poured around the box below the pavement.
- F. Device Mounting Heights:
1. Mounting heights of fixtures and devices shall be as follows unless otherwise indicated or when height has to be adjusted to be over or under counter tops.
    - a. Wall switches => 48 inches
    - b. Convenience outlets => 18 inches
    - c. Telephone outlets => 18 inches
    - d. Bracket fixtures => 7 feet 6 inches
- G. Cutting, Coring, Patching and Repairing:
1. The Contractor shall do all cutting and patching required to install his work. Any cutting which may impair the structure will require prior approval. Cutting and patching shall be done only by skilled labor of the respective trades. Where it is becomes necessary to cut into existing work for the purpose of making electrical installations, locate existing post tension cables, rebar and electrical services prior to core drilling using ground penetrating radar or similar technologies. All surfaces shall be restored to their original condition after cutting and patching.

### 3.03 FIELD ASSISTANCE

- A. General: Provide all equipment and supplies necessary to perform all testing. The Owner Representative shall have the option to witness and participate in the on-site tests performed by the installer.
- B. Per Electrical Specifications [Factory and Field Testing].

### 3.04 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

## SECTION 16120 – LOW VOLTAGE WIRE & DATA CABLE

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. Labor, materials, equipment, tools, safety gear, test equipment, incidentals, services, and transportation for a complete electro-mechanical installation as shown on the Drawings, included in these Specifications, or as can be reasonably implied from project descriptions.
- B. The scope of work includes:
  - 1. Furnish and install wire, splices, lugs, or other miscellaneous devices as defined in this specification.
  - 2. End to end wiring and terminations for each system, device, instrument, and piece of equipment shown in the Drawings as new, or rehabilitated, or reconnected.
  - 3. Testing of conductors and completed wired systems.
  - 4. Installations shall be designed and installed with components meeting the NEMA area designation.
- C. Work includes that specified in Electrical Specifications [Electrical General].

#### 1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Conduit and Boxes]
- C. Electrical Specifications [Grounding]
- D. Project Drawings

#### 1.03 QUALIFICATIONS

- A. Material furnished under this specification shall be installed by qualified installers meeting requirements specified in Electrical Specifications [Electrical General, Qualifications].

#### 1.04 SUBMITTALS AND DRAWINGS

- A. Provide submittals and drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].

## PART 2 PRODUCTS

### 2.01 WIRING AND ELECTRICAL DEVICES

#### A. GENERAL

##### 1. General

- a. Provide wiring and electrical devices specified herein and install field and internal panel wiring as shown on the Contract Drawings.
- b. This section applies to all wires or conductors used internal (non-field) to electrical equipment or external for field wiring.
- c. Field wire quantity and size shall be per "Conduit and Wire Routing Schedule."

##### 2. Analog Signals

- a. Analog signal transmission between electric or electronic instruments shall be 4-20 milliamperes and shall operate at 24 volts DC unless otherwise specified. Milliampere signals shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.
- b. Provide powered current isolators wherever the loops' load resistance exceeds the originating current signal transmitter's rating. Associated shunt resistors shall be located on rail-mounted terminal blocks. Exposed resistor leads shall be insulated with heat-shrink tubing.

#### B. LOW VOLTAGE WIRE AND CABLE (through 600V except instrument signals)

##### 1. General: Low voltage conductors shall be used for power, control, lighting and miscellaneous circuits. This Section applies to all wires or conductors used internal for all electrical equipment or external for field wiring. Wire shall be new, plainly marked with UL label, gauge, voltage, type of insulation, and manufacturer's name.

- a. Conductors shall be copper with a minimum of 98% conductivity.
- b. Control and instrument wiring shall have tinned copper conductors.
- c. Class C stranding. Solid conductors may be used for lighting and receptacle circuits.
- d. Wire shall be rated 600 volt (min).
- e. Size all conductors per NEC minimum or as shown on the drawings.
  - 1) Minimum #12 AWG for wires used in power transmission circuits or as defined on the drawings.
  - 2) Minimum #14 AWG for wires used in signal transmission circuits or as defined on the drawings.

##### 2. Wire colors and sizes shall not change within the circuit.

##### 3. Wire shall be properly fused or breaker protected at or below the maximum amperage rating allowed by the NEC.

##### 4. Control and Power Wiring:

- a. Field wire in conduit:

- 1) Type XHHW-2, XLPE insulation, rated 90 °C in wet or dry locations, oil resistant.
  - a) Use for power circuits carrying voltages higher than 200 volts phase to ground.
- 2) Type THHN / THWN, PVC with nylon jacket insulation, rated 90 °C in dry locations and 75 °C in wet locations, oil resistant, UL83.
  - a) Use for power circuits with voltages below 200 volts phase to ground, or control circuits.
- 3) Minimum #12 AWG for wires used in power transmission circuits or as defined on the drawings.
- 4) Minimum #14 AWG for wires used in signal transmission circuits or as defined on the drawings.
- b. Field wire in tray (Tray Cable type TC):
  - 1) Individual cables - Insulation type THHN/THWN, rated 90 °C in dry locations and 75 °C in wet locations, oil resistant, UL83.
  - 2) 3 or more conductor plus ground wire in a single cable.
  - 3) UL Listed as sunlight resistant, direct burial, and open wiring.
  - 4) Conductor sizing per ICEA Publication P-54-440 for cable tray and ICEA P-46-426 for conduit
  - 5) Minimum #12 AWG for wires used in power transmission circuits or as defined on the drawings.
  - 6) Minimum #14 AWG for wires used in signal or control transmission circuits or as defined on the drawings.
- c. Power cord
  - 1) Flexible wire cord shall be type SOW, SOOW, or G and be provided in 2, 3, or 4 conductor plus ground as required for connected load.
  - 2) EPR insulation, 90 deg C rating, oil and abrasion resistant., overall jacket plus individual conductor jackets. 600V rated
  - 3) Conductors shall be stranded copper.
  - 4) Cord shall be installed with cord grips on each end where it enters termination enclosures.
5. Instrument wiring:
  - a. Field: Instrument cables shall have 300V FEP insulation and FEP outer jacket with foil shielded twisted pair #18 stranded conductors with drain wire. Overall diameter of cable shall be 0.150" or less. Single twisted shielded pair (TSPR) cables shall be Belden 88760, or approved equal.
  - b. Non-Field: Instrument cables shall have 300V rated insulation and 100% individual shielded twisted pair #18 conductors with drain wire. Single twisted shielded pair (TSPR.) cables shall be Belden 8760, or approved equal. Three wire shielded cable shall be Belden 8770 or equal.
  - c. Field multi-pair instrument cable as required per conduit schedule shall have 300V rated insulation and 100% individual shielded twisted pair

- #18 conductors with drain wire. Multiple twisted shielded pair (T.S.PR.) cables shall be Belden 9773 thru 9777, or equal.
- d. Multi-pair cable is not allowed (unless specifically called out in conduit schedule or on plans) for use in field or non-field applications. One T.S.PR cable is required for each signal.
6. **Manufacturer Supplied Cables**
    - a. Cables and wiring for special systems provided by the manufacturer with the equipment shall be installed per the manufacturer's recommendations.
  7. **Data Cable**
    - a. Data network category 6 cable (indoor) shall consist of 4 pair unshielded twisted pair #23 awg solid copper conductors. The cable shall be rated by IEEE for service intended – plenum and dry.
      - 1) Cable: IEEE Category 6, various manufacturers.
      - 2) Connectors: Standard RJ-45 with boot.
    - b. Data network cable (outdoor) shall consist of 4 pair foil and braid shielded twisted pair #24 awg solid copper conductors with anti-crosstalk divider, and drain wire. Rated Level 2 Category 6+ Outdoor Carrier by IEEE for use in plenum, conduit, wet or dry.
      - 1) Cable: IEEE Category 6, Belden 2149a, or equal
      - 2) Connectors: Grounded RJ-45 with drain wire crimp.
  8. **Temporary motor or panel hook-up**
    - a. Temporary cable may be cord without conduit or PVC conduit with wiring. In either case, the cabling must be protected from damage during construction. Sections may be located out of harms way, buried, or sleeved in steel conduit as needed.
    - b. Power Circuits: Provide 2, 3, or 4 conductor plus ground power supply cable(s) for temporary pump connections or electrical power circuits. Cables shall be sized for breaker rating amperage, (minimum).
    - c. Provide multi-conductor (TC) cables for digital control circuits. Provide quantity of conductors as needed.
    - d. Provide instrument wiring for 4-20 ma instrumentation.
    - e. Voltage drop in power circuits shall not exceed 15% during motor start and 5% during operation.

**C. HEAT TRACE SYSTEM**

1. The heating cable shall consist of two 16 AWG or larger nickel-plated copper bus wires, embedded in a self-regulating polymeric core that controls power output so that the cable can be used directly on plastic or metallic surfaces. Cables shall have a temperature identification number (T-rating) of T6 (185°F or 85°C) without use of thermostats. Cable shall be designed for continuous exposure (maintain) capability up to 150°F (65°C).
2. A ground-fault protection device set at 30 mA, with a nominal 100-ms response time, shall be used to protect each circuit.

3. The heating cable shall have a tinned copper braid with a resistance less than the heating cable bus wire resistance as determined in type test (ASTM, B193, Sec. 5). The braid shall be protected from chemical attack and mechanical abuse by a modified polyolefin or fluoropolymer outer jacket.
4. In order to provide rapid heat-up, to conserve energy, and to prevent overheating of fluids and plastic pipe, the heating cable shall self-regulate with no more than 1% rise in wattage for every degree of cable temperature increase between 50 to 100 deg F.
5. The heating cable shall be Raychem® BTV-CT or BTV-CR self-regulating heater trace cable, as manufactured by Tyco Thermal Controls.
6. Coordinate with manufacturer's representative to select the appropriate cable wattage per foot based on the local expected historical low temperatures, protected piping and insulation requirements specified in the plans and Specifications.
7. The thermostat shall be electronic with line sensing stainless steel RTD probe. The thermostat shall be adjustable from 20 deg F to 80 deg F and shall be rated for up to 16A at 120 VAC minimum. The enclosure shall be NEMA 4X construction with screw cover lid. Terminal shall be provided for power supply and heat trace cable. Furnish Pentair DigiTrace AMC-1A or equal.
8. Junction box and splice point shall fasten to the pipe and provide a terminal point for the power and heat trace cables to connect. The junction box shall include an indicating light and a enclosed gooseneck for wire passage to the pipe. The gooseneck shall stand-off the pipe and allow up to 4" of pipe insulation without interfering with the cover. Furnish Raychem JBM-100 or equal.

D. COLOR CODE

1. All wires #8 and below shall have wire insulation the color specified. Wires #6 and larger may be black with color electrical tape at termination points.
2. No other colors shall be used without prior approval.
3. Color code color code of all wire shall conform with the following table:

**WIRE COLOR CODE TABLE**

<b>Description</b>	<b>Phase/Code Letter</b>	<b>Field wire or tape color</b>	<b>Non-Field Wire Color</b>
480V, 3 Ph	A	Brown	Brown
	B	Orange	Orange
	C	Yellow	Yellow
240V or 208V, 3 Ph	A	Black	-
	B	Red (Orange if high leg)	-
	C	Blue	-
	Neutral	White	White
240 / 120 V, 1 Ph	L1	Black	Black
	L2	Red	-
24V Positive	24+	Blue	Pink
24V Negative	24-	Gray	Gray
12V Positive	12+	Blue	Red
12V Negative	12-	Black	Black
AC Control		Red	Red (Yellow for foreign circuits)
DC Control		Blue	Blue
Ground	G	Green	Green
Shielded Pair	+	Red, Clear, or White	Clear or White
	-	Black	Black

**2.02 WIRE MARKING**

- A. All panel, enclosure and field wiring shall have wire labels on both ends of each wire. Labeling shall be neatly installed for visibility and shall be clearly legible. Each conductor of instrument shielded signal wiring shall be labeled. Wire labels shall be machine printed with on white heat shrinkable tubing. Each label shall fit a minimum 23 characters, 3/16” in height before shrink. Tubing shall be oversized for the wire and shrunk into place using an electric heat gun. The “shrunk” label shall have just enough give to allow the label to be rotated. Hand lettered wire labels are not acceptable and shall be replaced at the Contractor's expense. Provide Brady “PermaSleeve” or equal.

1. Node Style Wire Identification All wires that are electrically the same (connected to common termination points) and do not pass through a contact or other switching device shall have the same wire identification. The wire labeling code for each end of the same wire shall be identical.
  - a. The wire identification code for internal panel wiring shall be the number/letter as designated on the Drawing elementary and/or approved shop drawings.
  - b. Wire labeling for field wiring shall contain the field equipment name/tag as a prefix and the purpose. (I.E. FIT071--+ and FIT071-- or P10-124) where + or 124 are the field device terminal block name or purpose. The hierarchy of prefix label names is 1) Instrument Tag, 2) Electrical panel or equipment name, and 3) Equipment name. Therefore, wires from MCC50 P10 cubicle to PLC10 will be labeled MCC50-P10-xx where xx is the terminal number or the purpose. Wires from field pressure switch PSH10 to MCC50 P10 will be labeled PSH-10-xx where xx is the PSH terminal block name. See example PLC I/O wiring diagram.
  - c. Wire labels shall be per control panel submittal and/or interconnection submittal drawings using rules described above – Wire labels must be documented prior to printing and before they are applied. Abbreviations may be used in the wire label as long as they are consistent and understandable.
  - d. Wire labels for lighting and receptacle circuits shall consist of the panel board and circuit number and a unique node number. (I.E. LP#3-A, LP#3-B, LP#3-N)
  - e. Wire labels may be omitted on “neutral jumpers” less than 8” in length.
  - f. Wire labelling shall be documented and revised on drawings to as-built conditions.

### 2.03 ELECTRICAL TAPE / SHRINKABLE INSULATORS

- A. Vinyl tape shall be 7 mil, 600 volt rated, flame retardant, hot and cold weather resistant conforming to UL510. Provide 3M Scotch Super 33+ vinyl tape or equal
  1. Vinyl tape for color coding shall be 7 mil, ¾” width, vinyl tape conforming to UL 510. Provide 3M Scotch 35 vinyl tape or equal.
- B. Rubber Tape: EPR rubber, 90 deg C continuous rated. Provide 3M 130C rubber tape or equal.
- C. Varnished Cambric Tape: Adhesive backed, 7 mil, bias cut cotton tape, coated with yellow insulating varnish. Provide 3M Scotch 2510 or equal.
- D. Shrinkable insulators shall be heat shrinkable, polyolefin thick wall sleeves, end caps and cable repair sleeves are designed for use in splicing, sealing and re-jacketing of direct bury secondary cables. The insulators shall comply with UL 486D and be rated

up to 1000 Volts. They shall provide long-term reliable performance overhead, underground or submerged with mechanical and environmental protection. Shrinkable insulators shall be 3M ITCSN or 3M IMCSN per manufacturer instructions for the application or equal.

## PART 3 EXECUTION

### 3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].
- B. Perform work to remedy non-compliant installations after inspection.
- C. Upon notification, stop work on any portion of the installation that is determined to be substandard or being installed by unqualified personnel.

### 3.02 FABRICATION AND INSTALLATION

- A. System:
  - 1. Install all products specified in Electrical Specifications [Electrical General, Installation].
  - 2. Panels shall be completely factory wired and tested before shipment.
  - 3. All spare PLC input / output points shall be wired to terminal blocks.
  - 4. A minimum of 20% spare unwired terminals shall be provided in each panel.
- B. Wiring Methods:
  - 1. Wiring Separation: Wires carrying 100 volts and above shall be physically separated from lower voltage wiring by using separate bundles or wire ways with sufficient distance to minimize the introduction of noise, crossing only at 90 degree angles.
  - 2. Harness: All wiring shall be neatly bundled and laced with plastic tie wraps, anchored in place by screw attached retainer. Where space is available, wiring shall be run in slotted plastic wireways with dust covers. Wireways shall be sized such that the wire fill does not exceed 60%. Tie wraps shall be T&B TY RAP or equal.
  - 3. Retainers: Wireways, retainers, and other devices shall be screw mounted with round head 316 stainless steel screws or mechanically mounted by push in or snap in attachments. Glue or sticky back attachment of any type or style shall not be used. Retainers shall be T&B TC series or equal.
  - 4. Hinge Loops: Where wiring crosses hinged surfaces, provide a "U" shaped hinge loop protected by clear nylon spiral wrap. The hinge loop shall be of sufficient length to permit opening and closing the door without stressing any of the terminations or connections. Spiral wrap shall be Graybar T25N or equal.

5. Routing: Wires and cable shall be routed such as to maintain separation between 100 Volt or higher from 100 volt or lower wiring being run in the same duct or bundle. Wires and cables shall have sufficient length to allow slack and to avoid any strain or tension in the wire or cable.
  - a. Wires shall be routed in slotted plastic wireways with snap covers. Wires carrying 120 VAC shall be separated as much as possible from other wires and signal cables, and shall be routed only in ducts for 120 VAC. If the power wiring has to cross the signal wiring, the crossing shall be as close to a right angle as possible. Wireways for 24 VDC wiring shall be used for all other wires and cables. Routing of 120 VAC in combined wireways shall be minimized. Wires and cables shall be placed in the wireways in a straight, neat and organized fashion and shall not be kinked, tangled or twisted together. Additional wire ducting shall be provided for use by the electrical subcontractor for routing field wires to their landing points in the each electrical and instrumentation panel.
  - b. Provide 2" minimum separation between wireway and terminal blocks.
  - c. Wiring not routed in wireways shall be neatly bundled, treed, and laced with plastic ties.

C. Wire Terminations

1. Single wire and cable conductors shall be terminated according to the requirements of the terminal device as follows:
  - a. Crimp-on 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 Blocks: Remove the last +/- 0.25 inches insulation from of the conductor and insert it under the pressure plate to full length of the bare portion of the conductor. Tighten the screw to close the pressure plate onto the conductor. No more than two conductors shall be installed in a single terminal. All strands of the conductor shall be captured under the pressure plate.
  - c. Screw-less terminals: wire shall be stripped back and inserted per the terminal manufacturer's instructions.
  - d. Motors with pigtail leads: Install terminal connectors on the motor pigtails and the cable to be connected. Terminals shall be non-insulated crimp-on type applied with a ratchet-type crimping tool. The terminals shall be bolted together with a nut, bolt and lock washer combination. The connection shall be wrapped with four (4) layers varnished cambric tape, six (6) layers of rubber tape and six (6) layers of vinyl electrical tape, each half lapped.
2. When stripping insulation from conductors, do not score or damage conductor.
3. The drain wire and stripped end of outer jacket of shielded cables shall be covered with heat shrink insulating tubing. The drain wire shall be covered

along its full bare length between the cable jacket cover and the terminal lug and placed on end outer jacket to cover foil.

4. Condulets with wire nut connections shall be supplied for wire termination to devices with leads instead of terminals (i.e. solenoid valves, level probe, etc.).

D. Wire Splicing

1. No wires shall be spliced without prior approval.
2. Where splices are allowed or approved they shall conform to the following:
  - a. Wire splicing devices shall be sized according to manufacturer's recommendations.
  - b. Splices of #10 and smaller, including fixture taps, shall be made with nylon self insulated twist on wire nuts; T & B "Piggys", Ideal "Wing Nut" or equal.
  - c. Splices of #8 and larger shall be hex key screw, two way connectors, insulated with molded high-dielectric strength plastic; NSI Polaris IPL or IPLD Series terminal blocks or equal.
  - d. Non-Motor Splices #6 and smaller in underground pullboxes shall have wire-nut connections which are sealed with non-hardening silicone based sealant that protects the connection from moisture and corrosion. The wire nuts shall be factory filled with sealant and UL listed for waterproof connections. Provide Ideal Model 60 or equal.
  - e. Non-Motor Splices #4 and larger in underground pullboxes shall have double hex crimp barrel connections applied with adhesive/sealant filled heat shrinkable rubber insulation applied over the exposed connection. The cross-linked polyolefin shrink tube shall extend 4" on each side of the exposed connection minimum. Heat shrink tubing shall be 3M ITCSN or equal.
  - f. Motor lead Splices in underground pullboxes shall have terminal connectors on the motor leads and the cable to be connected. Terminals shall be non-insulated crimp-on type applied with a ratchet-type crimping tool. The terminals shall be bolted together with a nut, bolt and lock washer combination. The connection shall be wrapped with four (4) layers varnished cambric tape, six (6) layers of rubber tape and six (6) layers of vinyl electrical tape, each half lapped. Seal the connection with epoxy resin coating.

E. Wire Installation

1. Exercise care in pulling wires and cables into conduit or wireways so as to avoid kinking, stressing the cables, or damaging the insulation. Use a UL listed pulling compound for lubrication within conduits as necessary. The raceway construction shall be complete and protected from weather before cable is pulled in. Swab conduits before installing cables and exercise care in pulling, to avoid damage to the insulation or conductors.
2. All wire and cables (with the exception of coaxial antenna cable) shall be installed within UL listed raceways or enclosures. Install all wires and cables

in one continuous length unless splices are per Contract Drawings, required to connect equipment or submitted and favorably reviewed.

3. Bundle incoming wire and cables in panels. Zip-tie at intervals of 2” and neatly spread into trees and connect to their respective terminals. Allow sufficient slack in cables for alterations in terminal connections. Do not bundle, tape or tie wires within conduits.

### 3.03 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

## SECTION 16250 - AUTOMATIC TRANSFER SWITCH

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. The Contractor shall supply the automatic transfer switch (ATS) as specified herein.
- B. The ATS scope of work includes:
  - 1. Providing and installing one automatic transfer switch of rating shown on Contract Drawings.
  - 2. Submittal data and drawings.
  - 3. Startup assistance.
  - 4. Factory and field testing.
  - 5. Operation and maintenance manuals.
  - 6. Warranty of all components.
- C. Startup and configuration of ATS with installed voltages and loads.
- D. As required under Electrical Specifications [Factory and Field Testing], furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to perform factory and/or field testing.

#### 1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Factory and Field Testing]
- C. Project Drawings

#### 1.03 SUBMITTALS REQUIREMENTS

- A. Provide Submittals as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Include a record of each parameter available to be changed by the user. The list shall include factory defaults and space for entered values.

#### 1.04 OPERATION AND MAINTENANCE INFORMATION

- A. Provide operation and maintenance information as specified in Electrical Specifications [Electrical General, Operating and Maintenance Information].
- B. Include a record of each ATS parameter setup during startup and testing and place a copy of setting in each O & M manual.

## PART 2 PRODUCTS

### 2.01 AUTOMATIC TRANSFER SWITCH

#### A. General:

1. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATSS which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.
2. The ATS shall be rated to close on and withstand 42,000 RMS symmetrical short circuit amperes at the ATS terminals or otherwise shown. Provide overcurrent protection as shown on the Contract drawings.
3. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.
4. ATS types utilizing components of molded case circuit breakers, contactors, or parts thereof, are not acceptable.
5. The switch assembly shall be installed in a NEMA enclosure located as shown on Contract drawings.
6. The automatic transfer switch shall be an ASCO Model 7000, Zenith ZTSD, each with options to meet specified requirements, or equal.

#### B. Switch Unit:

1. The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be solenoid operated and only momentarily energized to minimize power consumption and heat generation.
2. The transfer switch shall feature a delayed transition mode. The switch shall remain in the neutral position (neither emergency nor normal) until the associated time delays have expired and allow the switch to complete the transfer.
3. The switch shall be 3 pole double throw with inherently interlocked construction. A solid neutral shall be provided for all systems.
4. Wide contact gaps shall be provided to insure positive isolation of the normal and emergency power sources.
5. The switch shall be fully rated for amperage shown on Contract Drawings, for switching all types of loads including induction motors. The ratings shall apply to the voltage and mounting arrangement as shown in the drawings.
6. The main power contacts shall have silver alloy contact construction featuring a wiping action each time the switch is operated. Arc chutes shall be utilized to contain the inherent spark created when switching under load.
7. The main contact design shall allow repeated making and breaking of rated full load current, with a combination of motor and other loads and without damage or undue wear to the contacts.

8. All main power contacts and auxiliary contacts shall be mechanically driven from a common actuator shaft.
9. The bus shall be constructed of silver plated copper.
10. Inspection of all contacts, linkages and moving parts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors.
11. All switch and relay contacts, coils, mechanical linkages, and control elements shall be serviceable or removable from the front of the mounted switch or accessory assembly without removal of the switch or assembly from the compartment and without disconnection of the power cables or control wiring.
12. The switch shall have a manual operating handle for maintenance purposes.
13. Compression screw type solder-less terminals or lugs shall be provided for connecting all external line & load power cables and control wiring. All connections shall be accessible from the front without removal of internal components.
14. A terminal strip shall be provided for terminating all control wiring. All terminals shall be numbered with machine printed lettering matching the wire number of the terminated wire.
15. All control wiring shall have permanent identification at each point of connection. Wire identification shall be by machine printed numbered wiring sleeves. Electrically common wires shall have the same wire number. Electrically different wiring shall have unique wire numbers.
16. Control wiring shall be neatly bundled and secured in place by plastic cable ties. Wiring shall be protected with plastic spiral wrap where it crosses over a hinge to the door.

C. **ATS CONTROL PANEL**

1. A control panel shall be provided to direct the operation of the transfer switch. The modules sensing and logic shall be controlled by a built in microprocessor. Control panels that do not utilize microprocessor electronics to control the operation of the switch are not acceptable.
2. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port.
3. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.
  - a. Sensing and control logic shall be provided on multi-layer printed circuit boards.
  - b. The panel shall be enclosed with a protective cover and be outer door or deadfront mounted such that it may be operated with the door closed for safety and ease of maintenance.
4. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage

sensing shall be true RMS type and shall be accurate to  $\pm$  1% of nominal voltage. Frequency sensing shall be accurate to  $\pm$  0.2%.

- a. The under-voltage of each phase of the normal source shall be monitored, with pickup adjustable from 85% to 100% of nominal and the dropout adjustable from 75% to 98% of pickup setting, both in increments of 1%. These adjustments shall be factory set at 85% dropout, and 90% pickup.
  - b. The voltage of each phase of the emergency source shall be monitored, with pickup adjustable from 85% to 100% of nominal. This adjustment shall be factory set at 95% pickup.
  - c. Frequency sensing of the emergency source shall be provided, with pickup adjustable from 90% to 100% of nominal. This adjustment shall be factory set at 97% pickup.
  - d. The control panel shall meet or exceed the voltage surge withstand capability in accordance with IEEE Standard 472 1974 (ANSI C37.90a 1974) and the withstand voltage test in accordance with the proposed NEMA Standard ICS1 109.21.
5. The transfer switch control panel shall be capable of operating over a temperature range of -20 to +60 degrees C.
6. The control panel shall include the following field adjustable time delays:
- a. Time delay to override momentary normal source outages, adjustable from 0 to 5 minutes. This adjustment shall be field set to place emergency generator on-line in 1 minute.
  - b. Transfer to emergency time delay for controlled timing of load transfer to emergency, adjustable from 0 to 5 minutes. This adjustment shall be field set switch position in 5 seconds after power has stabilized.
  - c. Emergency source failure time delay to ignore momentary transients during initial generator set loading, adjustable from 0 to 6 seconds. Set at 2 seconds.
  - d. Retransfer to normal time delay, adjustable 0 to 60 minutes. This adjustment shall be factory set at 5 minutes. The time delay is automatically bypassed if the emergency source fails and normal source is acceptable.
  - e. Unloaded running time delay for emergency engine generator cooldown, adjustable from 0 to 60 minutes. This adjustment shall be factory set at 5 minutes.
  - f. Delayed transition time delay for setting the dead time when all power is removed from the load side of ATS, adjustable 0 to 5 minutes. Set at 1 minute.
  - g. Generator Exercise Timer: Timer provided for operator adjustment of day of week, time of day and run duration for exercising the generator under operating loads by activating the automatic transfer switch. . Timer shall be mounted on the ATS outer deadfront door.
  - h. The controller shall provide an integral engine exerciser. The timer shall be field set by the Contractor with date and time during training. The

engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:

- 1) Enable or disable the routine.
  - 2) Enable or disable transfer of the load during routine.
  - 3) Set the start time of day, day of week, week of month, alternate or every time start, duration of run.
  - 4) At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.
7. The controller shall commit to start engine which requires the engine to reach proper output and run at least the duration of the cooldown setting, regardless of whether the load is transferred.
  8. Provide interface relays or main switch follower contacts to comply with I/O interface requirements as defined in the P&ID diagram. Interfacing relays shall be industrial grade plug-in type with dust covers. Interface connections shall be wired to backpan terminal blocks. At minimum, the switch shall have the following unused I/O contacts available:
    - a. Switch in Normal – SPDT rated 10 amps, 120 VAC
    - b. Switch in Emergency – SPDT rated 10 amps, 120 VAC
    - c. Engine starting contact -- DPDT gold-flashed contacts rated 10 amps, 32 VDC
    - d. Emergency Power available – SPDT rated 10 amps, 120 VAC
    - e. Normal Power available – SPDT rated 10 amps, 120 VAC
  9. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal.
  10. Provide separate LED signal lights with nameplates indicating the following:
    - a. Utility power is available (green)
    - b. Generator power is available (red)
    - c. ATS is connected to Utility source (green)
    - d. ATS is connected to the Generator source (red)
    - e. ATS in neutral position (wht)
  11. A three position momentary-type test switch shall be provided for the test / automatic / reset modes:
    - a. Test: simulate normal source failure
    - b. Automatic: normal operation
    - c. Reset: bypass the time delays on either transfer to emergency or retransfer to normal.
  12. All adjustments shall be field adjustable without the use of tools, meters, power supplies, or special test equipment and can be made safely without personal exposure to live parts
  13. Each adjustment resolution shall be settable within minimum increments of 1%.

14. Repetitive accuracy of timer, voltage and frequency settings over a temperature range of  $-20^{\circ}\text{C}$  to  $70^{\circ}\text{C}$  shall be within  $\pm 2\%$ .
15. The control panel programming shall be lockable via password protection.
16. The wire harness for connection of the control panel to the transfer switch shall have sufficient length to reach between the mounting locations shown on the Contract drawings.
17. Provide the following displays on the controller:
  - a. Event log to display 99 logged events with the time and date of the event, event type and event reason.
  - b. Total number of ATS transfers.
  - c. Number of ATS transfers caused by power source failures.
  - d. Total number of days ATS has been in operation.
  - e. Total number of hours that the normal and emergency sources have been available.

## PART 3 EXECUTION

### 3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

### 3.02 FIELD ASSISTANCE

- A. Testing, checkout and start-up of the ATS equipment shall be performed under the technical direction of a factory trained authorized manufacturer representative.
  1. The setup and programming of the ATS shall be provided by a factory-trained representative who is authorized by the ATS manufacturer to perform the startup. This setup and programming shall be done prior to and during the first application of power.
  2. Provide testing as specified in Electrical Specifications [Factory and Field Testing].
- B. Provide 1 hour of “ATS Setup” Training on operating and maintenance procedures.

### 3.03 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

## SECTION 16430 - LOW VOLTAGE SWITCHBOARD

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. This section applies to specifies switchboards rated 600 volts and below.
- B. Provide Switchboard(s) (SWBD) as specified herein and shown on the Drawings.
  - 1. The System Integrator shall perform and be responsible for procurement, submittals, shop drawings, interconnection drawings, factory testing, and all control wiring for the SWBD. System Integrator is defined in Electrical Specifications [Electrical General].
- C. All wiring, wire color codes, wire labeling and terminal blocks within SWBD shall be as specified in Electrical Specifications [Low Voltage Wire & Data Cable].
- D. The SWBD scope of work includes:
  - 1. Providing SWBD structure and all internal components.
  - 2. Installation of the SWBD on concrete pad per details.
  - 3. Submittal data and drawings.
  - 4. Startup and configuration of SWBD internal components.
  - 5. Factory and field testing.
  - 6. Operation and maintenance manuals.
  - 7. Warranty of all components.
  - 8. Seismic Anchorage Design Calculations and conforming installation.
  - 9. Conduit – support systems, wire, and grounding system, for equipment interconnection, and operation.
  - 10. System calibration, testing and documentation.
- E. Electrical Specifications [Factory and Field Testing]. Furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to perform factory and/or field testing.
- F. All electrical equipment and materials, and methods - including installation, calibration, and testing - shall conform to the applicable codes and standards listed in this and other Sections. All electrical materials and work shall conform to published standards of the National Electric Code (NEC), Institute of Electrical and Electronic Engineers (IEEE), and Underwriters Laboratories Inc (UL).

#### 1.02 REFERENCES

- A. Electrical Specifications [Electrical General]

- B. Electrical Specifications [Low Voltage Wire & Data Cable]
- C. Electrical Specifications [Automatic Transfer Switch]
- D. Electrical Specifications [Panelboard and Power Transformer]
- E. Electrical Specifications [Factory and Field Testing]

#### 1.03 SUBMITTALS REQUIREMENTS

- A. Provide Submittals as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Include a record of each configurable parameter available to be changed by the user for internal components. The list shall include factory defaults and space for entered values for each configurable component.

#### 1.04 OPERATION AND MAINTENANCE INFORMATION

- A. Provide operation and maintenance instructions as specified in Electrical Specifications [Electrical General].

### PART 2 PRODUCTS

#### 2.01 SWITCHBOARD

- A. General:
  - 1. The Switchboard shall be Cutler Hammer, Square D or approved equal.
  - 2. The Switchboard (SWBD) shall be built and tested in accordance with:
    - a. NEMA Standards
    - b. ANSI
    - c. Underwriters Laboratories, Inc.
  - 3. Switchboard enclosure shall be NEMA rated as shown in the drawings.
- B. Metering Switchboard:
  - 1. Provide metal enclosed, front accessible, self contained utility metering panel. Voltage, phase, AIC and continuous amperage rating shall be as shown on Contract Drawings. Panel will include meter socket, factory installed main breaker(s) and test by-pass facility.
  - 2. Design utility entrance and termination and other features per NEC, local codes, and serving Utility requirements.
  - 3. Enclosure shall be NEMA 3R construction for underground utility service. Enclosure shall be manufactured from galvanized 16 ga. (min) sheet steel. The enclosure shall be finished with ANSI 61 gray enamel paint. Provide pad mount, surface mount or flush mount cabinet per installation detail.

4. Utility metering switchboard shall be Cutler Hammer Pow-R-Line or equal.

C. Switchboard:

1. Switchboard shall be front accessible with group mounted, buss connected circuit protective devices. Where provisions for future circuit protective devices are required, space for the device, corresponding vertical buss, device connectors and the necessary mounting hardware shall be supplied.
2. Distribution section shall meet all requirements per NEC, local codes, and as defined in the drawings.
3. Buss shall be copper. Aluminum buss is not equal to copper buss. Furnish buss mounted cable lugs sized for cabling that is required to be directly buss connected.
4. Buss shall, 3 phase, 4 wire, 480 volt, 65,000 AIC minimum symmetrical (or as shown otherwise in the drawings).
5. Power buss:
  - a. Continuous amperage rating at least equal to the main circuit breaker or the power source and shall be braced to withstand stresses resulting from the maximum short-circuit current available.
  - b. Horizontal bus shall extend through all sections of the switchgear unless shown otherwise in the drawings with vertical connections to circuit breakers in each section.
  - c. Buss shall be mounted on heavy-duty insulated glass polyester supports, and main bus joints shall be bolted using a minimum of two bolts.
  - d. Shipping splits and provisions for future bus extensions shall have tin-plated bolted connections.
6. Neutral bus, when specified or required, shall have the same capacity as the main bus.
7. Ground buss shall be rated per NEC relative to the power buss amperage rating and shall extend the entire length of the switchboard.

## 2.02 MOLDED CASE CIRCUIT BREAKERS

A. General

1. Circuit breakers and motor circuit protectors shall be manufactured by Eaton Cutler-Hammer, Square D, G.E., Siemens, or equal.
2. Circuit breakers shall be the bolt-on type.
3. Multiple pole circuit breakers shall be designed so that an overload on one pole automatically causes all poles to open. The use of tandem or dual circuit breakers in a normal single pole space to provide the number of poles or spaces specified are not acceptable.
4. Molded case circuit breakers shall be operated by a single toggle-type handle and shall have a quick-make, quick-break switching mechanism. An automatic trip of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and have flash reduction arc chutes. A push-

to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

5. Minimum interrupting capacity:
  - a. 480 volt circuit breaker shall have a minimum interrupting capacity of 42,000 amperes.
  - b. 120 or 208 or 240 volt breaker shall have a minimum interrupting capacity of 22,000 amperes
6. Circuit breakers shall be UL listed for series application.
7. Where indicated circuit breakers shall be current limiting.
8. Where indicated on Drawings, provide UL listed circuit breakers for continuous duty at 100% of their ampere rating in the intended enclosure.
9. Furnish add-on features such as auxiliary position status contacts, trip indication contacts, zone interlocking, shunt trip coils, etc, as shown in the drawings.

**B. Trip Unit – Molded Case Circuit Breakers**

1. Circuit Breakers over 400 volt and over 90A trip units as defined herein. All other circuit breakers shall have shall have non-electronic thermal-magnetic (TM) trip units with inverse time-current characteristics.
2. The trip unit shall be Eaton type Power Expert Release (PXR) or equal.
  - a. Each circuit breaker trip unit shall have three (3) current sensors, voltage sensors, microprocessor, and flux transfer trip solenoid at minimum.
  - b. Trip units shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.
  - c. Trip units shall be powered from the primary voltage connected to the circuit breaker. Current flow shall not be required for settings functions. Circuit breaker trip units shall be operable and adjustable with zero current flowing through the circuit breaker.
  - d. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current and voltage sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached.
  - e. Trip units shall be provided with a display panel. Trip units shall have an information system that provides LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip
  - f. Programming may be done via a keypad at the faceplate of the unit. Programming via the communication network if or as shown in drawings.
  - g. The trip unit shall offer a three-event trip log that will store the trip data, and shall time and date stamp the event.
  - h. The trip unit shall have the following advanced protective features integral to the trip unit:

- 1) Adjustable undervoltage release (defeatable)
  - 2) Adjustable overvoltage release (defeatable)
  - 3) Reverse power and fault current
  - 4) Reverse sequence voltage
  - 5) Under-frequency
  - 6) Over-frequency
  - 7) Voltage phase unbalance and phase loss during current detection.
- i. Although not preferred but if needed, furnish 24VDC redundant power supply with terminal blocks and 0.5A miniature circuit breakers to distribute control power to each circuit breaker trip unit that requires it for settings. The power supply shall be connected below the main breaker and transfer switch but above any feeder circuit breakers. Provide option for external power supply input.
3. System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:
    - a. Adjustable long-time setting (set by adjusting the trip setting dial to an amount not to exceed rating plug)
    - b. Adjustable short-time setting and delay with selective flat or I<sup>2</sup>t curve shaping,
    - c. Adjustable instantaneous setting
    - d. Adjustable ground fault setting and delay with selective flat or I<sup>2</sup>t curve shaping.
  4. The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.
  5. Furnish internal ground fault protection with adjustable settings. Provide neutral ground fault sensor for four-wire loads. Bypass neutral sensor for 3 wire loads.
  6. Include ARMS technology for all circuit breakers 400A and above or where shown on drawings.
    - a. Activation and deactivation of the ARMS technology and local indication shall be accessible from the face of the trip unit without opening the circuit breaker door or cover and exposing operators to energized parts.
    - b. Recalibration or adjustment of trip unit parameters shall not be required when enabling / disabling the ARMS technology.
  7. Breakers shall have built-in test points for testing the long-time delay, instantaneous, and ground fault functions of the breaker by means of a test set.
- C. Manual operators
1. Furnish door interlocked manual operators for mains and selected feeder circuit breakers as shown in the drawings.
  2. Manually operated mechanisms designed to open, close and reset circuit breakers.

3. Operators shall be available in three basic configurations— flange mounted, through-the door rotating and direct handle through door to provide a variety of options for different applications and enclosure ratings.

## 2.03 ACCESSORIES

### A. Space Heaters:

1. Outdoor rated switchgear shall be provided with 120 volts AC thermostatically controlled space heaters. Heater wiring shall be to terminal blocks for connection to external power source. One heater shall be provided in each vertical breaker section. Heaters shall have guards to prevent accidental contact with power or control wiring.

### B. Key Interlocks:

1. Key interlocks shall be provided as shown on the drawings. The switchgear manufacturer shall be responsible for coordinating interlocks for switchgear main circuit breakers interlocked with generator circuit breakers. Key interlocks shall be as manufactured by Kirk Key Interlock Company, or equal.

### C. Surge Protective Device (SPD)

1. SPD shall be suitable Service entrance location per ANSI/IEEE C62.41, IEEE C62.45, and UL1449 3rd edition and tested according to IEEE C62.44 as Secondary Surge Arrestor.
2. Unit shall be sealed and not allow vapors from entering the switchboard enclosure after a voltage surge event.
3. Modes of protection – Line to Line, Line to Ground, Line to Neutral (as applicable). Voltage, phase and neutral connections per one-line diagram. Current surge capacity shall be 300,000 amps per mode minimum
4. The SPD shall be factory installed inside the switchboard during assembly by the original equipment manufacturer. The OEM design shall be integral to the design of the switchgear with special paneling and cutouts specifically designed for unit mounting.
5. The SPD connections shall be located as close as possible to the load side of main disconnect device and ground/neutral bar.
6. The SPD shall have integral 30-amp disconnect and fuses. Service of the SPD assembly, fuses or other serviceable components shall be from front access of the switchboard and shall not require disassembly of switchboard panels to repair or replace parts.
7. SPD shall be Cutler-Hammer Clipper, Current Technology TransGuard or equal.

### D. Power Monitor:

1. General:
  - a. Microprocessor based multifunction power and energy meter

- b. Designed for multifunction electrical power, voltage, and current measurement on 3 phase power systems.
  - c. Measured parameters: voltage, current, frequency, unbalance, kW, KVAR, KVA, power factor, kWh.
  - d. Support for 3-Element Wye, 2.5 Element Wye, 2 Element Delta, 4 wire Delta systems.
  - e. 200 ms update for power measurement, 100ms update for voltage, current, Hz.
  - f. Din rail mounting
  - g. 85 to 264 VAC control power, 5W.
  - h. Furnish compatible current transformers with ratio as shown in the drawings or as needed to measure full feeding circuit breaker rated current.
2. Voltage Inputs
- a. Configurable to potential transformer ratio.
  - b. Input impedance of 1 Mega Ohm, 0.014W at 120 Volts.
  - c. Direct voltage input range
    - 1) 347 Volts Line to Neutral
    - 2) 600 Volts Line to Line.
  - d. 2500V withstand.
3. Current Inputs:
- a. Configurable to current transformer (CT) ratio 1A or 5A input.
  - b. Burden 0.05VA, Impedance 0.002 ohms
  - c. Meter shall have a maximum burden of 0.005VA per phase, at the maximum of 15 Amperes continuous input.
  - d. Fault current withstand shall be 200 Amps for 1/2 second.
4. Digital I/O:
- a. Two status inputs 24VDC, dry contact.
  - b. One KYZ output, 24VDC, 30mA
5. Accuracy
- a. Revenue meter accuracy
  - b. +/- 1% or better for volts and amps
  - c. +/- 1% for power and energy functions.
  - d. True RMS measurements
6. Communications
- a. Ethernet - 100BaseT Ethernet IP Allen Bradley protocol
  - b. Modbus TCP
7. Acceptable Products
- a. Allen Bradley PM1000 1408-EM3A-ENT Ethernet
  - b. Or Equal
- E. CT Shorting Terminal Block
- 1. Panel mount inside control equipment with front screw terminal connections. Inserting a thumb screw shall short terminals to a top mounted ground bar.

Provide quantity of terminal poles as required for function and as shown in Drawings. Furnish Flex Core 170xSC or equal.

F. Current Transformers

1. Furnish mounted (preferable) or unmounted current transformers based on space allocated and installation requirements. The current transformer shall have wire leads or binding posts and ratio as shown on the drawings. The accuracy shall be metering accuracy class 0.6 at a minimum burden at 60 hz shall be 2.5 VA and as required to meet specified accuracy of device(s) fed.

PART 3 EXECUTION

3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship] and as specified herein.

3.02 INSTALLATION

- A. Vertical sections shall be mounted on steel channel sills continuous on two sides. The steel channel sills shall be heavy duty to meet the specific seismic requirements of this project location. These sills shall be mounted on the concrete pad to be installed per the Contract Drawings.
- B. Conduit entering Switchboard shall be stubbed up 1" into the bottom horizontal wireway (typically) directly below the vertical section in which the conductors are to be terminated.
- C. Base of Switchboard shall be adequately grouted, caulked or sealed to prevent the entry of insects and rodents.

3.03 FIELD ASSISTANCE

- A. Provide field testing as specified in Electrical Specifications [Electrical General, Testing].

3.04 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

## SECTION 16450 - GROUNDING

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. Labor, materials, equipment, tools, safety gear, test equipment, incidentals, services, and transportation for a complete electro-mechanical installation as shown on the Drawings, included in these Specifications, or as can be reasonably implied from project descriptions.
- B. The scope of work includes:
  - 1. Furnish and install grounding system required by Drawings, or if not shown or defined, as required by Article 250 of the NEC. Ground conductors shall be sized for the protective device, minimum.
  - 2. Furnish and install conduits, junction boxes, underground boxes, and associated hardware. Provide hardware, conduit, fittings, and other parts for a complete grounding installation.
  - 3. Installations shall be designed and installed with components meeting the NEMA area designation.
- C. Work includes that specified in Electrical Specifications [Electrical General].

#### 1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Low Voltage Wire & Data Cable]
- C. Project Drawings

#### 1.03 QUALIFICATIONS

- A. Material furnished under this specification shall be installed by qualified installers meeting requirements specified in Electrical Specifications [Electrical General, Qualifications].

#### 1.04 SUBMITTAL REQUIREMENTS

- A. Provide submittals and Drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Submit manufacturer's product information for connections, clamps, rods, terminals, and grounding system components.

## PART 2 PRODUCTS

### 2.01 GROUNDING SYSTEM

#### A. General

1. Grounding conductors shall be sized as shown on the Drawings or in accordance with NEC article 250, whichever is larger.
2. Components of the grounding electrode system shall be manufactured in accordance with UL 467 - Standard for Safety Grounding and Bonding Equipment.

#### B. Grounding System

1. The utility service ground shall be tied to a building ground grid consisting of a "UFER" and/or ground rod type grounding system.
2. Electrical Contractor shall design layout of ground system if one is not shown on drawings per requirements herein.
3. The UFER shall consist of minimum 25 feet minimum of code sized bare copper wire conductor laid at 3 foot minimum depth encased with ground enhancement material or as detailed on the Contract Drawings. UFER ground shall be located where soil moisture content will be maximized. Terminate UFER ground at ground rod in inspection box.
4. Ground enhancement material shall be permanent and be designed to lower earth resistance in all soil conditions. Once set, material shall have resistivity of not more than 20 ohm-cm resistance. Material shall be set by mixing it with water to form a slurry and shall not dissolve or decompose once cured. Ground enhancement material shall be Erico Ground Enhancement Material (GEM), Lyncole XIT, or equal.
5. Utility services 200A and below: Provide 1 ground rod connected to the service panel with #2 bare copper ground wire and as shown on the drawings.
6. Utility services- 400A: Provide 2 ground rods 8 feet apart, connected together, and to the UFER ground, and to the service panel with #2 bare copper ground wire. Connect ground system to switchboard ground bus in two places from ground rods.
7. Utility services - 600A to 800A: Provide 3 ground rods 8 feet apart, connected together, and to UFER ground, and to the service panel with #1/0 bare copper ground wire. Connect ground system to switchboard ground bus in two places from ground rods.
8. Utility services 1000A to 1600A: Provide 4 ground rods 12 feet apart minimum, connected together, and to UFER ground, and to the service panel with #4/0 bare copper ground wire. Connect ground system to switchboard ground bus in four places from ground rod inspection boxes.
9. Utility services 2000A: Provide 4 ground rods 12 feet apart minimum, rectangular pattern, connected together, and to the UFER ground, and to the service panel with #250 bare copper ground wire. Connect ground system to switchboard ground bus in four places from ground rod inspection boxes.

10. Utility services 3000A to 4000A: Provide 6 ground rods 16 feet apart minimum, rectangular pattern, connected together, and to the UFER ground, and to the service panel with #500 bare copper ground wire. Connect ground system to switchboard ground bus in four places from ground rod inspection boxes.
  11. The ground bonding wire(s) from the ground rod(s) shall extend through and appropriately sized conduit into the electrical panel. Connect the ground wire(s) to the ground bus with readily visible UL approved "ground clamp" attached to the ground bus.
  12. Install bare copper ground bond wires from the UFER ground to the various locations shown on the Drawings.
- C. Raceway Grounds
1. Metallic conduits shall be assembled to provide a continuous ground path. Metallic conduits shall be bonded using insulated grounding bushings.
  2. Provide separate code size wire ground conductor for PVC conduits
- D. Equipment and Enclosure Grounds
1. Electrical and distribution equipment shall be connected to the grounding system. Cables shall be sized as specified.
- E. Components
1. Ground rod shall be copper-clad steel, ¾" x 10 ft length. Rods shall have minimum copper thickness of 10-mils. Provide threaded, sectional type with coupling and driving stud so that extension rods of same diameter and length may be added where necessary to obtain necessary ground resistance improvements. Couplings and driving studs shall be by the same manufacturer as the rod. Rods shall be Joslyn; Thomas & Betts; or equal.
  2. Provide ground well enclosures for all outdoor ground rods. Furnish Christy type F8, Christy N9, or Christy B1017 (traffic areas), marked "GROUND" or equal unless otherwise shown on the Drawings.
  3. Ground rod clamps shall be bolt-on type as manufactured by O-Z Gedney type GRC, or equal.
  4. Every piece of equipment shall be grounded per NEC.
  5. Each electrical enclosure shall have a copper ground bus. Screw type fasteners shall be provided on all ground busses for connection of grounding conductors. Ground bus shall be a Challenger GB series, ILSCO CAN series or equal.

## PART 3 EXECUTION

### 3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in specified in Electrical Specifications [Electrical General, Workmanship].

### 3.02 INSTALLATION

#### A. Grounding System:

1. Install all products per Electrical Specifications [Electrical General, Installation].
2. Each nonmetallic conduit shall contain a code sized grounding conductor.
3. The system neutral conductor and all equipment and devices required to be grounded by the National Electrical Code shall be grounded in a manner that satisfies the requirements of the National Code.
4. The system neutral (grounded conductor) shall be connected to the system's grounding conductor at only a single point in the system. This connection shall be made by a removable bonding jumper sized in accordance with the applicable provisions of the National Electrical Code if the size is not shown on the Drawings. The grounding of the system neutral shall be in the enclosure that houses the service entrance main overcurrent protection.
5. Utilize mechanical connections in accessible locations and exothermic connections in non-accessible or buried locations.
6. The secondary on all transformers shall be grounded.
7. All raceway systems, supports, enclosures, panels, motor frames, and equipment housings shall be permanently and effectively grounded.
8. Install insulated grounding conductor with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards and distribution panels with 12ga. conductor to grounding bus
9. All receptacles shall have their grounding contact connected to a grounding conductor.
10. Branch circuit grounding conductors for receptacles or other electrical loads shall be arranged such that the removal of a lighting fixture, receptacle, or other load does not interrupt the ground continuity to any other part of the circuit.
11. Attachment of the grounding conductor to equipment or enclosures shall be by connectors specifically provided for grounding. Mounting, support, or bracing bolts shall not be used as an attachment point for ground conductors.
12. Install grounding electrode conductor and connect to reinforcing steel in foundation footing. Electrically bond building steel to ground system. Bond metal siding not attached to grounded structure.

### 3.03 FIELD QUALITY CONTROL

#### A. Inspections:

1. Ground system shall be inspected prior to cover.

#### B. Testing:

1. Complete applicable test forms if provided in testing specifications [Factory and Field Testing]. If form is not provided, furnish results on a vendor standard form.
2. Test each grounding connection to determine the ground resistance. The grounding test shall be IEEE 81.2 and NETA 7.13. The current reference rod shall be driven at least 100 feet from the ground rod or grid under test. The measurements shall be made at 10-foot intervals beginning 20 feet from the test electrode and ending 80 feet from it, in direct line between the ground rod or center of grid and the current reference electrode. Investigate ground resistance in excess of 1 ohm and revise or install new or additional ground electrodes as needed to reduce point to point resistance to less than 1 ohm.

END OF SECTION

## SECTION 16470 - PANELBOARD AND POWER TRANSFORMER

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. The Contractor shall supply panelboards and power transformers as specified herein and as shown in the Contract Drawings.
- B. The Contractor shall perform complete startup and testing services for the panelboard and power transformer per Electrical Specifications [Factory and Field Testing].
- C. Work includes that specified in Electrical Specifications [Electrical General].
- D. Reference drawings for panelboard and transformer location – electrical structures or stand-alone. If within electrical structures, the Contractor shall supply the electrical section with factory installed panelboard and transformer. If stand-alone, the Contractor shall install individual components with enclosures as specified herein.
  - 1. The quantity of breakers with size and number of poles as shown on panelboard schedules.
  - 2. Submittal data and drawings.
  - 3. Nameplates (denoting name/tag and as required by code)
  - 4. Startup assistance.
  - 5. Panelboard testing.
  - 6. Operation and maintenance manuals.
  - 7. Warranty of all components of the panelboard and power transformer.

#### 1.02 SUBMITTAL REQUIREMENTS

- A. Provide submittals and drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Provide ratings and characteristics including voltage, temperature rise, KVA, efficiency, materials of construction, NEMA enclosure rating, voltage taps, and impedance.
- C. Provide catalog cuts for circuit breakers and devices.
- D. Submit panelboard schedule for approval.

#### 1.03 OPERATION AND MAINTENANCE INFORMATION

- A. Provide operating instructions as specified in Electrical Specifications [Electrical General, Operating and Maintenance Instructions].

## PART 2 – PRODUCTS

### 2.01 PANELBOARDS

#### A. General

1. The Contractor shall furnish panelboards of a type indicated on the one-line Contract drawings and specified herein.
2. Furnish and install padlock lock-off attachment for each circuit breaker.
3. Panelboards shall comply with the applicable sections of UL, NEC, and NEMA and shall be Cutler Hammer Pow-R-Line, Square D, ITT or equal.
4. A machine-typed circuit directory with clear plastic cover shall be supplied mounted on the inside of door in a frame when equipment is shipped. Circuit directory shall be as approved in the Submittal.

#### B. Interiors

1. Interiors shall be completely factory assembled with bolt-on devices.
2. Main and feeder breakers shall include lockout padlock hasp suitable for frame size. Provide Cutler Hammer QLPB123PL, PLK1, or similar.
3. Full size insulated neutral bars shall be included. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
4. Main bus bars shall be plated copper sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 50 degrees C above an ambient 40 degrees C maximum.
5. A copper ground and neutral bus shall be included in all panelboards with terminal screws.

#### C. Boxes

1. Provide minimum gutter space in accordance with the National Electric Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.

#### D. Trims

1. Provide a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a catch, lock and trim.
2. Surfaces of the trim assembly shall be properly cleaned, primed and a finish coat of gray ANSI 61 or 49 or to Switchboards and MCCs.
3. Surface trims shall be same height and width as box for surface mount, and 3/4" (min) beyond box on all sides for flush mount.

#### E. Panelboard Ratings

1. Panelboards shall have voltage, phase and short circuit (AIC) ratings as shown on the drawings.
2. Breakers shall be a minimum of 100 ampere frame. Breakers 15 through 100 amperes trip size shall take up the same pole spacing.

3. Panelboards shall be labeled with a UL short circuit rating. When series ratings are applied with integral or remote upstream devices, a label shall be provided. Series ratings shall cover all trip ratings of installed frames. It shall state the conditions of the UL series ratings including:
  - a. Size and type of upstream device
  - b. Branch devices that can be used
  - c. UL series short circuit rating

## 2.02 POWER TRANSFORMER

- A. The power transformer shall be ventilated dry type. Voltage and KVA ratings shall be as shown on the Contract Drawings. The transformer shall be as manufactured by Cutler Hammer, Jefferson, ACME, Square D, G.E., or equal.
- B. Transformer shall meet latest DOE 2016 minimum efficiency standards.
- C. Coils shall be manufactured of electrical grade aluminum (if stand-alone) or copper (if within a MCC or Switchboard) and shall be adequately braced for short circuit ratings and defined in ANSI and NEMA standards.
- D. Transformers rated 31KVA and above shall have two 2½ percent taps above and below normal full capacity (ANFC and BNFC).
- E. The transformer shall carry full load continuously at rated voltage and frequency without exceeding the average temperature rise of 115°C above an ambient temperature of 40°C. Insulation shall be rated for 220°C (UL class 220°C).
- F. Impedance (Z): 4.0% +/- 0.3% or above to keep downstream fault currents to a minimum.
- G. Low noise. For transformers installed within electrical equipment, vibration isolators shall be installed between the transformer and its mounting surface to reduce case vibration and associated noise.
- H. For stand alone transformers, the transformer housing shall be securely fastened to the mounting surface with bolted connections sized appropriately to withstand seismic zone 4 forces.
- I. The transformer shall be finished with two coats of enamel to resist rust and corrosion.
- J. Transformers located inside electrical structures or enclosures shall be provided with adequate ventilation for heat removal as required.
- K. Transformer neutral shall be grounded in accordance with Article 250-26 and 450-10 of NEC and any applicable local ordinances. Installation and protection of the transformer grounding conductors and attachments shall be per NEC 250-24.

PART 3 – EXECUTION

3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].
- B. Perform work to remedy non-compliant installations after inspection.

3.02 INSTALLATION

- A. Provide installation as recommended by the manufacturer and as specified in Electrical Specifications [Electrical General, Installation].

3.03 FIELD ASSISTANCE

- A. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

3.04 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

## SECTION 16481 - VARIABLE FREQUENCY DRIVE

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. Provide each variable frequency drive as shown on elementary and one-line Drawings. Variable frequency drive shall be provided with full speed bypass, harmonic conditioner, line and/or load reactor, RFI filter and/or other accessories where shown on The Drawings. All VFDs shall be of the same manufacturer.
  - 1. The System Integrator shall perform and be responsible for procurement, submittals, shop drawings, testing, and all control wiring for the VFD. System Integrator is defined in Electrical Specifications [Electrical General].
- B. Provide enclosure (and side mounted wire chase as required) for top or bottom feed conduit connection as shown in the Drawings. Enclosure size shall not exceed the space allocated in the Drawings for such use.
- C. Provide cooling/ventilation system, mounting hardware, associated components, devices, and field control stations. Some components may be specified in other Electrical Specifications such as terminal blocks, wire, buttons, etc.
- D. Installation of the VFD with components as specified in Electrical Specifications [Electrical General]. The VFD scope of work includes:
  - 1. Providing and installing VFD(s) of rating shown on The Drawings.
  - 2. Submittal data and drawings.
  - 3. Startup assistance.
  - 4. Factory and field testing.
  - 5. Operation and maintenance manuals.
  - 6. Warranty of all components.
- E. Startup and configuration of VFD with actual motor load.
- F. Electrical Specifications [Factory and Field Testing]. Furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to perform factory and/or field testing.

#### 1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Low Voltage Wire & Data Cable]
- C. Electrical Specifications [Factory and Field Testing]

### 1.03 SUBMITTALS REQUIREMENTS

- A. Provide Submittals as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Include a record of each VFD parameter available to be changed by the user. The list shall include factory defaults and space for entered values.

### 1.04 OPERATING AND MAINTENANCE INFORMATION

- A. Provide operation and maintenance instructions as specified in Electrical Specifications [Electrical General].
- B. Include a record of each VFD parameter setup during startup and testing and place a copy of setting in each O & M manual.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. 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 and 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. All components and devices installed shall be industrial grade and shall be of sturdy and durable construction suitable for long, trouble-free service. Light duty, fragile, and competitive grade devices of questionable durability shall not be used.
- B. The VFD is inclusive of the input stage, buss, output stage, input filters, output filters, and all other assemblies, boards, or conditioning equipment, that make up the entire VFD system. The VFD system is herein referred to simply as “VFD” and is not to be parsed in any way to meet a specification as a specific part or assembly where it cannot be met as a system.
- C. 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 Owner and/or Engineer prior to installation.
- D. Underwriter’s Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment.

## 2.02 QUALITY

- A. 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.
- B. 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 and 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. 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 questionable durability shall not be used.
- C. 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 Owner and/or Engineer prior to installation.
- D. Underwriter's Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment.

## 2.03 VARIABLE FREQUENCY DRIVE

- A. This specification is based on Ultra Low Harmonic drives, Allen Bradey 755T, ABB ACS-880-31 or -34, or equal.
- B. The VFD shall be of the latest technology used to control and maintain a process variable (level, flow, pressure, speed, etc.) by varying the motor speed. The VFD shall be available from a single manufacturer in the horsepower range of 1 to 500 HP.
- C. Performance Requirements
  - 1. Harmonic Attenuation (applies to Ultra Low Harmonic (ULH) as shown in Drawings)
    - a. The VFD shall have an active filter line supply unit which controls the low order harmonic current to reduce the harmonic current impressed on the incoming power feeder.
    - b. The input current to the VFD shall limit the total harmonic content to less than 5% of the VFD's rated input on any power system and under all operating conditions.
    - c. The VFD shall comply with IEEE 519 requirements.
  - 2. Open loop static speed regulation shall be 0.5 % to 1% of rated motor speed. When motor speed feedback is provided from a suitable encoder, closed loop speed regulation shall be 0.1% of motor nominal speed. Dynamic speed

accuracy shall be less than 1%-sec with 100% torque step open loop and 0.5%-sec closed loop with 100% torque step. 2. Torque control response time shall be less than 10 ms with nominal torque. In the torque regulating mode, torque regulating accuracy open loop shall be +/- 5%; torque regulating accuracy closed loop shall be +/- 2%;

D. Ratings

1. The VFD shall employ a full wave rectifier to prevent input line notching and operate at a fundamental (displacement) input power factor of 0.98 at all speeds and nominal load.
2. The VFD efficiency shall be 97.5% or better at full speed and load. Efficiency is defined as the output power divided by the input power in terms of percentage. All internal system losses recognized.
3. Load The VFD shall be designed to continuously operate the following motor/pump load:
  - a. Motor NEMA design B, squirrel-cage induction or specialty specific use motor per Mechanical Division Specification as shown in Drawings.
  - b. Horsepower at full speed R.P.M. of submitted/approved motor.
  - c. Voltage, 230/460 VAC, three phase, 60 Hz.
  - d. Service factor, 1.15 S.F.
4. Input Power The VFD shall be rated to continuously operate under the following input power conditions:
  - a. The Drive shall be rated to operate from 3-phase power at nominal voltage (208VAC to 600VAC, +10% /-15% as shown in Drawings), 48Hz to 63Hz.
  - b. The overvoltage trip level shall be a minimum of 30% over nominal, and the undervoltage trip level shall be a minimum 35% under the nominal voltage.
  - c. Three phase, phase rotation insensitive.
  - d. Displacement power factor, 0.95 lagging at all loads and speeds above 10% rated load.
5. Output Power The VFD shall be rated to continuously operate while providing the following output power conditions:
  - a. Voltage, 0 to 500 VAC.
  - b. Frequency, 3 to 60 Hz.
  - c. Continuous motor horsepower.
  - d. VFD amp output (minimum).
  - e. Continuous current - as shown in Drawings or 115% of rated motor nameplate amps, whichever is higher.
  - f. Short term normal current, 110% of continuous rated current for a minimum duration of 1 minute per every 10 minutes running.
  - g. Short term heavy duty overload current, 150% of continuous rated current for a minimum duration of 1 minute per every 10 minutes running.
  - h. Waveform - sine coded PWM.

- i. The drive's switching pattern shall be continually adjusted to provide optimum motor flux and avoid the high-pitched audible noise.
    - j. Diodes and transistors shall have a minimum withstand of 1,200 peak inverse voltage (PIV).
  - 6. Environmental The VFD shall be rated to continuously operate under the following environmental conditions:
    - a. Ambient temperature, 5°F to 122°F (-15°C to 50°C).
    - b. Altitude, no derating below 3,300 ft.
    - c. Relative humidity, 95% non condensing.
    - d. The drive shall be protected from atmospheric contamination by chemical gasses and solid particles per IEC 60721-3-3, chemical gasses Class 3C2 and solid particles Class 3S2.
    - e. The drive shall be protected from vibration per IEC 60721-3-3 Class 3M4 (sinusoidal displacement 3.0 mm, 2Hz to 9Hz; acceleration 10m/s<sup>2</sup>, 9Hz to 200Hz).
- E. Protection The VFD shall be provided with the following protection:
  - 1. For each programmed warning and fault protection function, the Drive shall display a message in complete English words or Standard English abbreviations. The three (3) most recent fault messages along with time, current, speed, voltage, frequency and DI Status shall be stored in the Drive's fault history. The last ten (10) fault names shall be stored in Drive memory.
  - 2. The Drive shall include internal MOV's for phase to phase and phase to ground line voltage transient protection.
  - 3. Output short circuit withstand rating and ground fault protection rated for 100,000 AIC shall be provided per UL508C without relying on line fuses. Motor phase loss protection shall be provided.
  - 4. The Drive shall provide electronic motor overload protection qualified per UL508C.
  - 5. Protection shall be provided for AC line or DC bus overvoltage at 130% of max. rated or undervoltage at 65% of min. rated and input phase loss.
  - 6. A power loss ride through feature will allow the Drive to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.
  - 7. Stall protection shall be programmable to provide a warning or stop the Drive after the motor has operated above a programmed torque level for a programmed time limit.
  - 8. Underload protection shall be programmable to provide a warning or stop the Drive after the motor has operated below a selected underload curve for a programmed time limit.
  - 9. Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over-temperature trip level.
  - 10. The VFD shall constantly monitor the load current with an electronic thermal overload relay and trip the drive on motor overload. The electronic overload relay shall be adjustable and compensate for the reduced cooling of the motor at

reduced speeds. This protection provides an orderly shutdown should the motor's thermal capabilities be exceeded and eliminates the requirement for conventional motor overload relays.

- F. Digital programmer/controller –The VFD shall be equipped with a front mounted operator control panel (keypad) consisting of a backlit, alphanumeric, graphic display and a keypad with keys for Start/Stop, Local/Remote, Up/Down and Help. Two (2) Softkeys will be provided which change functionality depending upon the position within the parameter hierarchy or state of panel.
1. All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.
  2. The Display shall have contrast adjustment provisions to optimize viewing at any angle.
  3. The control panel shall provide a real time clock for time stamping events and fault conditions.
  4. The control panel shall include a feature for uploading parameter settings to control panel memory and downloading from the control panel to the same Drive or to another Drive.
  5. All Drives throughout the entire power range shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating.
  6. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus.
  7. The keypad shall be removable and insertable under Drive power, capable of remote mounting, and shall have its own non-volatile memory.
  8. Digital Programmer/Controller (HIM) shall be capable of remote door mounting. Cable for remote digital programmer/controller shall be supplied as shown in the Drawings. The HIM shall be mounted and housed to maintain the NEMA 12 door rating.
  9. The standard operator panel shall provide a start-up, maintenance and diagnostic assistants that guides a new user through initial start-up and commissioning of the Drive as well as provide indications for maintenance and help to diagnose a fault. In addition, a PID assistant, Real-time Clock assistant, Serial Communications assistant, and Drive Optimizer assistant shall be included. A Drive Optimizer assistant permits the user to choose Drive set-up for low noise, drive & motor efficiency or motor control accuracy.
  10. The door mounted human interface module (HIM) display shall be capable to view and adjust the following diagnostic and status indicators:
    - a. VFD Speed % or Frequency
    - b. Instantaneous overcurrent.
    - c. Ground fault.
    - d. Overtemperature.
    - e. Overvoltage.
    - f. Undervoltage.

- g. Overload.
  - h. Overfrequency.
  - i. Amps.
  - j. Voltage.
  - k. Temperature.
  - l. Auxiliary Fault.
  - m. Phase loss.
  - n. Current limit.
  - o. Power and kilowatt hours
  - p. Power up delay.
  - q. Status of discrete inputs and outputs.
  - r. Values of analog input and output signals
  - s. Values of PID controller reference, feedback and error signals.
11. Adjustments The following setting ranges shall be provided and made independently accessible for operator adjustment:
  12. Speed/Torque control functions shall include:
    - a. Minimum speed/torque limits.
    - b. Maximum speed/torque limits.
    - c. Selection of up to seven (7) preset speed settings or external speed control
    - d. Two (2) independent built-in PID controllers to control a process variable such as pressure, flow or fluid level.
    - e. Two (2) analog inputs shall be programmable to form a reference by addition, subtraction, multiplication, minimum selection or maximum selection.
  13. Output control functions shall include:
    - a. Current and torque limit adjustments to limit the maximum Drive output current and the maximum torque produced by the motor. These limits shall govern the inner loop torque regulator to provide tight conformance with the limits with minimum overshoot.
    - b. A torque regulated operating mode with adjustable torque ramp up/down and speed/torque limits.

- G. Input and Output Terminations The VFD shall have terminals for input and output cabling as defined in the Conduit and Wire Schedule as shown on the Contract Electrical Drawings.
1. Provide power terminal blocks for motor lead connections where drive terminals are hard to reach or require drive cabinet disassembly to connect.
  2. Five (5) digital inputs, all independently programmable with at least twenty-five (25) input function selections. Inputs shall be designed for 120 volts AC input or as otherwise shown in the Drawings. Input functions must include time delay start and hand and auto (Ethernet) control.
  3. Two (2) form C relay contact digital outputs, all independently programmable with at least thirty (30) output function selections. Relay contacts shall be rated to switch a maximum two (2) Amps rms continuous current at a maximum

switching voltage of 30VDC or 250VAC. Function selections shall include indications that the drive is ready (no faults and in remote), running, and are addressable from Ethernet as users choice.

4. Two (2) analog inputs, each selectable for 0VAC - 10VAC or 4mA - 20mA, and independently programmable with at least ten (10) input function selections. Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion. If the input reference (4-20mA or 0-10V) is lost, the VFD shall give the user the option of the following: (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The Drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus.
5. Two (2) analog outputs providing 0 (4) to 20mA signals. Outputs shall be independently programmable to provide signals proportional to at least twelve (12) output function selections including output speed, frequency, voltage, current and power.
6. Provide I/O input and relay output expansion card(s) as needed to accommodate the I/O wiring as shown in the Drawings. The option card shall be integrally mounted to the drive.

H. Communications – The VFD shall include communications module for interface to the PLC. All settable parameters and instantaneous operational registers shall be accessible from the communications port.

1. Type
  - a. Ethernet TCP/IP (Allen Bradley Ethernet/IP)
2. Add-On Instructions
  - a. The VFD manufacturer must have an add-on instruction that is compatible with the PLC on this project. The add-on instruction provides a preconfigured message command to send and receive information from the drive. The add-on instruction must be a free download available from the manufacturer website at the time of bid and thereafter.
3. Command and Metering registers to include:
  - a. Digital input reads (giving status of inputs)
  - b. Digital output commands (to relay DOs)
  - c. 3 phase voltage and current
  - d. Power in KW, KWH and Power factor
  - e. Elapsed motor run time
  - f. Start/Stop
  - g. Running
  - h. Fault conditions
  - i. Heat Sink Temperature
  - j. Others as available.

- I. Features The VFD shall have the following features:
1. Connection of the three incoming line leads and three-motor leads shall be the only connections necessary for manual operation of the VFD unit. All other wiring shall be prewired at the factory and self contained within the VFD unit. A 120 VAC control power transformer and other auxiliary power supplies shall be provided with the VFD for power to pilot lights, meters, relays, and miscellaneous devices specified to be supplied with the VFD. Lugs shall be provided for connection of all power leads; terminal blocks shall be provided for all other wiring. Relay logic, wiring and enclosure layout shall be equivalent to that shown on the Drawings.
  2. The VFD shall be protected by a circuit breaker disconnect unless otherwise shown in the Drawings. The disconnect shall be externally operated and shall have an operator mechanism that is an integral part of the enclosure. An operator mechanism shall be provided to allow padlocking the disconnect in the "off" position with up to two padlocks.
  3. AC input fuses shall be provided on the line and/or load side of the VFD (if required by the manufacturer) to isolate the VFD power circuitry upon a fault condition.
  4. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
  5. Transient and surge voltage power line input protection shall be provided for the VFD through use of metal oxide varistors (MOVs), surge protective module, or other approved equal methods. Transient protection integral to the VFD shall be provided to a minimum of 10,000 volts, 50 joules without failure. The transient protection shall meet or exceed ANSI C7, 90 1971 and IEEE 472 1974 Standards without failure. Failure is defined as loss of components in the VFD including power semiconductors and fuses. The VFD shall be protected from the following, as a minimum, power line transients and recover to automatically restart and resume normal operation without posting a fault:
    - a. Switching the primary of a power transformer.
    - b. Switching power factor correction capacitors "ON" and "OFF" line.
    - c. De energization or energization of contactors, relays, and other power equipment from the power line.
    - d. Starting and stopping of other motors when powered from Utility.
  6. The VFD shall not be affected by or generate excessive electro magnetic interference (EMI). The VFD shall be provided with a radio interference filter (RIF) to meet the following requirements:
    - a. The use of a 4 Watt hand held VHF/UHF transceiver within three feet of the VFD with its doors closed shall not cause erratic operation, loss of configuration, or any other deviation from normal operation.
    - b. The worst case conducted and radiated EMI generated by the VFD shall not be enough to prevent the use of hand held VHF UHF transceivers within three feet of the VFD with its doors closed.

7. Opening of the VFDs input switches, circuit breakers, or output contactors while the VFD is operating under load shall not result in damage to the VFD power or control circuit components.
  8. The VFD shall be capable of starting and operating without a motor load connected.
  9. Phase loss protection shall be provided to prevent single phasing of the motor load.
  10. The VFD shall have an instantaneous electronic trip circuit to protect the VFD from output line-to-line and line-to-ground short circuits. Output line-to-line and line-to-ground short circuits shall not damage the VFD.
  11. Automatic fault reset to automatically restart the drive after any type of fault condition. This automatic restart shall repeat up to three attempts. This automatic reset shall be provided to prevent a drive fault from completely locking out on isolated nuisance fluctuations. When the drive is locked out after its automatic reset attempts the operator shall be able to reset the VFD by a local or remote manual reset pushbutton. Fault lockout shall be indicated on the door mounted drive fail pilot light.
  12. The VFD shall be capable of continued operation during an intermittent loss of incoming line power up to five cycles.
  13. The VFD shall automatically restart upon reapplication of power after a loss of line power. Momentary or sustained power failures shall not fault trip out the VFD or blow any fuses.
  14. Any configuration of adjustments or controls not set by a switch or potentiometer shall be stored in nonvolatile memory. No configuration information shall be lost due to power failures of any duration.
  15. The VFD shall be capable of starting into a rotating motor without tripping out on a fault.
  16. The drive shall have an adjustable voltage boost control capable of providing additional starting torque to the motor at start. This control shall provide the additional voltage only at the frequency range required to start the motor thus reducing the additional motor heating excess voltage would cause at normal operating speeds.
  17. The drive shall be equipped with critical frequency jump circuitry which allows the VFD to be setup to skip two bands of frequencies which cause excessive vibration or noise.
- J. Enclosure The enclosure type shall be as shown in the Drawings - freestanding, wall mount, motor control center full section, or MCC cubicle mount construction. All components shall be accessible from the front of the enclosure. Rear or side access shall not be required in order to remove or service any component. The enclosure shall include the following in its construction:
1. The VFD shall incorporate thermostat/run controlled fans for cooling. The air flow through the VFD compartment shall provide proper cooling of the operating VFD at an (external cabinet) ambient temperature of 104°F. Fan

- mounting shall include reusable air filters on suction. Provide fans for suction and discharge vents as required maintaining air flow and forcing circulation.
2. Provide specific use fans located within the enclosure to cool, directly, specific components such as line filters or DV/DT filters.
  3. Thermostat shall have bi-metallic adjustable set point range of 30° to 140°F. Thermostat shall have a switching capacity of 10A at 120 VAC. Provide Hoffman A-TEMNO temperature switch or approved equal to operate fans. Thermostat shall operate fans in parallel with motor running output of VFD.
  4. The VFD, including the enclosure and input protection, shall be UL listed for a minimum of 42,000 RMS symmetrical ampere fault withstand capability. VFDs consisting of the VFD, enclosure, and all accessories, that are not UL listed will not be approved.

#### 2.04 SINGLE TURN POTENTIOMETER

- A. Provide manual single turn potentiometer. Potentiometer shall be compatible with the VFD input for manual speed control. Potentiometers shall be Allen-Bradley 800H, Cutler Hammer or equal.

#### 2.05 dV/dT Output Filter

- A. Provide output load filter that is designed for use with AC adjustable frequency drives. The filter shall be rated for application at a maximum fundamental system frequency of 60Hz at nominal system voltages up to 600V. The filter shall operate at a maximum carrier frequency of 8kHz at 40% of fundamental voltage. The ambient temperature of operation shall be 0°C to 40°C. Output filter application shall be effective for motor lead distances between the drive and the motor that range from 50 feet to 3,000 feet.
- B. The three phase filter shall be designed for harmonic filtering service and for slowing the rate of rapid current and voltage changes. The RLC dampened, low pass filter consists of three phase, iron core inductor; AC-rated polypropylene capacitors; and wire-wound resistors. Filter shall be sized to VFD maximum amperage or as shown in the Drawings. The design maximum temperature rise for output filter shall be 115°C at rated current. Inductance shall remain above 50% of nominal for any overload up to 200% of rated current. Filter shall not sustain any thermal damage for levels up to 150% of rated current for a minimum period of five minutes.
- C. A NEMA rated enclosure shall be provided if the device is shown remote to the VFD panel or if insufficient space is allocated within the VFD panel/section. Enclosure shall be constructed from 14 gauge steel with enamel finish. Enclosure openings shall be provided to allow for air flow convection cooling.
- D. The output filter shall be coordinated and compatible with the VFD being submitted. The output filter shall not cause operational problems for the VFD, motor, cables, or other components within the VFD or adjacent systems.

- E. The output filter shall be Trans-coil, Inc. “KLC” series, MTE Corporation “RL” series or equal.

## PART 3 EXECUTION

### 3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].
- B. Requirements of Related Electrical Sections apply to design, documentation construction and assembly of Variable Frequency Drives.
- C. Perform work to remedy non-compliant installations after inspection.

### 3.02 FIELD ASSISTANCE

- A. Testing, checkout and start-up of the variable frequency drive equipment shall be performed under the technical direction of a factory trained authorized manufacturer representative.
  - 1. The setup and programming of the VFD shall be provided by a factory-trained representative who is authorized by the VFD manufacturer to perform the startup. This setup and programming shall be done prior to and during the first application of power to the motor. The VFD electronic motor overload protection shall be set to meet the motor nameplate and NEC Code requirements.
  - 2. Provide testing as specified in Electrical Specifications [Factory and Field Testing].
- B. Provide 1 hour of “VFD Setup” Training on operating and maintenance procedures.

### 3.03 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General; Warranty].

END OF SECTION

## SECTION 16600 - FACTORY AND FIELD TESTING

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. This Section defines factory and field testing requirements of electrical and instrumentation equipment and as specified in this section and in Electrical Specifications. All equipment provided under Electrical Specifications and electrical equipment provided under other sections shall be tested as specified herein.
- B. The Electrical Contractor shall coordinate at no additional cost to the Owner, the services of an approved qualified third party independent testing company for the purpose of performing specific tests as outlined in EXECUTION, Field Test of this section.
- C. The System Integrator, Application Programmer, Testing Company and/or Electrical Contractor shall provide all labor, tools, material, power, and technical supervision to perform the specified tests and inspections.
- D. The Electrical Contractor shall be present during field testing and assist the System Integrator, Application Programmer, and/or Testing Company in testing all equipment. The Electrical Contractor shall be ready to correct any wiring problems found during testing.
- E. The Application Programmer (defined in Electrical Specifications [Electrical General].) and/or Construction Manager will be actively engaged in Operational Testing and Commissioning. Testing will require combined efforts of the Contractor, System Integrator, Application-Programmer, and Construction-Manager. The Contractor shall facilitate test as outlined herein such that hardware, software and application programming are tested completely and all applicable test documentation is completed.
  - 1. Expect that field testing of system operational testing (PLC and/or SCADA checkout) is going to require 2 weeks after pre-operational tests are done. Contractor and System Integrator shall assist in this start-up. Coordinate with Construction Manager to schedule this testing and start-up period.
- F. It is the intent of these tests to ensure that all equipment is operational within industry and manufacturer's tolerances and is assembled in accordance with design plans and Specifications.
- G. The Construction Manager may witness testing in effort to insure quality and verify results. The Contractor is required to provide notification 2 weeks prior to any test that are intended to be documented and submitted for approval or are final tests. The Construction Manager must specifically decline witness of each test to be performed,

and the test must be successful, and it must be documented on the day of test, in order for it to not have to be repeated in the presence of an authorized witness. Only the Construction Manager may assign an authorized witness.

- H. All tests shall be documented in writing by the person performing the test on the test forms submitted (and similar to those shown at the end of this section) and signed by the Engineer as satisfactorily completed. The Testing Company, Electrical Contractor or System Integrator performing tests shall keep a detailed log of all tests that failed or did not meet Specifications, including date of occurrence and correction.
- I. The Contractor shall perform all applicable testing of Owner supplied or existing equipment as a unit and as part of a system. Testing shall include documentation and witness sign-off.
- J. The communications equipment shall be completely configured by the Contractor for permanent operation. Diagnostics, addresses, and configuration shall be recorded and provided with testing submittals. Provide data in tabular format on Excel spreadsheet. Contractor is required to test every path, link, repeater until optimum results are obtained. Test form example is not provided for this purpose and must be generated by the Contractor.

## 1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Project Drawings
- C. Additional testing may be specified in other Electrical Specifications.

## 1.03 FACTORY AND FIELD GENERAL REQUIREMENTS

- A. Testing General
  - 1. Prior to any field testing Operation & Maintenance Manuals shall have been submitted and approved.
  - 2. The test forms shall be completed by the contractor during testing and calibration of all equipment. All tests shall be witnessed by the Construction Manager. Completed test forms shall be given to the Construction Manager the day of the test. Complete two sets of test forms if Contractor wants to keep a copy.
  - 3. The Contractor shall give the Engineer 10 working days notice of the dates and time for inspections and testing.
  - 4. Include test results in the Maintenance and Operational Manual.
  - 5. As a minimum, all the tests indicated/specified on the test forms shall be performed and test forms filled out by the Contractor.
  - 6. Prepare and submit formal test procedures and forms at least two weeks prior to the start of testing. Testing shall not commence until the test procedures have

been reviewed and approved. Submit a combined test procedure submittal with separate sections for factory and field tests.

7. If the results of any of tests are unacceptable, the Contractor shall make corrections and perform the tests again until they are acceptable; these tests shall be done at no additional cost.

B. Failure to Meet Test

1. Any system, material or workmanship which is found defective on the basis of these tests shall be reported immediately following the test. The Contractor shall replace the defective material or equipment and have tests repeated.

C. Safety

1. Testing shall conform to the respective manufacturer's recommendations. All manufacturers' safety precautions shall be followed.
2. Safety, as shown herein and in other divisions, shall be a combination of all methods and practices described. Safety practices may not be determined based on the least restrictive requirement, but instead, on the most restrictive requirement. Obtain clarification if there is any question prior to performing tests.
3. The procedures stated herein are guidelines for the intended tests, the Contractor shall be responsible to modify these tests to fit the particular application and ensure personnel safety. Absolutely no tests shall be performed in such a fashion that personnel safety is jeopardized.
4. The Contractor shall have two or more personnel present at all tests.
5. Two non-licensed portable radios shall be provided by the Contractor for use during testing.
6. Contractor shall comply with California Electrical Safety Orders (ESO) and Occupational Safety and Health Act (OSHA): All test and procedures shall comply with ESO and OSHA as to safety, protective clothing, clearances, padlocks and barriers around electrical equipment energized during testing.
7. The first set of tests to be performed (pre-energization) shall determine the suitability for energization and shall be completed with all power turned off.

## 1.04 QUALIFICATIONS

A. Testing Company

1. Testing company shall have been actively engaged in the type of electrical testing specified in this Division for the past three years (minimum). The Testing Company representative shall have two years experience in field testing of equipment working for the Testing Company or equivalent. The following Electrical Testing Companies are pre-approved.
  - a. EETS (916) 339-9691
  - b. Industrial Test (888)-809-8550
  - c. Emerson Electrical Reliability Services
  - d. Apparatus Testing and Engineering (916) 853-6280

- e. Apparatus Testing and Engineering (925) 454-1363
  - f. Power Systems Testing (925) 583-2361
  - 2. Testing Companies not listed are required to submit company and individual representative resumes for review and approval.
- B. System Integrator Representative
- 1. The system integrator representative shall have 1 year experience in field testing of equipment working for the System Integrator or equivalent. If the representative does not demonstrate necessary experience or competence during testing or start-up, the System Integrator shall provide a representative meeting the required competence and experience.
- C. Electrical Contractor Representative
- 1. The Electrician shall have 5 years minimum experience working with industrial control systems and have a Journeyman level experience rating.

#### 1.05 SUBMITTAL REQUIREMENTS

- A. The Contractor shall ensure that the Testing Company, System Integrator, and all equipment suppliers provide the submittal documentation required in this section. Submittals shall be complete, neat, orderly, and indexed. The Contractor shall check all submittals required under this Division for the correct number of copies, adequate identification, correctness, and compliance with the Contract Specifications and Drawings, and initial all copies certifying compliance.
- B. The System Integrator shall assemble and submit for approval complete testing procedures and forms at least two weeks prior to the start of testing. Contractor is responsible for compiling testing procedures and forms from multiple sub-contractors as required.
- C. Test submittal shall include: (as applicable)
- 1. Proposed procedure for operational testing whether it is performed in the factory or field. Procedure shall include method, simulated I/O requirements, bypass piping, telemetry, and necessary materials and equipment to conduct test.
  - 2. Test forms (for all tests, factory and field, and regardless of who performs tests). Test forms shall be electronically completed prior to submittal with entry spaces filled to the extent possible. The only remaining data that shall require completion during the test is the test data itself. Test forms shall be provided as illustrated at the end of this section or equal.
  - 3. Approved shop one-line, elementary diagrams and PLC I/O drawings.
  - 4. Control strategies photocopied at 75% reduction with room at the side of page for comments on each paragraph or control strategy.

## PART 2 PRODUCTS

### 2.01 TEST EQUIPMENT

- A. Test equipment required to perform testing and document results shall be provided by Contractor, Testing Company or System Integrator.
- B. Test instruments shall be calibrated to references traceable to the National Institute of Standards and Technology. Instrument calibration shall be current to one year from date of start-up. Test equipment accuracy shall be at least twice the accuracy of instrument being calibrated. Test instrument certificates of calibration shall be on-hand and provided prior to testing.

All test equipment to be used as part of the testing shall be listed in the submitted testing sheets. Contractor supplying the component or system to be tested shall provide all necessary test equipment.

- C. The overall accuracy of each input and output loop shall be checked to ensure that it is within manufacturer's Specification tolerances. In no case shall the error exceed 0.25% or 0.04 mA.

## PART 3 EXECUTION

### 3.01 FACTORY TESTING

- A. General Requirements
  1. The System Integrator shall conduct a thorough and complete factory test witnessed by Engineer per the criteria specified herein. Factory test shall be held within 150 miles of project location.
  2. Temporary wiring and equipment shall be provided and connected during these tests to simulate the complete assembled system.
  3. The testing shall not be started until the manufacturer has completed fabrication, wiring, setup, programming; quality control testing; and can demonstrate the system is complete and operational.
  4. The equipment required for factory testing shall consist of, but is not limited to, control panels, MCCs, and/or miscellaneous electrical panels as provided under this contract.
  5. Two digital multimeters/signal generators (minimum +/- 0.1% accuracy) with clip on leads shall be supplied and utilized during testing for measurement of digital and analog outputs.
  6. All factory tests shall be conducted at the System Integrator's facility. All factory tests shall be completed prior to shipment to the jobsite. The equipment shall be fully assembled, and connected similar to as it will be installed.
  7. The length of the factory testing shall be a minimum of one (1) working day(s) (8 hours per day).

8. If the equipment is not ready for factory testing, the test will be cancelled and rescheduled for a later date. The Contractor shall be responsible for paying liquidated damages for expenses incurred by the Owner Representative to come to a cancelled test. One thousand dollars (\$1000.00) in liquidated damages shall be deducted from his contract each occurrence.
9. Faulty and/or incorrect hardware or software operation of major portions of the system may, at the discretion of the Engineer, be cause for suspension, cancellation, or restarting of the factory test, at no additional cost to the Owner or extension in Contract time.
10. The Systems Integrator shall develop, furnish, and install a test program to be loaded into PLCs to verify all Logic Controller I/O Point to Point Tests prior to start of applications program testing. Systems Integrator shall use a computer running PLC programming software to confirm I/O calibration and status, force outputs and communications configuration.
11. The factory test will be considered complete only when the integrated system has successfully passed all tests. No electrical equipment shall be shipped to jobsite without completed test documentation.
12. During the testing period, under the supervision of the System Integrator, the Construction Manager shall have unlimited and unrestricted access to the usage and testing of system hardware, configuration, software, meters and tools.
13. The System Integrator shall pay all expenses incurred by his personnel including labor, material, transportation, lodging, daily subsistence, and other associated incidental costs during the factory testing.
14. Acceptance and witnessing of the factory tests does not relieve or exclude the Contractor from conforming to the requirements of the Contract Documents.
15. Upon conclusion of factory testing, and at the request of the Application Programmer, the System integrator shall remove the PLC, OI, and communication equipment for Application Programmer's use and programming. The System Integrator shall provide equipment to Application Programmer immediately or ship unit within 2 working days. The System Integrator shall not be responsible for equipment while in Application Programmer's care.
16. All modifications to documentation as a result of the factory tests shall be corrected and completed before the submittal and delivery of "Operation and Maintenance" Manuals.
17. Copies of the completed and witnessed factory testing forms shall be included in the Operation and Maintenance Manual.

**B. Factory Tests**

1. Structured Factory Tests: The associated factory tests are to be performed by the System Integrator and witnessed by the Construction Manager. The associated test forms shall be completed during each stage of the test.
  - a. Visual and Mechanical Inspection Tests
  - b. Wiring Tests

- 1) Contractor shall confirm correct panel wiring per System Integrator panel shop drawings. Panel shop drawings shall be compared with Contract P&IDs and other Drawings to verify all hardwire logic are accounted for. Panel drawings used in factory tests shall be redlined and inserted into Factory Testing Results submittal.
- c. MCC and Control Panel Pre-Operational Tests
- d. Logic Controller I/O Point to Point Tests
- e. Simulated Alarm Tests
  - 1) Simulate the digital and/or analog signals at the terminals to verify that each PLC I/O point is functional and properly programmed. Verify that all parameters (i.e., setpoints, enable/disable toggle bits, timers, etc.) for the alarms operate according to the Specifications. Multiple alarm states (i.e., LO, LO LO, HI, HI HI, etc.) shall be checked.
- f. Simulated Operational Control Tests
  - 1) Simulate the digital and/or analog signals at the field terminals to verify that each control system is functional and properly configured and programmed.
  - 2) Each line of control logic in the Control Strategies section shall be checked. When the complete control strategy has been checked, it shall be signed and dated by testing person and person witnessing test.
  - 3) Verify that all parameters (i.e., setpoints, runtimers, totalization, etc.) operate according to the Specifications.
2. Unstructured Factory Tests: The various unstructured tests shall include, but are not limited to, the following.
  - a. Simulate the equipment failure and power fail/restart of PLC. Check the effects of each failure on maintaining operations with the remaining equipment.
  - b. The factory tests, as a minimum, shall simulate all normal and abnormal operating conditions including steady state, change of state, variable changes, fluctuations, transients, upsets, start up, shutdown, power failure, and equipment failure conditions.
  - c. Communications test to devices located within control panel and/or in MCCs.
  - d. Measure and test all power supplies for correct voltage. Operate rechargeable devices under battery power to test run duration, alarms and automatic recovery.

### 3.02 FIELD TESTING

- A. General Requirements
  1. Field testing is broken down into 4 components
    - a. Pre-Energization testing

- b. Pre-Operational Testing
  - c. Operational Testing
  - d. Trial Period/Commissioning
2. Project wide, all Pre-Energization testing must be completed prior to Pre-Operational testing, all Pre-Operational testing must be completed prior to Operational Testing, and all Operational Testing must be completed prior to Commissioning.
    - a. Any deviation of this order, whether on a component level or larger scale, must be approved.
    - b. Out of order testing, if allowed, will be evaluated on a case-by-case basis when brought to the attention of the Construction Manager. The Construction Manager may require that the entire system, or portions thereof, be retested once the missing component(s) are installed and functional.
  3. All equipment supplied by the Contractor or others shall be tested by Contractor per these specifications.
  4. Two digital multimeters/signal generators (minimum +/- 0.1% accuracy) , AC current meters, torque wrench, and other specialized test equipment shall be provided by the Contractor for use during testing.
  5. If the equipment is determined not to be ready for testing, the test will be cancelled and rescheduled for a later date.
  6. Faulty and/or incorrect hardware or software operation of major portions of the system may be cause for suspension, cancellation, or restarting of the area of testing, at no additional cost or extension in Contract time.
  7. During the Operational testing period, under the supervision of the System Integrator, the Construction Manager shall have unlimited and unrestricted access to the usage and testing of all hardware and software in the system.
  8. The System Integrator shall pay all expenses incurred by his personnel including labor, material, transportation, lodging, daily subsistence, and other associated incidental costs during field testing.
  9. Acceptance and witnessing of the tests does not relieve or exclude the Contractor from conforming to the requirements of the Contract Documents.
  10. All modifications to documentation as a result of the tests shall be corrected and completed before the delivery of "as-built" documentation.
  11. Copies of the completed and witnessed field testing forms shall be included in the Operation and Maintenance Manual.
  12. The various contractors on this project (General Contractor, Electrical Contractor, Testing Company, and System Integrator) shall assume the lead role in testing activities as listed below. The Contractor shall obtain assistance of suppliers and/or manufacturers representatives for any major equipment testing.
    - a. Electrical Contractor:
      - 1) Pre Energization Tests
        - a) Visual Mechanical Tests
        - b) Wire Insulation and Continuity Tests.
        - c) Panelboard Tests

- d) Breaker Tests
- 2) Operational Tests.
  - a) Generator Tests
- 3) Trial Period
- 4) Commissioning.
- b. System Integrator:
  - 1) Pre-Operational Tests
    - a) Visual Mechanical Tests
    - b) Control panel pre-operational test
    - c) MCC pre-operational test
    - d) Motor Tests.
    - e) PLC I/O point to point tests.
    - f) Instrumentation switch tests
    - g) Instrumentation transmitter tests.
  - 2) Operational Tests.
  - 3) Trial Period
  - 4) Commissioning
- c. Testing Company
  - 1) Grounding System Tests
  - 2) Breaker Device Tests
- d. General Contractor
  - 1) Test Scheduling
  - 2) Operational Tests.
  - 3) Trial Period
  - 4) Commissioning.
- e. Application Programmer (software systems)
  - 1) Operational Tests.
  - 2) Trial Period
  - 3) Commissioning.

B. Electrical Field Tests – The following test shall be performed within each test category. Complete test forms for each electrical panel, instrument, and/or device. Provide separate form for each component to be tested.

- 1. Pre-Energization Inspections and Tests:
  - a. Visual and Mechanical Inspection Tests
  - b. Wire Insulation and Continuity Tests
  - c. Grounding System Tests
  - d. Panelboard Tests
  - e. Breaker Tests
- 2. Pre-Operational Tests:
  - a. MCC Pre-operational Tests:
  - b. Control Panel Pre-operational Tests:
  - c. Motor Testing:
  - d. Generator Testing:
  - e. Harmonic Measurement:

- f. Instrumentation Switch Calibration Tests
  - g. Instrument Transmitter Calibration Tests
  - h. PLC I/O point tests.
  - i. Communication Tests
    - 1) The Contractor shall verify that all communications via radio, telephone, wireline, fiber optic, or other are functional and ready for operational testing. Revise all configurable parameters without additional cost to the Owner as required for an optimally functional system.
    - 2) Verify that all components of the communication system operate together under all operating and power restart conditions. If faults occur, investigate source of problem and correct. Revise all configurable parameters without additional cost to the Owner.
    - 3) Change setpoints from SCADA and confirm that corresponding field setpoint changes correctly. Check every I/O point on every screen, trend, and database.
3. Operational Tests:
- a. After all the previous tests in this subsection are complete, the test forms are completed and signed-off, the Contractor shall conduct operational testing.
  - b. Representatives from the General Contractor, Electrical Contractor, System Integrator, and Construction Manager shall be present during testing. Operational testing shall be performed by Contractor in the presence of the Construction Manager.
  - c. During operational testing the Contractor shall follow the instructions of the Owner. The Owner may place restrictions on operation that must be followed by the Contractor during testing. Any accidents or fines caused by actions of the Contractor where warnings or restrictions were placed, shall be remedied or paid by the Contractor.
  - d. Alarm Tests
    - 1) Generate the digital and/or analog signals at the primary device to verify that each PLC I/O point is functional and properly programmed. Verify that all parameters (i.e., setpoints, enable/disable toggle bits, timers, etc.) for the alarms operate according to the Specifications. Multiple alarm states (i.e., LO, LO LO, HI, HI HI, etc.) shall be checked.
  - e. Operational Control Tests
    - 1) Generate the digital and/or analog signals at the primary device by raising or lowering the actual measured process. Inject signal into the terminals or utilize a “force” function within the device only as necessary. Verify that each control system is functional and properly configured and programmed.
    - 2) Each line of control logic in the Control Strategies section shall be checked. When the complete control strategy has been

checked, it shall be signed and dated by testing person and person witnessing test.

- 3) Verify that all parameters (i.e., setpoints, runtimers, totalization, etc.) operate according to the Specifications.
- 4) Verify that all data, setpoints, alarms are being received at SCADA correctly and that all I/O points on screen are true and accurate representations of field information.

f. Other Tests

- 1) Force a power failure and power fail/restart of PLC and all other systems. Check the effects of each failure on each piece of equipment and automatic recovery.
- 2) Force a PLC communication error. Demonstrate error detection, alarming, and recovery.
- 3) Perform additional operational testing that has not already been witnessed.
- 4) Perform any additional operational testing as necessary to confirm robust and error free operation under all operational conditions.

4. Trial Period

- a. Station/Equipment shall be activated to automatically run for 5 days, 24 hours per day Monday through Friday.
- b. During the trial period the Construction Manager will test all modes of operation and will look for errors and malfunctions. A punchlist will be generated to be completed by Contractor and re-tested prior to Commissioning.
- c. If equipment failure occurs during the trial period, the Contractor shall repair or replace the defective equipment and shall begin another trial period, Monday through Friday.
- d. This test shall be repeated until all new equipment functions acceptably and without failure for consecutive days.

C. Commissioning:

1. Commissioning shall not commence until Operational testing and System Training are complete with documentation submitted and with prior approval.
2. Commissioning period
  - a. The new equipment shall be activated by the Contractor to operate in full automatic for 10 consecutive days, 24 hours per day. Commissioning shall only start on Mondays or Tuesdays.
  - b. During Commissioning, the Owner will monitor and run the station in normal automatic mode. If equipment failure occurs during Commissioning, the Contractor shall repair or replace the defective equipment and shall begin another commissioning period after repairs are complete.
  - c. Parallel, existing and/or back-up systems shall remain in place and functional during commissioning period. Demolition of parallel,

existing or back-up systems shall not begin until commissioning is completed.

- d. This test shall be repeated until the new equipment functions acceptably for a consecutive commissioning period.
- e. Warranty will begin at the start of a successful commissioning period. However, if major hardware failure occurs during commissioning, the warranty and commissioning will restart once the problem has been identified and repaired.

### 3.03 WARRANTY:

- A. Provide warranty per Electrical Specifications [Electrical General, Warranty].
  - 1. The completion of the above tests does not relieve the Contractor from any warranties specified in the Electrical Specifications or other sections.
  - 2. Warranty shall begin on the start date of a successful Commissioning period.

### 3.04 FINAL ACCEPTANCE:

- A. Final Acceptance per Electrical Specifications [Electrical General].

**SECTION 16600**  
**TEST FORMS**

Index of Forms:

PC	Power Conductor Test Form
CC	Control Conductor Test Form
IC	Instrumentation Conductor Test Form
GS	Grounding System Test Form
VM	Electrical Equipment Visual and Mechanical Inspection Form
PB	Panelboard Test Form
CPO	Control Panel Operational Test Form
BD	Breaker Device Test Form
GCL	Generator Field Check List
GPT	Generator Performance Test Form
GSLD	Generator Sound Level Data Form
MOTOR	Motor Test Form
HM	Harmonic Measurement Test Form
IOP	Programmable Logic Controller I/O Point-to-Point Test Form
ISC	Instrumentation Switch Calibration Test Form
ITC	Instrumentation Transmitter Calibration Test Form

END OF SECTION



# CONTROL CONDUCTOR TEST FORM

PROJECT NAME: \_\_\_\_\_  
 TESTING COMPANY: \_\_\_\_\_

DATE OF TEST: \_\_\_\_\_  
 TEST LOCATION: \_\_\_\_\_

INSULATION TESTS											
COND. # OF #	COND. TO GROUND	CONDUCTOR TO CONDUCTOR									
		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
1		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X									
2		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X								
3		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X							
4		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X						
5		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X					
6		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X				
7		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X			
8		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X	X		
9		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X	X	X	
10		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X	X	X	X

**NOTES:**

- 1) Use single form for each conduit.
- 2) Disconnect both ends of wiring prior to megger tests.
- 3) Megger insulation resistances of all 600 volt insulated conductors using a 500 volt megger for 10 seconds. Make tests with circuits installed in conduit and isolated from source and load. Each conductor shall be meggered conductor-to-conductor and conductor-to-ground. These tests shall be made on cable after installation with all splices made up and terminations installed but not connected to the equipment.
- 4) Each megger reading shall not be less than 22 Meg-ohms resistive. Corrective action shall be taken if values are recorded less than 10 Meg-ohms. Conductors with low ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.
- 5) Values of different phases of conductors in the same conduit run showing substantially different Meg-ohm values, even if showing above 22 Meg-ohms shall be replaced.

CERTIFIED BY: \_\_\_\_\_  
 SIGNATURE

\_\_\_\_\_  
 COMPANY

\_\_\_\_\_  
 DATE

WITNESSED BY: \_\_\_\_\_  
 SIGNATURE

\_\_\_\_\_  
 COMPANY

\_\_\_\_\_  
 DATE



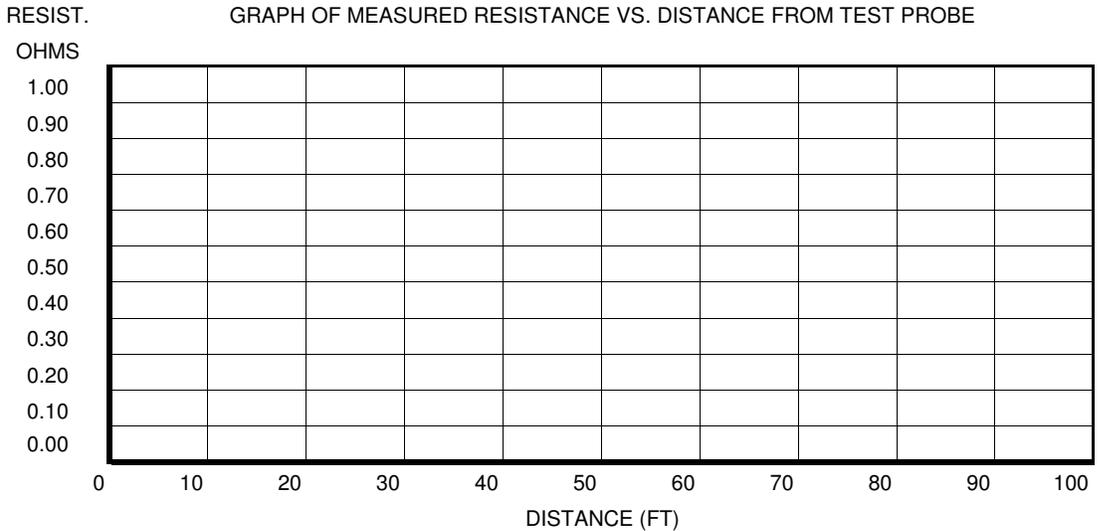
# GROUNDING SYSTEM TEST FORM

PROJECT NAME: \_\_\_\_\_ DATE OF TEST: \_\_\_\_\_  
 TESTING COMPANY: \_\_\_\_\_ TEST LOCATION: \_\_\_\_\_  
 TECHNICIAN: \_\_\_\_\_ TEST LOCATION: \_\_\_\_\_  
 EQUIPMENT NAME: \_\_\_\_\_  
 SOIL CONDITION:      circle one      WET      DRY      MOIST      DAYS SINCE LAST RAIN      # \_\_\_\_\_ OVER 7 \_\_\_\_\_  
 TEST ROD LOCATION RELATIVE TO SYSTEM GROUND UNDER TEST (DISTANCE AND DIRECTION) \_\_\_\_\_  
 COMMENTS:

## FALL OF POTENTIAL TEST

GRAPH OF MEASURED RESISTANCE VS. DISTANCE FROM TEST PROBE

MEASURED VOLTAGE PROBE	
DIST.	RESIST.
20	
30	
40	
50	
60	
70	
80	
90	



**NOTES:**

- 1) Use ground resistance test meter and perform separate ground test for each building or independently derived grounding system.
- 2) Verify ground system is in compliance with drawings and specifications.
- 3) Perform the test not less than two days after the most recent rainfall and in the afternoon after any ground condensation (dew) has evaporated.
- 4) Investigate point-to-point resistance values which exceed 1.0 ohm. Correct (by adding additional grounding systems as necessary) and re-test. Consult design engineer if for direction on additional grounding materials and methods.
- 5) Connect all ground electrodes and/or UFER ground together and perform fall of potential test.
- 6) Perform fall-of-potential test in accordance with IEEE Standard 81 and NETA 7.13 on the main grounding electrode or system. Install test electrodes a minimum of 100 feet from system under test.
- 7) Measurements shall be made at 10 feet intervals beginning 20 feet from the test electrode and ending 80 feet from it in a direct line between the system being tested and the test electrode. Plot resistance readings on graphical chart above.
- 8) Perform point-to-point tests to verify low resistance between the main grounding system and all electrical equipment connected to the grounding system. Purpose is to check Cad-Weld connections and continuity point to point.

CERTIFIED BY: \_\_\_\_\_  
SIGNATURE      COMPANY      DATE

WITNESSED BY: \_\_\_\_\_  
SIGNATURE      COMPANY      DATE

# ELECTRICAL EQUIPMENT VISUAL AND MECHANICAL INSPECTION FORM

PROJECT NAME: \_\_\_\_\_  
 TESTING COMPANY: \_\_\_\_\_  
 EQUIPMENT NAME: \_\_\_\_\_

DATE OF TEST: \_\_\_\_\_  
 TEST LOCATION: \_\_\_\_\_  
 EQUIPMENT #: \_\_\_\_\_

### NAMEPLATE DATA (complete as applicable)

MANUFACTURER: \_\_\_\_\_  
 MODEL #: \_\_\_\_\_  
 VOLTAGE: \_\_\_\_\_  
 BUS AMPERAGE: \_\_\_\_\_  
 BUS TYPE: \_\_\_\_\_  
 VERTICAL BUS: \_\_\_\_\_  
 GROUND BUS: \_\_\_\_\_

ENCLOSURE: \_\_\_\_\_  
 U.L. #: \_\_\_\_\_  
 PHASE: \_\_\_\_\_  
 SERVICE: \_\_\_\_\_  
 BUS BRACING: \_\_\_\_\_  
 HORIZONTAL BUS: \_\_\_\_\_  
 NEUTRAL BUS: \_\_\_\_\_  
 SERIES #: \_\_\_\_\_

### PHYSICAL INSPECTION CHECKLIST

ENTER A-ACCEPTABLE R-NEEDS REPAIR OR REPLACEMENT NA-NOT APPLICABLE

ITEM	CHECK	NOTES
CHECK NON-ELECTRICAL FASTENERS FOR TIGHTNESS		
TORQUE TEST ALL WIRING AND BUS CONNECTIONS		
VERIFY ANCHORAGE IS PER SPECS AND/OR CALCS		
CHECK BUS BRACING AND CLEARANCE		
CHECK MAIN GROUNDING CONNECTION AND SIZE		
VERIFY GROUND BUS BONDING		
VERIFY EQUIPMENT GROUNDS		
VERIFY CONDUIT GROUNDS AND BUSHINGS		
CHECK NEUTRAL BUS AND CONNECTIONS		
VERIFY ALL BREAKERS AND FUSES ARE RATED PROPERLY		
INSPECT FOR BROKEN OR DAMAGED EQUIPMENT		
INSPECT ALIGNMENT OF PANEL AND DOOR		
VERIFY REMOVAL OF ALL DEBRIS AND DUST		
VERIFY WIRE LABELS ARE INSTALLED		
VERIFY ALL WIRE TERMINATIONS		
CHECK FOR PROPER WIRE SIZES		
CHECK FOR PROPER WIRE COLOR CODES		
VERIFY ALL NAMEPLATES		
CHECK FOR PROPER CLEARANCES AND WORKING SPACE		
INSPECT ALL PAINT SURFACES		
CHECK HEATERS AND THERMOSTATS		
CHECK VENTILATION AND FILTERS		
CHECK IF DRAWINGS MATCH EQUIPMENT		
CHECK ACCURACY OF OPERATION & MAINTENANCE		

**NOTES:**

- 1) Complete checklist above. Note any items that were found out of compliance.
- 2) Torque all electrical connections to values defined by equipment manufacturer or per NEC 110-14.

CERTIFIED BY: \_\_\_\_\_  
SIGNATURE

\_\_\_\_\_   
COMPANY

\_\_\_\_\_   
DATE

WITNESSED BY: \_\_\_\_\_  
SIGNATURE

\_\_\_\_\_   
COMPANY

\_\_\_\_\_   
DATE

## PANEL BOARD TEST FORM

PROJECT NAME: \_\_\_\_\_  
 TESTING COMPANY: \_\_\_\_\_  
 PANEL NAME: \_\_\_\_\_

DATE OF TEST: \_\_\_\_\_  
 TEST LOCATION: \_\_\_\_\_  
 PANEL TAG #: \_\_\_\_\_

### PANELBOARD NAMEPLATE DATA

UL #: \_\_\_\_\_  
 MAIN BREAKER RATING: \_\_\_\_\_  
 PHASE: \_\_\_\_\_  
 VERTICAL BUS RATING: \_\_\_\_\_  
 NEUTRAL BUS RATING: \_\_\_\_\_  
 GROUND BUS RATING: \_\_\_\_\_  
 ENTRY LOCATION: \_\_\_\_\_

MANUFACTURE: \_\_\_\_\_  
 MODEL #: \_\_\_\_\_  
 VOLTAGE: \_\_\_\_\_  
 BUS AMPERAGE: \_\_\_\_\_  
 BUS TYPE: \_\_\_\_\_  
 ENCLOSURE: \_\_\_\_\_  
 SERIES: \_\_\_\_\_

### PHYSICAL INSPECTION CHECKLIST

ITEM	CHECK	NOTES
TIGHTEN ALL BOLTS AND SCREWS		
TIGHTEN ALL WIRING AND BUS CONNECTIONS		
VERIFY ALL BREAKERS AND FUSES ARE RATED PROPERLY		
CHECK BUS BRACING AND CLEARANCE		
CHECK MAIN GROUNDING CONNECTION AND SIZE		
VERIFY GROUND BUS BONDING		
VERIFY EQUIPMENT GROUNDS		
VERIFY CONDUIT GROUNDS AND BUSHINGS		
CHECK NEUTRAL BUS AND CONNECTIONS		
INSPECT FOR BROKEN OR DAMAGED EQUIPMENT		
INSPECT ALIGNMENT OF PANEL AND DOOR		
VERIFY ANCHORAGE		
VERIFY REMOVAL OF ALL DEBRIS AND DUST		
VERIFY CIRCUIT BREAKER LEGEND PER CONTRACT		
INSPECT ALL PAINT SURFACES		
VERIFY WIRE LABELS ARE INSTALLED		
VERIFY ALL WIRE TERMINATIONS		
VERIFY PANEL SCHEDULE WITH TERMINATIONS		
VERIFY PROPER WIRE SIZE		

**NOTES:**

1) Complete checklist above by entering a checkmark for acceptable, R for needs repair or attention

CERTIFIED BY: \_\_\_\_\_  
SIGNATURE

\_\_\_\_\_

COMPANY

\_\_\_\_\_

DATE

WITNESSED BY: \_\_\_\_\_  
SIGNATURE

\_\_\_\_\_

COMPANY

\_\_\_\_\_

DATE

# CONTROL PANEL PRE-OPERATIONAL TEST FORM

PROJECT NAME: \_\_\_\_\_  
 TESTING COMPANY: \_\_\_\_\_  
 CONTROL PANEL NAME: \_\_\_\_\_  
 CONTROL PANEL MANUFACTURER: \_\_\_\_\_

DATE OF TEST: \_\_\_\_\_  
 TEST LOCATION: \_\_\_\_\_  
 CONTROL PANEL TAG #: \_\_\_\_\_  
 CONTROL PANEL TYPE: \_\_\_\_\_

CATEGORY	EQUIPMENT TAG #	DEVICE CHECKS AND TEST								
		CONTROL SWITCHES	OPERATOR INTERFACE	PANEL METERS	PANEL LIGHTS	PANEL NAMEPLATES	PLC POWER SUPPLY	I/O CARDS		
Height										
Voltage										
Function										
CATEGORY	EQUIPMENT TAG #	POWER SUPPLY 1 (V)	POWER SUPPLY 2 (V)	POWER SUPPLY 3 (V)	UPS	PANEL LIGHTS				
Function										
Voltage										

**NOTES:**

- 1) Set configurable parameters and verify voltage input prior to applying power.
  - 2) Verify equipment powers up and operates correctly.
  - 3) Perform trip functions and verify equipment returns to normal operation with only necessary operator intervention.
  - 4) Complete checklist above by entering a checkmark (CM) for acceptable, or R for needs repair or attention, or NA for not applicable
- Attention Required:

CERTIFIED BY: \_\_\_\_\_  
SIGNATURE
COMPANY
DATE

WITNESSED BY: \_\_\_\_\_  
SIGNATURE
COMPANY
DATE

# BREAKER DEVICE TEST FORM

PROJECT NAME: \_\_\_\_\_ DATE OF TEST: \_\_\_\_\_  
 TESTING COMPANY: \_\_\_\_\_ TEST LOCATION: \_\_\_\_\_  
 PANEL NAME: \_\_\_\_\_ PANEL TAG #: \_\_\_\_\_  
 PANEL TYPE: \_\_\_\_\_

### EQUIPMENT INFORMATION

EQUIPMENT NAME: \_\_\_\_\_ EQUIPMENT H.P.: \_\_\_\_\_  
 EQUIPMENT TAG#: \_\_\_\_\_ EQUIPMENT KVA: \_\_\_\_\_

### BREAKER INFORMATION

MANUFACTURE: \_\_\_\_\_ VOLTAGE: \_\_\_\_\_ CHARACTER: \_\_\_\_\_  
 PART #: \_\_\_\_\_ INTERRUPT: \_\_\_\_\_ CURVE: \_\_\_\_\_  
 FRAME #: \_\_\_\_\_ RATING: \_\_\_\_\_ LOCATION: \_\_\_\_\_

### BREAKER TESTS

MFGR TRIP TIME @300% MIN: \_\_\_\_\_ BREAKER RATING/ RANGE: \_\_\_\_\_  
 MFGR TRIP TIME @300% MAX: \_\_\_\_\_ FINAL BREAKER SETTING: \_\_\_\_\_  
 MFGR INST. PICKUP AMPS: \_\_\_\_\_

#### CONTACT RESISTANCE TESTS - OHMS

#### INSULATION RESISTANCE TESTS - MEGOHMS

PHASE A	PHASE B	PHASE C	A-GND	B-GND	C-GND

#### CURRENT TESTS

#### INSTANTANEOUS CURRENT TRIP TESTS

##### TRIP TIME IN SECONDS @ 300% AMPS

##### AMPS

PHASE A	PHASE B	PHASE C	PHASE A	PHASE B	PHASE C

#### ADDITIONAL TESTS AND SETTING AS APPLICABLE

FUNCTION	PICK UP		DELAY-TIME		
	RANGE	SETTING	RANGE	SETTING	
LONG TIME					
SHORT TIME					
GROUND FLT.					

**NOTES:**

- 1) All breakers shall be checked for proper mounting, conductor size, and feeder designation. Operate circuit breaker to ensure smooth operation. Inspect case for cracks or other defects. Check tightness of connection with torque wrench in accordance with manufacturer's recommendations.
- 2) Thermal magnetic breakers, 100 amps and above, shall be test per NETA specification 7.6.1.1. Time current characteristic tests shall be performed bypassing 300% rated current through each pole separately. Trip time shall be noted. Instantaneous pickup current shall be determined by run up or pulse method. Clearing times should be within 4 cycles or less. At end of test, the thermal breakers shall be set by Contractor. Test Ground-Fault Protection per NEC 230.95.
- 3) Magnetic breakers (MCP), regardless of amperage rating, shall be tested. Instantaneous pickup current shall be determined by run up or pulse method. Clearing time should be within 4 cycles or less. At end of test the breaker trip setting shall be set by Contractor based on the motor locked rotor current.
- 4) Contact resistance shall be measured and be compared to adjacent poles and similar breaker. Deviations of more than 50% shall be reported to Engineer. Insulation resistance shall be measured and shall not be less than 50 megaohms. All trip times shall fall within NETA Table values. Instantaneous pickup current levels should be within 20% of manufacturer's published values.

CERTIFIED BY: \_\_\_\_\_  
SIGNATURE
COMPANY
DATE

WITNESSED BY: \_\_\_\_\_  
SIGNATURE
COMPANY
DATE

# MOTOR TEST FORM

PROJECT NAME: \_\_\_\_\_ DATE OF TEST: \_\_\_\_\_  
 TESTING COMPANY: \_\_\_\_\_ TEST LOCATION: \_\_\_\_\_  
 MOTOR NAME: \_\_\_\_\_ MOTOR TAG: \_\_\_\_\_  
 SERIAL #: \_\_\_\_\_

## MOTOR NAMEPLATE DATA

MFG: \_\_\_\_\_ PHASE: \_\_\_\_\_ TYPE: \_\_\_\_\_ P.F: \_\_\_\_\_ S.F: \_\_\_\_\_ NEMA: \_\_\_\_\_  
 VOLTS: \_\_\_\_\_ HP: \_\_\_\_\_ DUTY: \_\_\_\_\_ RPM: \_\_\_\_\_ CODE: \_\_\_\_\_ DESIGN: \_\_\_\_\_  
 FREQ: \_\_\_\_\_ FLA: \_\_\_\_\_ MODEL: \_\_\_\_\_ FRAME #: \_\_\_\_\_ ROTATION (CW/CCW): \_\_\_\_\_

## INSULATION RESISTANCE TEST PHASE-TO-GROUND/PHASE-TO-PHASE

A: \_\_\_\_\_ / \_\_\_\_\_ B: \_\_\_\_\_ / \_\_\_\_\_ C: \_\_\_\_\_ / \_\_\_\_\_

## CONTROL SETTINGS AND TESTS

MOTOR HEATER MEASURED AMPS: \_\_\_\_\_ (AMPS) MOTOR OVERLOAD SETTING: \_\_\_\_\_ (AMPS)  
 MOTOR THERMAL TRIP TEST: \_\_\_\_\_ OVERLOAD RESET TEST: \_\_\_\_\_ (YES/NO)  
 MINIMUM SPEED (IF VFD): \_\_\_\_\_ (HERTZ) COIL RESISTANCE: AB BC CA

## PHYSICAL MOTOR TESTS - ACTUAL MEASURED VALUES

VOLTAGE (VOLTS)	AMPERAGE (AMPS)	POWER
AB: _____ V	A: _____ A	POWER FACTOR: _____
BC: _____ V	B: _____ A	POWER DRAW: _____ KW
CA: _____ V	C: _____ A	HORSEPOWER: _____ HP
IMBALANCE: _____ %	IMBALANCE: _____ %	

### NOTES:

- 1) Perform coil resistance measurements on motor leads with a low-resistance ohmmeter. Note measurements.
- 2) Perform insulation-resistance test utilizing 500 volt megger and/or accordance with manufacturer's published testing procedures. Motors 200 HP and more test duration 10 minutes, 200 HP and less test duration 1 minute.
- 3) Perform DC overpotential tests on motors rated 1000 HP and 4000 volts or greater in accordance with ANSI/IEEE Standard 95.
- 4) Verify that pump/shaft seals are lubricated and that automated lubrication systems are functional.
- 5) Verify that motor protection/monitoring circuits are installed and connected per contract drawings and manufacturer requirements.
- 6) Verify that the motor space heater is functional.
- 7) Perform a rotation test to insure correct shaft direction by "bumping" motor. Reverse as necessary in appropriate place. Phase taping must remain in order on terminals left-to-right once completed.
- 8) Measure running current and evaluate relative to load conditions and nameplate full-load amperes.
- 9) Record the voltage and current on all phases while operating under full-load. If voltage or current imbalance is above 2 percent, or if current is above nameplate FLA or expected level, investigate cause and report on findings. Calculate imbalance by dividing (high minus low measurement) by the average measurement of all 3 phases.
- 10) Vibration tests shall be conducted in cases of discernable abnormal vibration or when ordered by the Engineer (due to perceived excessive vibration). Vibration shall not exceed 0.1 in./sec as measured opposite driven end of motor. Make necessary corrections to reduce vibration below limit at all operational speeds and loads.

### COMMENTS:

CERTIFIED BY: \_\_\_\_\_  

SIGNATURE
COMPANY
DATE

WITNESSED BY: \_\_\_\_\_  

SIGNATURE
COMPANY
DATE

# HARMONIC MEASUREMENT TEST FORM

PROJECT NAME: \_\_\_\_\_  
 TESTING COMPANY: \_\_\_\_\_  
 TECHNICIAN \_\_\_\_\_  
 POINT OF MEASUREMENT: \_\_\_\_\_

DATE OF TEST: \_\_\_\_\_  
 TEST LOCATION: \_\_\_\_\_  
 EQUIPMENT NAME: \_\_\_\_\_

(If available, take measurements on primary side of main breaker, otherwise, on secondary side of main breaker.)

COMMENTS:

MEASURED HARMONIC VOLTAGE VALUES												
RUNNING CONDITION			TIME	VOLT	AMPS	THD(V)	THD(A)	5TH	7TH	11TH	13TH	15TH
PUMP 1 SPEED	PUMP 2 SPEED	PUMP 3 SPEED										
0	0	0										
70	0	0										
90	0	0										
100	0	0										
70	70	0										
90	90	0										
100	100	0										
70	70	70										
90	90	90										
100	100	100										

**NOTES:**

- 1) Measure the harmonics with a harmonic analyzer with each combination of pumps shown or as designated by Engineer at start-up in operation on the Utility source. Repeat test on generator (if applicable).
- 2) Use multiple forms and/or attach printouts of harmonic analyzer machine.
- 4) Expand this chart for pump stations/systems with more than 3 VFD pumps.
- 5) All harmonic conditioning equipment shall be on-line and operate other non-VFD loads as normal during test.

CERTIFIED BY: \_\_\_\_\_  
SIGNATURE

\_\_\_\_\_  
 COMPANY

\_\_\_\_\_  
 DATE

WITNESSED BY: \_\_\_\_\_  
SIGNATURE

\_\_\_\_\_  
 COMPANY

\_\_\_\_\_  
 DATE

## PROGRAMMABLE LOGIC CONTROLLER I/O POINT-TO-POINT TEST FORM

PROJECT NAME: \_\_\_\_\_  
 TESTING CO: \_\_\_\_\_  
 PANEL NAME: \_\_\_\_\_  
 PLC NAME: \_\_\_\_\_

DATE OF TEST: \_\_\_\_\_  
 TEST LOCATION: \_\_\_\_\_  
 PANEL TAG #: \_\_\_\_\_  
 RACK # \_\_\_\_\_ SLOT # \_\_\_\_\_ I/O TYPE \_\_\_\_\_

I/O POINT				Scale					Digital	Operator	SCADA	Pass/Fail
I/O #	TYPE	TAG #	Description	@4mA	@8mA	@12mA	@16mA	@20mA	On/Off	Interface	Screen	CM or R
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												

- NOTES:
- 1) Connect signal generator to each I/O point for factory testing.
  - 2) Utilize actual instrument to generate signals for field pre-operational tests where possible.
  - 3) Verify function and accuracy of loop by switching the digital signal or modulating the analog signal from the connected device or instrument
  - 4) Field verify all instruments and indicators within loop of signal.
  - 4) Confirm polarity of signals and calibration ranges are equivalent for all components in loop.
  - 5) Include significant digits past decimal in scale columns
  - 6) Complete checklist above by entering a checkmark (CM) for acceptable, or R for needs repair or attention
  - 7) Note items that need attention below

Attention Required:

CERTIFIED BY: \_\_\_\_\_  
SIGNATURE

\_\_\_\_\_  
COMPANY DATE

WITNESSED BY: \_\_\_\_\_  
SIGNATURE

\_\_\_\_\_  
COMPANY DATE

## INSTRUMENTATION SWITCH CALIBRATION TESTS FORM

PROJECT NAME: \_\_\_\_\_  
 TESTING COMPANY: \_\_\_\_\_  
 INSTRUMENT NAME: \_\_\_\_\_  
 INSTRUMENT UNITS: \_\_\_\_\_  
 TYPE: \_\_\_\_\_  
 SERIAL #: \_\_\_\_\_

DATE OF TEST: \_\_\_\_\_  
 TEST LOCATION: \_\_\_\_\_  
 INSTRUMENT TAG#: \_\_\_\_\_  
 NAME: \_\_\_\_\_  
 MODEL: \_\_\_\_\_

MANUFACTURER			INSTRUMENT		
NAME: _____ TYPE: _____ MODEL: _____ SERIAL #: _____			UNITS: _____		
PROCESS SETPOINT	INCREASING TRIP POINT	DECREASING TRIP POINT	DEADBAND	SETPOINT TIME DELAY	ACTUAL TIME DELAY

**NOTES:**

- 1) Field test instrumentation and associated control systems in accordance with the specifications and the manufacturer's instructions. Instrumentation shall function as intended under actual process conditions or shall be repaired or replaced at Contractor's expense.
- 2) Complete a separate calibration form for each instrument provided.
- 3) Simulate process variable in field by applying known pressure, temperature, opening/closing measured device, raising/lowering actual level, etc. as required to confirm calibration. This step must be witnessed by inspector.

CERTIFIED BY:	_____	_____	_____
	SIGNATURE	COMPANY	DATE
WITNESSED BY:	_____	_____	_____
	SIGNATURE	COMPANY	DATE

## INSTRUMENTATION TRANSMITTER CALIBRATION TEST FORM

PROJECT NAME: \_\_\_\_\_  
 TESTING COMPANY: \_\_\_\_\_  
 INSTRUMENT NAME: \_\_\_\_\_

DATE OF TEST: \_\_\_\_\_  
 TEST LOCATION: \_\_\_\_\_  
 INSTRUMENT TAG#: \_\_\_\_\_

MANUFACTURER				INSTRUMENT			
NAME: _____				RANGE: _____			
TYPE: _____				SCALE: _____			
MODEL: _____				UNITS: _____			
SERIAL #: _____				TRANSMITTER OUTPUT: _____			
REMOTE SENSOR TYPE: _____ (If Applicable)				FACTORY SPECIFIED ACCURACY: _____			
				REMOTE SENSOR OUTPUT: _____ (If Applicable)			
DESIGNED VALUE				ACTUAL VALUE			
INPUT SIGNAL	OUTPUT	ENG VALUE	CALCULATED TOLERANCES	INSTRUMENT DISPLAY	INSTRUMENT OUTPUT SIGNAL	PROCESS INDICATOR	LOGIC VALUE

**NOTES:**

- 1) With this form, attach and submit factory calibration forms for flowmeters and transmitters that are available from factory.
- 2) Field test and calibrate instrumentation and associated control systems in accordance with the specifications and the manufacturer's instructions. Instrumentation shall meet specified accuracy or shall be repaired or replaced at Contractor's expense.
- 3) Complete a separate calibration form for each instrument provided.
- 4) Simulate process variable in field by applying known pressure, temperature, pH, etc. as required to confirm calibration. This step must be witnessed by inspector.
- 5) Provide parameter value for each parameter changed from factory default.

CERTIFIED BY: \_\_\_\_\_  
SIGNATURE

\_\_\_\_\_   
COMPANY

\_\_\_\_\_   
DATE

WITNESSED BY: \_\_\_\_\_  
SIGNATURE

\_\_\_\_\_   
COMPANY

\_\_\_\_\_   
DATE

## SECTION 16630 – ELECTRICAL SYSTEM ANALYSIS

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. Short Circuit Study.
- B. Protective Device Coordination Study.
- C. Arc Flash Study and labeling.
- D. Harmonic Analysis.
- E. Labor, materials, equipment, tools, safety gear, test equipment, incidentals, services, and transportation to complete the work and implement the conclusions.
- F. Analysis shall be prepared utilizing electrical systems analysis software with all calculation modules within the same program. Analysis software shall be SKM Power Tools, Easy Power, or approved equal.
- G. Study shall be prepared by or under the direct supervision of a California registered Electrical Engineer and bear that engineer's seal and signature.
- H. Work includes analysis of all electrical equipment in the facility, new and existing; i.e. buses, circuit breakers, main switchboards, motor control centers, conductors, fuses, etc. Collect field data, coordinate with Utility, and document new and existing conditions as required for a thorough system analysis.
- I. Work includes that specified in Electrical Specifications [Electrical General].

#### 1.02 SUBMITTAL REQUIREMENTS

- A. Provide submittals and drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Submittals shall be provided in multiple steps:
  - 1. Included with first electrical equipment submittal but under separate cover. Purpose will be to confirm selected equipment meets requirements for interrupt capacity and is able to be coordinated.
  - 2. Included with subsequent electrical equipment submittals but under separate cover. Comments and changes related to electrical equipment shall be incorporated.
  - 3. Two weeks prior to equipment start-up. Final wire lengths, and other information related to actual field installation shall be incorporated. New or

revised utility information as it exists. Order/furnish equipment labels upon approval of study.

- C. Submit input data and reports generated by analysis software for review after approval of power distribution equipment but prior to procurement. Submittal shall include, but not limited to;
  - 1. Load Flow drawing and analysis with voltage and current at each node.
  - 2. Fault drawing and analysis with incident energy shown at each node.
  - 3. Time-Current Curve and Coordination
  - 4. Settings Table
  - 5. Arc Flash and incident energy table
  - 6. Arc Flash warning labels (printout)
- D. Changes to electrical equipment required due to selective coordination requirements will need to be implemented prior to procurement of the power distribution equipment.
- E. Submit system model in native software file format for use by the City when performing modifications in future years.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. Perform study(s) using the latest version of electrical analysis software created specifically for this purpose. Program name and version shall be clearly stated within report.
- B. The coordination study shall begin at the utility company's connection and include all of the electrical protective devices down to and include the largest feeder circuit breaker and motor starter in the 480 Volt motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers, and all protective devices.
- C. Obtain utility source information for proper modeling of source supply.
- D. Perform and provide fault calculations for each power source, and every possible switched configuration.
- E. Input electrical equipment individually into the program, not as groups. All electrical equipment shall be included.
- F. Utilize equipment / component tag names and numbers where shown. Follow similar standards when naming equipment without defined tags.

- G. Obtain manufacturer data from submittals provided by vendors and integrators on the project and from the Utility Company directly. The Owner and Engineer are not responsible for providing information.
- H. Provide time-current curves (TCC) diagrams for all protective equipment and breakers. Provide trip settings for each circuit breaker on the TCC diagram.
- I. Protective device settings shall be applied prior testing and start-up of electrical equipment.

## 2.02 SHORT CIRCUIT STUDY AND LOAD FLOW ANALYSIS

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition.
- B. Transformer design impedances and standard X/R ratios shall be used when test values are not available.
- C. Short circuit study shall provide the following information:
  - 1. Bus impedances.
  - 2. Transformer impedances based on actual submittals or ANSI standards.
  - 3. Cable length, impedance, size, type, and quantity.
  - 4. Utility data:
    - a. Transformer KVA, impedance, voltage.
    - b. Primary voltage of Utility transformer.
    - c. Utility Company primary fault currents (Min, Max, normal values), three phase bolted, line to ground, X/R ratio (positive sequence) and X/R ratio (zero sequence).
- D. Voltage and current at each node within the system.
- E. Protective relay model and settings.
- F. Calculate Short Circuit fault currents for three-phase bolted fault and line-to-ground fault at each node including the following.
  - 1. Incoming Utility
  - 2. High / Medium / Low voltage switchgear
  - 3. Power transformer primary and secondary
  - 4. Switchboard
  - 5. Motor Control Centers (MCCs)
  - 6. Panelboards
  - 7. 480V, 3 phase motor and equipment loads 2 HP and larger
- G. Compare ratings of transformers, cable, equipment, and protective devices to the calculated short circuit stresses. Note any areas or equipment that may be deficient.

- H. Provide Short Circuit and Load Flow study report showing the following minimum information.
  - 1. Assumptions
  - 2. Input data to program
    - a. Circuit diagrams (conductors, circuit disconnects, transformers, panelboards, main switchboards, generators, transfer switches, buses, etc.)
    - b. Symmetrical and asymmetrical line-to-line and line-to-ground fault currents.
    - c. Impedances
    - d. X/R ratios
    - e. Motor contributions
  - 3. Equipment evaluations (protected and non-protected devices) showing ratings, manufacturer, status, equipment type, and calculated minimums.
  - 4. Bus rating of equipment.
  - 5. Electric Utility company data.
  - 6. Results, conclusions, and recommendations.

## 2.03 PROTECTIVE DEVICE COORDINATION STUDY

- A. Provide Protective Device Coordination drawings for each section of distribution system.
- B. Provide coordination time-current curves (TCC) on conventional log-log curve sheets. Each time-current curve shall be labeled to identify its purpose. This identifier shall be used in the tabulated settings spreadsheet and on the associated one-line diagram.
- C. Provide the following curves (minimum):
  - 1. 12 kv distribution system, relay, fuses, cable, etc.
  - 2. Transformer, circuit breakers, and motor loads
- D. Partial one-line diagram of specific portion of distribution system associated with time-current curves in question. One-line diagram shall include the following:
  - 1. Coordination name identifier – usually the protected device.
  - 2. Voltages, amperages, impedance and node names.
  - 3. Circuit devices such as transformers, cables, breakers, fuses, etc. with their corresponding amperage, KVA, and HP ratings.
- E. Show maximum fault current to which device is exposed as calculated in short circuit study.
- F. Characteristics plotted on TCC diagrams shall include; but, not be limited to:
  - 1. Protective relays.
  - 2. Fuses including melting curve, tolerance, and damage bands.
  - 3. Circuit breaker trip with tolerance bands.
  - 4. Transformer full-load and magnetizing current.

5. Transformer and cable damage curves.
  6. Transformer withstand parameters ANSI.
  7. Motor and equipment full load currents.
  8. Ground fault protective device settings.
  9. Other electronic protective devices.
- G. Provide the following recommended settings in spreadsheet format in the Protective Device Coordination study report:
1. Relay settings including CT values.
  2. Circuit Breakers adjustments:
    - a. Long trip amperage and delay.
    - b. Short trip amperage and delay.
    - c. Instantaneous trip amperage.
    - d. Ground trip amperage and delay.
- H. Settings for all configurable electronic motor starters and VFDs.
- I. Provide settings for settable circuit breakers and MCPs. Provide settings according to actual equipment installed.
- J. Identify each curve by description, manufacturer, function, amperage and model as necessary to distinguish it from others.

#### 2.04 HARMONIC STUDY

- A. Perform a harmonic analysis study in accordance with the latest version of IEEE 519 utilizing computer software specifically designed for this purpose.
- B. The total harmonic distortion (THD) at the point of common coupling (PCC) shall be calculated through computer analysis of the electrical system. PCC shall be considered as the main breaker of switchboard and at the generator terminals. Contractor shall calculate TDD and THD at each PCC.
- C. If the calculations determine that the harmonic distortion levels are higher than the voltage and current specified, the drive manufacturer shall revise VFDs, wiring or provide harmonic mitigating components until system meets IEEE 519 requirements.

#### 2.05 ARC FLASH HAZARD STUDY

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E including annexes.
- B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.

- C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway, and splitters) where work could be performed on energized parts.
- D. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary for incident energy of 1.2 cal/cm<sup>2</sup> or greater.
- E. Provide Arc flash calculation on line and load side of main breaker if there are serviceable components in a main breaker compartment.
- F. Provide a table with the following parameters in the Arc Flash Hazard study report:
  - 1. Arc fault magnitude
  - 2. Device clearing time and/or arc duration
  - 3. Arc flash boundary
  - 4. Incident energy
  - 5. Working distance

## 2.06 STUDY REPORTS

- A. Reports shall contain:
  - 1. Description of studies performed and brief introduction.
  - 2. Report calculations and spreadsheets results.
  - 3. Selected equipment deficiencies.
  - 4. Short circuit and coordination studies results.
  - 5. Comments or suggestions to improve safety:
    - a. Changes and additions to equipment rating and/or characteristics.
    - b. Highlight any equipment or devices that are deficient.
  - 6. Protective device settings:
    - a. Breaker Frame make and model
    - b. Trip unit make and model number
    - c. Long, Short, Instantaneous, and Ground settings
  - 7. Stamped, signed and dated by Electrical Engineer registered in the State of California who performed the analysis.
  - 8. Reports are to be updated to reflect as-built conditions at the end of the project to reflect change orders and other changes that have taken place since submittal.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Perform settings to equipment as required to obtain conformance with the Short Circuit and Protective Device Coordination Studies.

- B. Submit as-built Power System Analysis report and project in PDF and native software file format for future use by the OWNER. Furnish all files needed to re-create the report.

### 3.02 FIELD QUALITY CONTROL

- A. Test all protective devices as specified in section 16600.
- B. Submit with any related field changes with final copies of studies and documentation.
- C. The individual performing the Arc Flash hazard study shall direct the installation of the arc-flash hazard labels:
  - 1. Remove and replace any improperly applied labels.
  - 2. Repair the equipment finish damaged by removal of any labels.

### 3.03 ADJUSTING

- A. After review and acceptance of the recommend settings, the supplier's field service technician shall set all recommended settings according to values determined during coordination Study.
- B. Install arc-flash hazard labels on all equipment covered by the study.

### 3.04 ARC FLASH WARNING LABELS

- A. Labels shall comply with latest codes and standards as they frequently change and the latest information may not be reflected here.
- B. Provide minimum 3.5in. x 5in. Polyester with polyvinyl polymer over-laminate, self-adhesive warning sticker for each work location analyzed. Labels shall be resistant to:
  - 1. UV Rays
  - 2. Chemicals and common cleaning solvents
  - 3. Scuffing
  - 4. Wide temperature changes
- C. Each label shall have a header with the wording, "DANGER (red) or WARNING (orange) - ARC FLASH HAZARD", and shall include the following machine printed information:
  - 1. Location designation
  - 2. Nominal voltage
  - 3. Flash protection boundary
  - 4. Incident energy
  - 5. Working Distance
  - 6. Minimum Arc Rating of Clothing and other PPE
  - 7. Engineering report/issue date and revision number

- D. Labels shall be professionally manufactured, machine printed, and not be hand-made and/or hand marked.
- E. After review and acceptance of the Arc Flash hazard submittal and/or report by the Engineer, install all arc-flash hazard labels:
  - 1. Install labels at all locations required by NFPA, ANSI, or IEEE standards.
  - 2. At a minimum install labels in the following locations:
    - a. The front of each main or incoming service compartment. Provide label for line and load sides of main.
    - b. The front of each low voltage switchgear section.
    - c. The front of each medium voltage circuit breaker door.
    - d. Each motor control center compartment displaying hazard below the circuit breaker when energized.
    - e. Each panelboard covered by the study.
    - f. Each control panel, individual starter, VFD or other equipment covered by the scope of the study.

### 3.05 ARC FLASH TRAINING

- A. Provide Arc Flash Training for up to 4 classes of 6 people, 2 hours each.
- B. Provide outline and curriculum for training prior to class.
- C. Training shall be administered by the author of the study or submitted alternate if approved.

END OF SECTION

## SECTION 16905 - CONTROL PANELS

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. Provide and install Control Panels, Terminal Panels, and custom specific purpose panels per Drawings and Specifications.
- B. Provide complete wired and tested panel with all devices installed per the contract Drawings and as stated herein.
- C. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the control panel to equipment provided under other Sections.

#### 1.02 REFERENCES

- A. Electrical Specifications [Electrical General].
- B. Electrical Specifications [Low Voltage Wire & Data Cable]
- C. Electrical Specifications [PLC & OI Hardware]
- D. Electrical Specifications [PLC & OI Application Programming]
- E. Electrical Specifications [Instrumentation]

#### 1.03 SUBMITTAL REQUIREMENTS

- A. Provide submittals and Drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Submit shop construction Drawings for the Control Panel. The following Drawings shall be provided as a minimum:
  - 1. Scaled drawings of the Control panel elevation, baseplan. The dimensions and locations of the cutouts shall be dimensioned from the bottom left corner of the door(s).
  - 2. Scaled drawings of the backpan including all mounted components and wireways.
  - 3. Wiring diagrams for AC and DC power distribution, I/O for each card in the PLC and communications block diagrams.
- C. Calculations for environmental controls. Environmental controls (including air conditioners, exhaust fans, heaters and circulation fans) shall maintain interior panels

temperatures within ratings of all internal equipment given the intended installation location.

1. Design and install environmental control systems to meet requirements herein and prevent premature failure of panel internal components.
2. Environmental controls may be shown in the Drawings and shall be considered the minimum level required. Additional components or systems shall be provided to meet internal temperature requirements.
3. Environmental control systems shall prevent and control intrusion of dust and bugs through the use of filtration systems.
4. Environmental control systems shall maintain humidity below that of the external ambient air and without condensation within panel.

#### 1.04 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Provide operating instructions as specified in Electrical Specifications [Electrical General].

### PART 2 PRODUCTS

#### 2.01 ENCLOSURE

- A. The enclosure for the control panel shall be (at minimum) sized as shown in the Contract Drawings.
  1. Arrangement: Where so indicated, the instruments mounted in the panels shall have the nominal size and general arrangement shown. Panel layouts and nameplates shall conform to the approved submittal.
  2. Assembly: Mount all equipment on 12 ga. painted white backpan(s) that is bolted to rear (and sides) of the enclosure. Use drill and tap method for machine thread screws for all internal components on mounting panels. Provide extra mounting bolts through the rear of the structure if equipment weight exceeds backpanel mounting stud capacity.
  3. Hardware: Provide door latch and accessories as detailed in the Contract Drawings or as required to meet NEMA area ratings.
    - a. Provide one or two single point latches for panels up to 36" height.
    - b. Provide 3 point latching mechanisms for panels over 36" height consisting of rotating handle with latch, extension bars with plastic wheels at ends and guide slots at top and bottom of door, or as otherwise shown on drawings.
    - c. Hinges, pins, bolts and screws shall be of 316 stainless steel only.
  4. When physical size requirements for individual components are different than that detailed on the Control Panel backpan drawing, the wiring diagrams and specifications herein shall supersede the elevation drawing and the Contractor shall furnish additional panel width as needed to fit the electrical equipment. Deviations with sufficient evidence for the change shall be submitted for

approval. The Contractor is required to provide for all equipment including spares and spaces as shown in the wiring diagrams.

## 2.02 CONTROL PANEL CIRCUIT BREAKERS

- A. Furnish circuit breakers and accessories as required per Drawings and application.
  - 1. Copper busbar systems, up to 480VAC, 115A, 1, 2 or 3 phase as needed for application
  - 2. Trip rating per Drawings or as needed for protected device. Trip curves as selected by System Integrator.
    - a. B curve magnetic trip point: 3 to 5 times the rated current, typically used for computers and electronic equipment with very low inrush loads (PLC wiring).
    - b. C curve magnetic trip point: 5 to 10 times the rated current, typically used for small transformers, pilot devices, etc.
    - c. D curve magnetic trip point: 10 to 20 times the rated current, typically used for transformers or loads with very high inductive loads.
  - 3. Quantity of pins and feed in lugs as required.
  - 4. Auxiliary contact, shunt trip as required in Drawings.
  - 5. DIN rail mounted, 18mm width per pole, finger safe pressure plate terminals.
- B. Motor applications:
  - 1. UL489 for branch circuit protection up to 40A, 1 to 3 pole.
  - 2. 5 kAIC interrupting capacity @ 480 VAC
  - 3. Alltech, Eaton FAZ, or equal.
- C. Control circuit transformers and other Non-motor applications:
  - 1. UL1077 supplementary protection up to 63 amps, 1 to 2 pole, AC or DC.
  - 2. Used where a UL489 protective device is upstream powering the circuit (from a panelboard or other source).
  - 3. Used within control circuits for power supplies, control power transformers, relays and PLC I/O points.
  - 4. Used in place of fuses that are applied as supplementary protection.
  - 5. Eaton FAZ, or equal.

## 2.03 FUSES AND FUSE HOLDER

- A. Fuses shall not be used in branch or control circuits unless specifically shown in the Drawings. Circuit breakers shall be furnished and utilized where possible.
- B. Fuses used in circuits 200 VAC and above shall be time delay, 13/32" x 1 1/2", and have an interrupting rating of 10,000 AIC at 500 VAC. Fuses shall be Bussman type FNQ or approved equal. Fuse holders shall feature open fuse indication lights and shall be rated 30A at 600 VAC. Fuse holders shall be Bussman Optima Series OPM or equal.

- C. Fuses used in 120 VAC shall be time delay, 1/4" x 1 1/4", and have a rating of 250 VAC. Fuses shall be Bussman type MDA or approved equal. Fuse holders shall be of the same manufacturer, series and color as the adjacent terminal blocks and have blown fuse neon indicators. Fuse holders shall be Entrelec ML 10/13.SFL, Allen Bradley 1492-H4 or equal.
- D. Fuses used in signal and 24 VDC circuits shall be fast acting, 5mm x 20mm and have a rating of 250 VAC. Fuses shall be Bussman type GMA or approved equal Fuse holders shall be of the same manufacturer, series and color as the adjacent terminal blocks and have blown fuse LED indicators. Fuse holders shall be Entrelec M 4/8.SFDT, Allen Bradley- 1492-H5 or equal
- E. Fuses shall be sized in conformance with the NEC.

## 2.04 TERMINAL BLOCKS AND ACCESSORIES

- A. General
  - 1. Terminal blocks to be clamp type, 5 spacing, 300 volt, minimum rating of 20 amps, and mounted on DIN rail. DIN rail shall be same type as used for the relays. Install extra DIN rail on each type of terminal strip with 10% spare terminals for future additions.
    - a. Provide larger terminal as necessary based on gauge of connected wiring. Those terminals with 10 gauge larger gauge wiring or more than one 12 gauge wire should be evaluated and changed.
  - 2. Provide terminal blocks with "follower" plates that compress the wires and have wire guide tangs for ease of maintenance. Terminal blocks that compress the wires with direct screw compression are unacceptable. All power, control and instrument wires entering and leaving a compartment shall terminate on terminal blocks with wire numbers on terminals and on both ends of the wires.
  - 3. Provide end clamps, separators, din rails, and jumpers to complete terminal block system. See example PLC I/O drawing for additional information. Engineer can provide on request if not available in plans.
  - 4. Terminal Tags and Markers: Each terminal strip shall have a unique identifying alphanumeric code at one end ( i.e.: TB1, TB2, etc. ) or as shown in Drawings.
  - 5. Plastic marking tabs shall be provided to label each terminal block. These marking tabs shall have a unique number/letter for each terminal which is identical to the "elementary" and "loop" diagram wire designation. Numbers on these marking strip shall be machine printed and 1/8" high letters minimum.
  - 6. Terminal blocks shall be physically separated into groups by the level of signal and voltage served an by PLC I/O card. Power and control wiring above 100 volts shall have a separate group of terminal blocks from terminal blocks for wiring below 100 volts, intermixing of these two types of wiring on the same group of terminal blocks is not allowed.
  - 7. Terminal blocks shall be gray in color unless otherwise shown on the Drawings.
  - 8. Provide a ground terminal or connection point for each grounding conductor.

9. Provide a separate signal, common, and/or neutral terminal for every wire and PLC or remote device connection at minimum.

B. CP – Control Panel Terminal Blocks

<u>Description</u>	<u>Model number, Allen Bradley or equal</u>
General Purpose Terminal Block, 20A	1492-W3
Disconnecting Terminal Block, 20A	1492-JKD3
Grounding Terminal Block	1492-JG4
PLC AI Sensor Block, 3 Level. Use upper terminal for AI +/- and lower blocks for 24+ and 24-.	1492-WTS3 (2 per AI)
PLC Digital Output Relays, 120VAC, 6A, SPDT	700-HLT1U1

Note 1: General purpose relays are defined in ELECTRICAL – GENERAL

Note 2: Utilize two terminal blocks for each AI. Upper terminal shall be the analog signal, the middle block shall be 24v +, and the lower terminal shall be 24v -. Buss each terminal 24+ to each other, and buss each 24 – to each other utilizing terminal jumpers (copper finger buss or center screw type)

Note 3: Accessories are not listed such as end caps, anchors, jumpers, bridges, marking strips, or other items necessary to make up a complete terminal block layout. Furnish all parts necessary per manufacturer’s intended solution.

C. MCC – Motor Starter Cubicle Terminal Blocks

1. MCC cubicle terminal blocks shall be pull apart as supplied standard by MCC manufacturer.

D. Power – Power terminal Blocks

1. Backpan mounted termination blocks shall be rated for 600V (min). The power termination blocks shall be rated to accept Copper or Aluminum cable and rated as shown on Contract one-line diagrams. Termination blocks shall be insulated with molded plastic covering and finger safe cover. Each termination block shall be provided with quantity and size of primary and secondary cable connections as required per installation. The power termination blocks shall be Erico UD, UDJ, BD, TD, or SB series or equal.
2. Unmounted termination blocks shall be constructed of aluminum and suitable for use with Aluminum and copper wire. Size and quantity of cable connections shall be as required for installation. Termination blocks shall be insulated with molded high-dielectric strength plastic covering and eliminate the need for tape insulation of electric connection. The termination block shall have removable access plugs over the wire entry and hex screw ports. Provide NSI Polaris IPL or IPLD Series terminal blocks or equal.

E. Panel Receptacles

1. Ground fault circuit interrupter receptacles shall be used where shown for convenience use. Dedicated receptacles for equipment may be standard duplex outlets. GFI and standard receptacles shall be commercial grade, duplex, ivory, 20A, 120V, back and side wired. Furnish Leviton, Hubbel, or equal.

F. Panel Ground

1. Each electrical enclosure shall have a copper ground bus. Screw type fasteners shall be provided on all ground busses for connection of grounding conductors. Ground bus shall be a Challenger GB series, ILSCO CAN series or equal.
2. A 12ga. copper ground wire shall be attached between the ground bar and the panel enclosure, and between the ground bar and the mounting panels. The ground connection to the enclosure and panel shall be made by sanding the paint finish off a small area, drilling a hole for a 0.25 inch bolt and mounting a 0.25-20 bolt to the panel to serve as grounding stud. The grounding stud shall be attached with a nut and flat washers on both sides of the enclosure/panel, and with an inside tooth star lock washer next to the panel surface. The star lock washer shall be on the inside surface of the enclosure, and the front surface of the mounting panel. The grounding wire shall be secured to the stud with a nut and inside tooth star lock washer. These grounding points shall be located within 12 inches of the bottom to the grounding bar. Each terminal strip rail shall be individually grounded by means of a #12 AWG wire to the ground bus.
3. Components within the panel shall be grounded according to the manufacturer's recommendations.

## 2.05 POWER SUPPLIES

A. Uninterruptible Power Supply (UPS)

1. The UPS shall be installed within the control panel and power all process related 120 VAC devices and DC power supplies.
2. The UPS capacity/size shall be as shown in the contract Drawings. The battery capacity shall be such that it may provide nameplate power for 10 minutes (min) from a fully charged battery(s).
3. The UPS shall provide surge protection and filtering: 0.3% IEEE surge let-through, zero clamping response time to meet UL 1449. The inverter shall provide true sine wave output.
4. When the Utility power voltage is outside of a preset range (approx.  $<100 < V < 130$  VAC) then the UPS shall power the load from storage batteries and a solid state inverter.
5. The power supply shall be wired into the control panel power circuit per the contract Drawings.
6. The UPS operating ambient temperature range shall be 32 deg F to 122 deg F minimum.
7. The inverter shall be self resetting and continuously on-line regardless of the Utility power existence. Configure the UPS to restart automatically upon restart

of utility power without operator intervention. The rectifier/charger shall recharge and maintain float charge on the batteries automatically.

8. The UPS shall be of a readily available commercial manufacturer. Provide American Power Conversion Smart UPS with SMART slot I/O module, or equal.

B. DC Power Supply (PS)

1. The DC power supply shall utilize a switching power stage, rectifier and voltage regulator. The power supply case shall be DIN rail mountable.
2. The power supply shall operate on 120V AC and provide DC output voltage and current as shown in the Contract Drawings.
3. The power supply shall be wired and fused per manufacturer instructions and Contract Drawings. Power supply output shall include self resetting overcurrent protection.
4. Power supplies below 101 Watts output power shall be Class 2 rated.
5. The power supply shall provide 2% voltage regulation for a change of 10% load to 100% full load.
6. The DC power supply shall be IDEC PS5R Series (non-redundant applications), Sola SDN-C, Phoenix Contact Quint Power, or equal.

## 2.06 MISCELLANEOUS COMPONENTS

- A. Wireway: Manufactured from light gray rigid PVC suitable for continuous use at temperatures up to 50 deg C. Wireway shall be 2" height, width as required with 0.5" slot spacing with removable covers. Provide Panduit type "F" or equal.
- B. Intrusion Switch: The intrusion switch shall have a pin plunger that is depressed when the door is closed. The form C contacts shall be rated 2A at 120 VAC. Provide Hoffman A-LFSWD, Microswitch 1AC2 or equal.
- C. LED Strip Light: The LED light shall be an "under cabinet" style with multiple LED lamps and acrylic diffuser. Lamp shall be switched on/off from integral switch or PIR motion sensor. Light housing shall be capable of magnet mount to top or side of enclosure or will include mounting tabs for mounting to brackets. Lamp shall be powered from 120VAC or from 24~48 VDC or shown in the contract Drawings. LED Strip Light shall be Stego 02540, or equal.
- D. Circulation Fans: The control panel temperature shall be maintained 10 deg. F below lowest internal device's temperature rating. The fans shall be 4" or 6" unless otherwise noted on Contract Drawings. The Contractor shall calculate the heat generation of all internal components and determine if the fans submitted will meet the cooling requirements of the internal components. Circulation fans shall include louver with filter and bug screen for outdoor installations.
- E. Forced Air Heater: The control panel temperature shall be kept above 50 deg. F through the use of a resistive forced air heater when the panel is located outdoors. The

heater shall contain a fan, heating elements, and thermostat within a single self contained unit. The wattage of the heater shall be as calculated by the supplier using the manufacturers sizing method to meet the temperature requirements. The heater shall be Hoffman D-AH series, or equal.

- F. Thermostats: The air circulation fans shall be controlled by adjustable thermostat. The thermostat shall be mounted near the top of the panel and easily accessible by a technician. The thermostat shall be capable of control of a heater or cooling fan(s) by selecting the proper contact logic. The thermostat range shall be adjustable from 30 to 140 deg F. Thermostat shall be Hoffman A-TEMxx, or equal.

## PART 3 EXECUTION

### 3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

### 3.02 FABRICATION

- A. Equipment Mounting:
  - 1. Mount all equipment using manufacturers mounting tabs/holes or brackets where possible. Where not possible, construct custom brackets to panel mount or backpan mount components as shown in the Contract Drawings.
  - 2. Equipment or laptop shelves shall be provided where shown on the Contract Drawings. Equipment shown on shelves shall not be placed on the bottom of the panel after field installation.
  - 3. All nuts, bolts, screws, washers and hinges used in the panel shall be stainless steel. All components shall be mounted using bolts or screw fasteners only which are drilled and tapped into the backpan. Pop rivets shall not be allowed within panel except for enclosure support arms.
- B. Environmental:
  - 1. Control panel environmental accessories including fans, louvers, filters, bugscreens, air conditioners, etc. shall be provided as noted in the Drawings and as necessary for a complete environmental solution.
  - 2. Panels environmental controls shall be designed during shop drawing submittal and fabricated to maintain temperatures 10 degrees F below lowest internal equipment maximum temperature rating.
  - 3. Contractor shall provide [additional] fans, louvers, screens, sunshades, air conditioners, etc. as necessary to prevent equipment malfunction or premature failure. Provide associated wiring and thermostats as needed.
  - 4. Environments:

- a. NEMA 4X rated panels shall be cooled/heated with closed loop type conditioning systems to include air conditioners, internal panel circulation fans and resistive heaters.
- b. NEMA 3R rated outdoor panels shall be cooled/heated with open loop type conditioning systems to include air conditioners, exhaust fans and louvers, internal panel circulation fans and resistive heaters. All exhaust fans and louvers shall include filters and bugscreens.
- c. NEMA 12 or 1 rated indoor panels shall be cooled/heated with open loop type conditioning systems to include air conditioners, exhaust fans and louvers, internal panel circulation fans and resistive heaters. All exhaust fans and louvers shall include filters and bugscreens.

C. Wiring:

- 1. Panel Wiring: All wiring shall be installed in wireways between terminal blocks, PLC, and devices. Reference Contract Drawings for control panel power distribution diagram and control panel elementary diagrams.

### 3.03 INSTALLATION

A. Wiring:

- 1. Install all equipment per Electrical Specifications [Electrical General].
- 2. All internal and field wiring shall be per Electrical Specifications [Low Voltage Wire].
- 3. Panel Wiring: All wiring shall be installed in wireways between terminal blocks and devices. Reference Contract Drawings for Control panel power distribution diagram and control panel elementary diagrams.
- 4. Field Wiring: Wireways shall be provided for field wiring. Reference Contract Drawings for control panel power distribution diagram and control panel elementary diagrams.

B. Cleaning:

- 1. The Contractor shall clean the inside of the control panel of any dust or debris remaining at the completion of installation and testing.
- 2. The Contractor shall exercise care when using a vacuum cleaner or compressed air such as not to damage any component within the panel.
- 3. Many electrical and computer components are open for ventilation. Falling debris can penetrate the openings and cause equipment failure. Equipment with debris inside shall be removed, cleaned and/or replaced.

### 3.04 FIELD ASSISTANCE

- A. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

3.05 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

3.06 FINAL ACCEPTANCE

- A. Final Acceptance per Electrical Specifications [Electrical General].

END OF SECTION

## SECTION 16910 - PLC & OI HARDWARE

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. Providing and installing Programmable Logic Controller (PLC) and Operator Interface Hardware and all supporting hardware, wiring and devices as specified in Electrical Specifications.

#### 1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Low Voltage Wire and Data Cable]
- C. Electrical Specifications [PLC and OI Application Programming]

#### 1.03 SUBMITTAL REQUIREMENTS

- A. Provide submittals per Electrical Specifications [Electrical General, Submittal Requirements].
- B. Submit documentation showing the number and type of I/O modules required to meet the I/O requirements specified herein. Include complete manufacturer's part and model numbers.
  - 1. PLC I/O points are determined by the P&ID Drawings. The Contractor shall count and total the PLC I/O points per PLC controller and per type of I/O required based on the P&ID diagrams. Provide 25% spare I/O points per I/O type per PLC.
- C. Submit calculations showing that the power supply meets the specified requirements and the requirements of the devices powered. Confirm PLC power supply is sufficient for all possible operable conditions.
- D. Submit shop drawings showing physical backpan layout of equipment in Control Panel.
- E. Submit communications block diagram including PLC, OI, motor controls, power supplies, switches, routers, radios, and any other connected components.
- F. Submit hardware Operations and Maintenance Manual per Electrical Specifications [Electrical General].

## 1.04 OPERATION AND MAINTENANCE INFORMATION

- A. Provide the following spare parts
  - 1. One I/O card of each type used.
- B. Provide special tools, cabling and equipment necessary for normal operation, maintenance and calibration.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. Provide PLC modules from a single family of products, using the same software and interchangeable I/O cards, that can be configured for a range of applications from small, uncomplicated sites to large, complex sites with a variety of equipment.
- B. Provide a PLC that will meet the following requirements:
  - 1. Size and provide a CPU and power supply to accommodate the CPU, I/O cards, communication devices, etc. as specified herein.
- C. Provide a PLC that can be expanded in the field by the addition of the following types of plug-in modules or cards and interface cables without rendering the originally furnished PLC components obsolete.
  - 1. Digital Inputs
  - 2. Digital Output
  - 3. Analog Input
  - 4. Analog Output with PID control
- D. Size the PLC enclosure such that local I/O modules and supporting hardware required to meet the ultimate point count, as specified herein, will fit into the space of a single enclosure.

### 2.02 MECHANICAL

- A. Provide modular PLC consisting CPU, power supply, communications, and I/O modules.
- B. Provide I/O modules with removable terminal strips so that I/O modules can be removed without disconnecting field wiring.

### 2.03 PLC COMPONENTS

- A. The following components (Allen Bradley, no equal) shall be provided to complete the PLC(s). Only major components are listed. Multiples of some components are required- see Drawings.

- B. Compact Logix 5380
  - 1. Processor – (1MB, 8 I/O, 24 IP nodes) 5069-L310ER
  - 2. Power Supply 5069-FPD
  - 3. Digital Input Module (AC) 5069-IA16
  - 4. Digital Output Module (Relay) 5069-OW16
  - 5. Analog Input Module 5069-IF8
  - 6. Analog Output Module 5069-OF4
  - 7. Extension Cable 5069-CRRx
  - 8. Address Reserve Module 5069-ARM
  - 9. Terminal Block 6 point 5069-RTB6
  - 10. Terminal Block 18 point 5069-RTB18
  - 11. Terminal Block 6-4 point 5069-RTB64

#### 2.04 ISOLATION/INTERFACE RELAYS

- A. Provide output isolation relays on all digital outputs that operate devices external to the control panel and on spare outputs or as otherwise shown in the Drawings. The relay coil connection shall be on one side of the relay base and form-C output contacts on the other.
- B. Relays shall be 6A SPDT, coil voltage as required, indicating, plug in style as manufactured by Allen Bradley 700-HLT1U1 or equal. Provide jumper bars for common buss connections, Allen Bradley 700-TBJ20G, or equal.

#### 2.05 ETHERNET SWITCH

- A. The unmanaged Ethernet switch shall have minimum 8 ports. Ports shall be 10/100 Base-Tx with RJ-45, 8 pin female connectors. Switch shall be suitable for power from 10 - 30 VDC. Switch shall be N-Tron 108TX, Allen Bradley Stratix 2000, or equal.

#### 2.06 IP SERVICE ROUTER

- A. Acceptable products: Netgate SG-2100.
- B. Provide shelf for panel mounting of router.
- C. General Specifications
  - 1. 2x 1 Gigabit WAN/LAN ports plus a 4 port switch provide high-speed wired connectivity
  - 2. PF-Sense firewall to support stateful packet filtering, firewall, and pure router capability.
  - 3. Supports IPsec, OpenVPN, PPTP, IPv6, NAT, BGP, RADIUS
  - 4. ARM v7 Cortex-A9, 2 GB DDR4L memory, M.2 expansion for SSD, or LTE.

## 2.07 BROADBAND WIRELESS CELLULAR ROUTER

- A. Acceptable products: Sierra Wireless RV50NX 4G LTE intelligent gateway, or equal. Compatible with Verizon and AT&T
- B. General Specifications
  1. Internet Connections Supported: 1 Embedded 3G/4G connection
  2. Networks Supported for Embedded Modem: Verizon 2G, 3G, and 4G
  3. Ethernet ports: 1 LAN, 10/100.
  4. SIM card slot for with broadband plan (by Owner)
  5. AC wall pack power supply or 12 to 28 VDC from panel power supply.
  6. AWS, LTE, HSDPA, HSDPA+
  7. Onboard IPsec SSL VPN client, SSH, HTTPS
  8. Operating Temperature: -30°C to +70°C (-22 to 158°F)
- C. Host Interfaces:
  1. 10/100 Base-T RJ45 Ethernet
  2. RS-232 Serial Port
- D. LED Indicators:
  1. Signal strength, Activity, Power
- E. Antenna:
  1. 800-1900 MHz Magnet Mount Antenna
  2. SMA Male Connector and 10-Foot RG174 Coax Cable
  3. Wilson Electronics, or equal

## 2.08 OPERATOR INTERFACE (OI)

1. Automation Direct C-More Model EA9-T15CL or equal.
2. Touch Screen
  - a. 15 inch screen size with 1024 x 768 resolution, 65536 colors.
  - b. TFT color touchscreen with LED backlight and 300nits brightness.
  - c. Alarm history screen with present status and acknowledge functions.
3. Communications
  - a. Modbus RS232, RS485 and Ethernet communication options. Provide cables for connection to PLC.
  - b. Built in Web server for remote access and viewing screens on a network Windows computer.
  - c. Remote control of process through web server interface.
  - d. Type B USB port for programming.
  - e. Type A USB port for data logging and alarm history.
4. Data storage
  - a. 82MB backed up RAM for program, Two SD RAM slots for data.
  - b. Furnish one 32GB SDHC card for data storage.
  - c. Trending for up to 16 pens (colors) with historical data access from USB RAM drive.

5. Furnish EA9-PGMSW programming software with original packaging.
6. Environmental conditions:
  - a. Operating Temperature: 32 to 122 degrees F
  - b. Storage Temperature: -4 to 140 degrees F
  - c. Humidity Rating: 10 to 90%, non-condensing at 32° F to 86° F
  - d. Rating: NEMA 12, 13, 4X (indoor only)

## PART 3 EXECUTION

### 3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

### 3.02 INSTALLATION

- A. Fabrication
  1. Mount, wire and Ground PLC and OI per manufacturer's recommendations.
  2. Organize equipment on control panel backpan per Backpan Layout detail in Contract Drawings.
  3. Locate and install PLC(s) and OI(s) per Contract Drawings.
- B. Wiring
  1. Terminate status, control and analog wiring on terminal blocks.
  2. Label and wire PLC to terminal blocks per Electrical Specifications [Wire, Fuses & Terminal Block] and Example I/O Wiring Diagram in the Drawings.
  3. All spare I/O points shall be wired to terminal blocks.
  4. Install communication cables to connect the PLC to external devices.
  5. Bundle and tie down wires in a neat and orderly manner.
  6. Terminate drain wire of shielded cables at backpan terminal block only.

### 3.03 FIELD ASSISTANCE

- A. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

### 3.04 WARRANTY

- A. Provide warranty per Electrical Specifications [Electrical General, Warranty].
- B. Perform the following services during the warranty period:
  1. Repair or replace damaged modules returned for service within 24 hours.
  2. Determine and report the cause of failure of modules returned for service.
  3. Resolve design or implementation problems discovered.

3.05 FINAL ACCEPTANCE

- A. Final Acceptance per Electrical Specifications [Electrical General].

END OF SECTION

## SECTION 16940 – INSTRUMENTATION

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. The major components in the instrumentation scope of work are:
  - 1. Furnish, configure, test, commission, and warrant instrumentation as shown in the P&IDs, plans, and/or listed in specification section.
    - a.
  - 2. Include necessary piping, valves, pressure reducers, mounting brackets or flanges, supports, and anchors to complete installation.
  - 3. Provide sunshades for instrumentation for all instruments that are exposed to direct sunlight.
- B. System Integrator selection of instrumentation shall be per manufacturer's recommendation for the application and per specifications. If a manufacturer's recommendation or installation instructions are inconsistent with the Contract installation details or specifications, then the Contractor shall submit an RFI describing the inconsistency. If the inconsistency is due to substitution from the first named equipment, then the responsibility of coordination and any additional cost shall be borne by the Contractor.
- C. Projects that come into contact with drinking water: (NSF-61 certification)
  - 1. Furnish NSF/ANSI 61 certified products that have undergone testing for any device, valve, instrument, or assembly that will come into contact with drinking water.
  - 2. The certification determines what contaminants may migrate or leach from the product into drinking water and confirms if they are below the maximum levels allowed to be considered safe.
  - 3. Flowmeters, pressure transmitters, and chemical analyzers are a few of the products that may fall into this category requirement.
- D. Provide all devices, valves, tubing, fittings, wiring, terminal blocks, calibration consumables, initial calibration equipment, accessories, sunshades and enclosures as specified herein and as shown on Contract Drawings.
- E. The Contractor shall furnish all tools, calibration equipment, calibration materials, specialized parts and incidentals necessary to integrate the instrument to the application.
- F. Contractor shall furnish labor for installation, verification, start-up, calibration, testing and commissioning. Contractor shall prove proper function of instrument prior project completion.

## 1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Factory and Field Testing]

## 1.03 SUBMITTALS AND DRAWINGS

- A. Submit shop documents and drawings for approval in accordance with this subsection and as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Submit Operating Instructions (O&M Manuals) for each instrumentation device prior to equipment installation.

## 1.04 OPERATING AND MAINTENANCE INFORMATION

- A. Provide operating instructions as specified in Electrical Specifications [Electrical General, Operating and Maintenance Instructions].

## PART 2 PRODUCTS

### 2.01 QUALITY

- A. Electrical Specifications [Electrical General, Quality].
- B. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without requiring a manual reset.
- C. Signal transmission from remote or field electric and electronic devices shall be 4-20 mA, sourced by a 24 VDC supply internal to the instrument or from a 24 VDC power supply located within the panel that is to receive the signal. Nonstandard transmission methods such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted.
- D. Transmitters or devices located in Class 1, Division 1 hazardous areas shall be rated for hazardous location installations per NEC and UL. Explosion proof enclosures and raceways or current/spark limiting devices located inside or outside of the classified area shall be furnished to comply with code requirements.
- E. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately converted to 4-20 mA signals for remote transmission.

## 2.02 INSTRUMENT IDENTIFICATION

- A. All major instrumentation and equipment items or systems specified in this Division and/or on the P&IDs are identified by tag numbers. Tag field equipment with assigned instrumentation tag number and functional description.
  - 1. Tags shall be 1/2" stainless steel DYMO impressed tape with 3/16"(minimum) height characters.
  - 2. Metal tape embosser shall feature a built in hole punching device and scissor cutoff tool.
- B. Attach tags to equipment with a 4" long, 20-gage stainless steel wire leash for small devices, or two stainless steel screws for larger instruments; however, such permanent attachment shall not be on an ordinarily replaceable part or in an area that will be subject to unintended overuse fatigue. Make the tag plainly visible.

## 2.03 LEVEL COMPONENTS

- A. Submersible Level Transmitter
  - 1. The submersible level transmitter shall be 4-20 mA loop powered with integral manufacturer's cable containing electrical conductors and breather tube. The transmitter shall include lightning protection and a desiccant air dryer for installation on the end of the breather tube.
  - 2. Lightning protection
    - a. Lightning protection shall be incorporated within the level transmitter and shall be consistent with IEC 61000-4-5, Level 4 requirements.
    - b. Lightning protection module shall be installed in termination box and grounded per manufacturers instructions.
  - 3. The calibration of the level transmitter and cable length shall be as shown in the instrument schedule.
  - 4. The body of the transmitter shall be rated IP68 and constructed of stainless steel with a ceramic diaphragm measuring cell. The transmitter shall be suspended from the electrical cable.
  - 5. The submersible level probe shall be Endress and Hauser FMX-21 Water Pilot or approved equal.
- B. Radar Level Transmitter:
  - 1. The radar level transmitter shall utilize non-contacting radar signal reflection technology to provide level monitoring for up to 66 ft range.
  - 2. The transmitter shall feature advanced echo processing algorithms that can be configured to ignore selected echos.
  - 3. The level indicating transmitter (LIT) shall have the following features:
    - a. Rated for Class 1, Div. 2 hazardous atmospheres.
    - b. 6" Flange connection, 4" antenna cone, 8 degree beam angle with antenna extension as required to enter tank completely.
    - c. NEMA 4X / IP65 enclosure.

- d. 2 wire 24 vdc loop powered, ground isolated, 4-20 mA output, max load of 750 ohm.
- e. Integral 3 button keypad for configuring parameters.
- f. Integral 1" x 3" (min) backlit LCD display.
- g. Operating temperature range from -40 to 140 deg. F in full sunlight.
- 4. The calibration of the level transmitter shall be as shown in the instrument schedule.
- 5. Coordinate with Contractor for antenna length extension as required such that it extends below installation pipe tube completely.
- 6. The radar level transmitter shall be Endress and Hauser Micropilot FMR20 40mm antenna, or equal.

## 2.04 PRESSURE COMPONENTS

### A. Gauge, Absolute, or Differential Pressure Transmitter:

- 1. The pressure indicating transmitter shall be a loop powered, two wire, 4 20 mA signal transmitting device with signal derived from the applied sensor pressure. Transmitter shall be capable of driving 0 to 500 ohm loads with 24 VDC supply.
- 2. The transmitter shall have the following features:
  - a. Programmable 4-digit Liquid Crystal Display (LCD) process indicator.
  - b. HART programming with programming selections for square root extraction, output calibration, and adjustable dampening 0.0 to 36.0 seconds, minimum.
  - c. Integral microprocessor based circuitry with RFI filtering and shielding.
  - d. The transmitter shall have accuracy of +/- 0.1% of span over a range of minimum 10 to 1 turndown. Elevated zero setting capable of 0-30% upper calibration limit.
  - e. Operating temperature range shall be -40 to 185°F (minimum). Process wetted materials shall be compatible with fluid being measured with minimum hastalloy or ceramic diaphragm and 316 stainless steel wetted parts.
  - f. Process connection shall be as follows:
    - 1) Low solids content - 1/2" MNPT with calibration valve.
    - 2) High solids content - 1-1/2" or 2" flange with flushing ring and valve.
    - 3) And as required per installation detail.
  - g. The transmitter shall be scaled as shown in the instrument schedule.
- 3. Provide mounting bracket per mounting requirements shown in Contract drawings.
- 4. The gauge pressure transmitter shall be Endress and Hauser Cerabar M PMC 71, Rosemount Smart 3051, or equal.

### B. Calibration Valve:

1. Calibration valve for use with gauge transmitters shall have the following features:
  - a. Stainless steel body with integral blocking valve and calibration valve and port.
  - b. Calibration port shall be 1/4" FNPT with 1/4" MNPT x 1/2" FNPT adapter.
  - c. Valve shall have a non-rotating stem tip and a fully backseated bonnet.
  - d. Process and transmitter connections shall be 1/2" MNPT. Include 1/2" stainless steel close nipple as required.
2. Calibration valve shall be Hex HB59, Anderson Greenwood, or equal.

C. Pressure Switch:

1. Each pressure switch shall be SPDT rated minimum of 15 amps @ 120VAC. Pressure switch shall consist of a pressure sensing mechanism and the switch itself enclosed in a NEMA rated housing. Pressure switch shall be diaphragm type with stainless steel wetted parts and mechanical snap action switch. Switch shall have two setpoint adjustments (trip & reset setpoints), narrow deadband with setpoint indicator calibrated in engineering units. Pressure switch shall be UL listed. The pressure switch shall be Static-O-Ring 66 Series, Ashcroft B series; ASCO or equal.

D. Pressure Gauge:

1. The pressure gauge shall be 1% accurate with C-type bourdon tube. The bourdon tube, socket and connection tube of the gauge shall be 316 stainless steel. The case and bezel ring shall be constructed of type 304 stainless steel. The dial shall be 4" in diameter with a black pointer and a white gauge face with black print. The gauge shall be filled with liquid glycerin. A bottom mount process connection shall include a snubber as a separate component. The process connection shall be 1/2" stainless steel. The pressure gauge shall be Ametek gauge model 1550, Ashcroft 1009, or equal.

## 2.05 FLOW COMPONENTS

A. Magnetic Flow Meter:

1. The magnetic flow meter shall consist of a flow tube FE and a converter FIT, complete with interconnecting cables.
2. The magnetic flow meter shall be of the low frequency electromagnetic induction type and shall produce a DC pulse signal directly proportional and linear to the flow rate, with the duration not less than 100 milliseconds. Complete zero stability shall be an inherent characteristic of the metering system. Meters requiring field zero adjustment will not be acceptable. The meter accuracy shall not be affected by changes in fluid pressure, temperature, viscosity, or conductivity.
3. Accuracy

- a. The maximum error of the complete metering system including flow element and flow indicating transmitter shall be 0.30% of actual flowrate (in specified units) and readout over the range of full scale velocity settings from 1 to 30 feet per second. Variations in temperature, voltage, and frequency within the ranges listed herein shall not affect the overall measuring accuracy.
  - b. The flow meter shall not require more than three diameters of straight pipe length from the center of the meter to upstream or downstream obstructions to obtain specified accuracies.
  - c. Lack of straight pipe or obstructions to straight length pipe requirements shall not cause overall flowmeter inaccuracies to exceed more 0.5% of actual flowrate over the range of full scale settings from 1 to 30 feet per second.
4. Flow Element (FE)
- a. The flow element shall be based on a pipe spool with ANSI class 150 flange connections or be flangeless construction as required by mechanical drawings. Class 300 flanges shall be provided where shown or when the pressure and temperature of the process fluid exceeds the rating of a 150 lb flange. The flow element size shall be as shown in the mechanical drawings and listed in the Instrumentation Schedule. Flange type and bolt pattern shall be coordinated with the mechanical Contractor prior to submittal.
  - b. The flow element shall have Hastalloy C4 coil and grounding electrodes.
  - c. Stainless steel grounding rings shall be provided at both ends of the flow element for all flowmeter applications. Grounding rings shall be manufactured from stainless steel, 2 mm thickness with grounding tab for electrical wire connection, and fit within the flange bolt circle. Grounding ring shall be self centering within pipe.
  - d. The flow element internal liner material shall be Teflon, polyurethane or hard rubber, unless recommended otherwise by the manufacturer for the application and approved.
  - e. Nema rating as defined in the Instrumentation Schedule.
5. Flow Indicating Transmitter (FIT)
- a. The electronic flow indicating transmitter shall be mounted remotely from flow tube as shown on Contract drawings.
  - b. The electronic transmitter shall be provided in a NEMA rated enclosure per the Instrumentation Schedule.
  - c. The transmitter shall be interchangeable with all sizes of flow elements and shall be field replaceable (without replacing flow element) in the event of transmitter failure.
  - d. The transmitter shall be microprocessor controlled, utilizing digital signal processing with automatic zero correction to provide a linear 4 20 mA signal proportional to flow rate.

- e. The transmitter shall incorporate a high impedance amplifier of 100,000 Megohms or greater, eliminating the need for electrode cleaning systems.
  - f. The transmitter shall contain a self test mode to allow the operator to manually simulate the output 4 20 mA signal to any value between 0% and 100% to check out any driven devices in the loop.
  - g. Rate indicator and totalizer: An alphanumeric LCD backlit display shall be provided to continuously display the flowrate and totalizer with units and all programming functions.
  - h. All programming configuration of the Flowmeter shall be completed through the transmitter's pushbutton interface. A communication device shall not be necessary to configure the flow transmitter.
  - i. PC based software shall be available and included for configuration and troubleshooting. Connection to flowmeter shall be via computer USB port and include interface cables as required.
  - j. The transmitter shall be designed for operation from a power source of 120 volts AC, with a power consumption of less than 20 watts. The flow element shall be powered from the transmitter.
  - k. The transmitter shall operate continuously without fault in an ambient temperature range from 14 to 140 °F. The flowmeter shall be suitable for operation in direct sunlight without the use of a sunshade. If a sunshade becomes required after installation for any operational reason, one shall be furnished and installed free of charge.
  - l. The following configurable parameters shall be provided at a minimum:
    - 1) Field adjustable flow signal dampening.
    - 2) Low flow cutoff (forces zero flow signal) between 0.0-5.0% of full scale rate.
    - 3) Empty pipe detection (forces zero flow signal) if the pipe is not full.
    - 4) Selection for forward/reverse/both flow directions.
6. Flow Indicating Transmitter (FIT) I/O Interface
- a. Flow Signal: 4-20 mA signal proportional to the flow. The signal shall be field configurable for the flow calibration specified and others within the flow tube accuracy range. The flow signal shall be capable of measurement for forward and reverse flows combined by offsetting zero to mid scale (12 mA).
  - b. Flow Totalization Pulse: The Flowmeter shall feature a pulse output that is scaled to 1000 gallons per pulse unless otherwise shown.
    - 1) Provide solid state interfacing relay within control panel (as required) between flow meter voltage output and PLC discrete voltage input. Provide any necessary interfacing devices to make flow meter pulse duration and output rate compatible with PLC discrete pulse input rate.
  - c. Meter Positive Zero Return: This contact input shall force the flow reading and output flow signal to zero flow.

- d. Flow direction digital output: Open collector transistor or relay output capable of driving 24 volt interface relay up to 100 mA. Output shall be configurable for either forward or reverse flow directions.
- 7. If the flow indicating transmitter (FIT) is shown in the Contract drawings to be mounted remotely from the flow element (FE), the manufacturer shall provide all cabling between flow element and flow indicating transmitter.
- 8. All mounting hardware and/or devices necessary to complete the installation shall be provided by the manufacturer at no additional cost to the Owner.
- 9. The meter shall be hydraulically calibrated at a facility located in the United States and the calibration shall be traceable to the National Bureau of Standards. A certified copy of the calibration test results shall be submitted to the Owner prior to shipment of the meter.
- 10. The magnetic flowmeter shall be Endress and Hauser Promag 400L, Rosemount 8705, or equal.

B. The flow switch for eyewash/shower service:

- 1. Vane operated to actuate 5A DPDT 120 VAC snap action switch. Motion of the vane shall actuate the switch by action of a magnet linked to the switch inside the sealed switch body.
- 2. Pipe connections 1-1/4" NPT inlet and outlet.
- 3. Flow activation of switch at 2.4 GPM and above.
- 4. Flow activation Flow switch shall be W.E. Anderson Dwyer Flowtect, Item No. 166550-00, Haws Model SP154DPDT, or equal.

## 2.06 ANALYTICAL ELEMENTS

A. Residual Sulfite Analyzer

- 1. The sulfite monitoring system shall consist of an electronic monitor, a chemistry module containing a gas phase sulfite sensor, pumps and associated accessories.
- 2. Sulfite monitors shall measure residual sulfite using the method of acidification of the sample containing sulfite ion and measurement of the sulfur dioxide released from the solution. The released sulfur dioxide shall be measured by air stripping it from the treated sample and passing the air/gas stream past a special gas phase sulfur dioxide sensor. This method shall insure that the residual sulfite concentration can be read continuously without contact between the sensor and the sample.
- 3. The chemistry module component shall provide the sample conditioning and air stripping components required for sulfite measurement. Peristaltic pumps shall provide sample and reagent metering, with quick-load pump heads to facilitate tube changes. Air stripping of the sulfur dioxide shall occur in a special stripping chamber with air supplied from an internal diaphragm pump. Airflow shall be controlled at a fixed flow rate using a precision metering valve, and an internal rotameter shall provide flow indication. A sample overflow assembly shall be provided on the outside of the chemistry module. This assembly shall

allow high sample flow rates (10-20 GPH) to the analyzer to reduce sample transport time to a minimum.

4. The sensor for the sulfite measurement shall be a special gas phase sulfur dioxide sensor which plugs into the sensor flow block. Air passes through the stripping chamber and removes the sulfur dioxide from the water phase and into the gas phase. The sulfur dioxide-rich air then flows out of the stripping chamber and into the sensor flow block. The sulfur dioxide diffuses into the sensor where it reacts with the sensing electrode. The sensor shall generate a current signal linearly proportional to measured sulfur dioxide concentration, and a 25-foot sensor cable shall be supplied for connection to the sulfite monitor. The sensor shall have a quick-disconnect plug at the back to facilitate sensor replacement when necessary.
5. Monitors shall be powered by 90-260 VAC single-phase line power. The monitor shall provide two isolated 4-20 mA outputs as standard, with an option for a third 4-20 mA output. Outputs shall be configurable for sulfite concentration, temperature, or PID control. Analog outputs shall be both ground isolated and isolated from each other. The chemistry module shall be powered by either 115 VAC or 230 VAC.
6. For alarm purposes, monitors shall contain three SPDT relays. Relay functions shall be programmable for control, alarm, or fail functions, and may be designed for either normal or failsafe operation. For monitors supplied with only 2 analog outputs, monitors shall have the option of an additional 3 low-power relays to allow for additional external alarm functions.
7. The residual sulfite monitor electronic assembly shall provide a variety of functions as follows:
  - a. Provide user selectable display of PPM residual sulfite, process temperature, or PID % output on the main display. Main display variable shall be indicated with a minimum character height of 0.75" to allow easy readability up to 20 feet away.
  - b. Allow selection of operating ranges of 0-200 PPB, 0-2 PPM, or 0-20 PPM. Display ranges shall be configurable by operators, or the monitor may be configured for Auto-Ranging. The auto-ranging function shall automatically switch to the display range that provides the best resolution for any given operating level.
  - c. Provide the ability to use the 4-20 mA output for PID control. Proportional, Integral, and Derivative functions shall be user adjustable, and also provide for output hold when needed.
  - d. Provide two isolated 4-20 mA outputs, with output spans programmable by the user for any segment of a display range. An optional third analog output is available, providing separate outputs for residual sulfite and temperature.
  - e. Provide output hold and output simulate functions to allow for testing or remote receiving devices or to allow maintenance without disturbing control systems.

- f. Provide three 6 amp SPDT relay outputs in standard unit. Software settings for relay control include setpoint, deadband, phase, delay, and failsafe. Provide an optional 3-relay card, for 0-30 V signals, to bring the total to 6 relays. Relays shall be programmable for either control or alarm function, or relays may be assigned to diagnostic functions for use in indicating trouble conditions at a remote location.
  - g. Provide option for digital communications. These options shall include Profibus-DP, Modbus-RTU, or Ethernet-IP.
  - h. Diagnostic functions shall be incorporated into the transmitter. The 4-20 mA output shall be capable of being assigned to safely rise to 20 mA, fall to 4 mA, or be left alone, during diagnostic failures. Diagnostic error messages shall be displayed in clear language; no confusing error codes shall be displayed.
8. The complete Residual Sulfite Monitor shall be Series Q46S/66 as manufactured by Analytical Technology, Inc. or approved equal.

**B. Chlorine Residual Analyzer:**

- 1. Description: Direct sensing chlorine analyzer to monitor a continuous flow of process water to determine free chlorine residual level.
- 2. On-line Chlorine Analyzer shall be provided to continuously measure FREE chlorine residual as shown in the P&IDs or shown in other drawings.
- 3. The Chlorine Analyzer shall consist of a direct measuring chlorine sensor, a clear constant-head flowcell, 25 feet of sensor interconnect cable with quick disconnect plug, and an electronic monitor housed in a NEMA 4X enclosure suitable for wall, pipe, or panel mounting.
- 4. The system shall provide continuous on-line measurement of residual levels from 0-5 mg/l to 0-20 mg/l. The display shall be capable of 0.01 mg/l resolution (min) for the lower scale range.
- 5. Operating temperature: 32° F to +122° F. Provide sunshade when exposed to direct sunlight.
- 6. Analyzer Electronics.
  - a. The analyzer shall be controlled by microprocessor based electronics powered from 120 VAC. Analyzer shall be protected from voltage fluctuations commonly found in water/wastewater applications. Additional external noise filtering shall be provided as necessary for a robust and operational system. System lock-ups or microprocessor malfunctions will be grounds for rejection throughout the warranty period.
  - b. Analyzer electronics shall be enclosed in a NEMA 4X polycarbonate enclosure.
  - c. User interface shall include a membrane keypad and backlit LCD display.
  - d. Alarm conditions shall be identified through the display.
  - e. The system shall have one isolated 4-20 mA output which represents chlorine residual and scaled by the user during commissioning from a

- selected list of ranges from 0-0.1 to 0-200 mg/l. Output signal shall be configurable to desired span without recalibration of the sensor.
- f. Three (3) user configurable alarm relays shall be provided for low residual, high residual and diagnostic conditions.
  - g. Relay contacts shall be rated 5 amperes at 120 vac.
7. Flowcell assembly:
- a. Constructed of colorless and clear material allowing the condition of the sensor membrane to be inspected without removal of the sensor.
  - b. The sensor shall slide easily into the side of the flowcell, with a double o-ring seal to prevent water leakage.
  - c. Flow to the sensor shall be regulated automatically through a constant-head overflow arrangement. Hose barbs for sample inlet (1/4" I.D. tubing) and drain (1/2" I.D. tubing) shall be supplied as part of the flowcell.
8. Chlorine Probe
- a. The chlorine sensor shall be a direct measuring polarographic sensor utilizing a special polymeric or aperometric membrane to isolate the sensing electrodes from the sample and eliminate the potential for electrode contamination.
  - b. The membrane shall allow chlorine to diffuse into the sensor where it shall react with the sensing electrode, generating a signal that is linearly proportional to chlorine concentration. The sensor assembly shall also contain a precision RTD temperature sensor to continuously measure sample temperature to allow temperature compensation of the measured chlorine value.
  - c. The probe shall include temperature sensor for temperature compensation in chlorine measurement.
  - d. The chlorine sensor shall be constructed with a quick disconnect receptacle to allow easy sensor servicing or exchange.
9. PH Sensor:
- a. The chlorine monitor shall be supplied with a pH sensor. The pH sensor shall allow free chlorine monitors to automatically correct the chlorine value for changes in sample pH to maintain measurement accuracy over wide pH swings from pH 7 to pH 9.5.
  - b. The pH sensor shall fit into the inlet chamber of the chlorine sensor flowcell.
  - c. The pH value shall be available for display on the second line of the monitor display, and one analog output shall be assignable as a pH output
10. Backboard:
- a. Provide all components, mounted, wired, and plumbed on a 3/8" thick sheet of ultra high molecular weight polyethylene (UHM) for wall or panel interior mounting.

- b. If shown in drawings with an enclosure, or if located outdoors, furnish 316 stainless steel, fiberglass, or polycarbonate enclosure sized as appropriate for backboard.
- 11. Spare Parts.
  - a. Provide at least 10 of each, spare membranes, electrolyte refills, o-rings, and other consumable items as needed.
- 12. Chlorine Analyzer shall be ATI Q46H, no equal.

2.07 TEMPERATURE DEVICES

- A. NOT USED

2.08 EVENT, STATE OR POSITION DEVICES

- A. Position Switch:

- 1. Door switch – door intrusion switch shall have a wide gap magnetic sensor with S.P.D.T. contacts mounted in 1535an extruded aluminum housing with integral 3 foot stainless steel armored cable for wiring to a junction box. Switch contacts shall have 0.25A at 30VAC/VDC minimum capability. When attaching to a ferrous metal surface, space sensor components away from metal by minimum ¼” using plastic spacer in order to maintain magnetic gap. Intrusion door switches shall be Sentrol 2507-A or equal.
- 2. Overhead door switch – door intrusion switch shall have a wide gap magnetic sensor with S.P.D.T. contacts mounted in an aluminum housing with integral 3 foot stainless steel armored cable for wiring to a junction box. Switch contacts shall have 0.5A at 30VDC minimum capability. When attaching to a ferrous metal surface, space sensor components away from metal by minimum ¼” using plastic spacer in order to maintain magnetic gap. Intrusion door switches shall be Seco-Larm SM Series, Sentrol 2200 series or equal.

- B. Solenoid Valve:

- 1. General:
  - a. Liquid / Air or Inert gas for general service
  - b. Brass Body with NPT fittings per drawings.
  - c. Watertight NEMA 4X (minimum) or Explosion-proof as required per area designation in drawings.
  - d. Replaceable operating coil operating from 120 VAC or as otherwise shown in the drawings.
- 2. Solenoid valve shall be ASCO 8210 series or equal.

- C. Smoke Detector:

- 1. General
  - a. The smoke detector shall detect smoke produced by fire and signal an alarm system. The detector shall be housed in a flame retardant plastic housing and shall be unaffected by vibration. Detector shall be sealed against dirt, insects and back pressure

- b. Detector shall utilize photoelectronic sensor technology.
  - c. The detector/base shall be 120V, four-wire operation with built-in Form A and Form C dry contacts. Form A contact shall be rated for 2.0A at 30VAC/DC. Form C contact shall be rated for 2.0A at 30VAC/DC and 1.0A at 120VAC.
  - d. The detector shall have an operating temperature 32 to 120°F and an operating humidity of 10 to 93% relative humidity.
  - e. The detector shall have built-in test switch (magnetic proximity actuation) and 360 degree view angle of built-in alarm LEDs.
  - f. The detector shall be approved by UL and Factory Mutual and meet requirements of NFPA 72.
2. The fire alarm smoke detector shall be photoelectric type. The smoke detector shall be System Sensor 100 Series model 2151 with B114LP base, Gentex 8000 Series with 120VAC base, or equal.

## 2.09 INSTRUMENTATION SCHEDULE

- A. The Instrumentation Schedule spreadsheet (located at the end of this section) is intended to be a summary of instrumentation equipment required for this project. Not all instrumentation details are shown on the schedule. Some requirements may be shown in the Instrumentation Schedule such as enclosure rating and instrument span that are not described in the specifications. Both are required for a complete specification.
- B. If an instrument is shown in the P&IDs or on the site plan, then the device shall be provided whether or not it is shown on the Instrumentation Schedule.

## PART 3 EXECUTION

### 3.01 WORKMANSHIP

- A. Instrumentation work shall conform to workmanship standards specified in Electrical Specifications [Electrical General, Workmanship].
- B. The Contractor shall employ personnel who are skilled and experienced in the installation and connection of equipment defined in this section. Contractor qualifications are specified in Electrical Specifications [Electrical General].
- C. Verify that all equipment and materials fit properly.
- D. All instrumentation configuration, programming and calibration shall be completed prior to the start of field tests.
- E. Equipment without approved submittals shall not be installed.

- F. All equipment shall be properly stored indoors while awaiting installation. Protect installed equipment from construction debris or mishaps. The Contractor will replace any equipment that is not in new condition at the time of installation and/or start-up.
- G. Perform work to remedy non-compliant installations after inspection.

### 3.02 INSTALLATION

- A. Install and supply all products necessary to provide an operational instrumentation system. This shall include the following:
  - 1. Contract Drawings are intended to show the basic functional requirements of the instrumentation system. Insufficient detail does not relieve the Contractor from the responsibility to provide a complete and functioning system. If additional detail or clarification is required, the Contractor shall request such information prior to installation.
  - 2. Provide relays, signal converters, isolators, boosters, power conditioners, circuit cards, and other miscellaneous devices as required for the compatible and functional interface.
  - 3. Provide analog loop isolators where required to eliminate "ground loops."
  - 4. The instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions and located as shown on the Drawings or as approved. When manufacturer's installation literature specifies a particular location or orientation in a process line due to measurement accuracy considerations, the installation shall be in conformance with the manufacturer's instructions.
- B. Instrument installation methods.
  - 1. Install instruments at the location shown on the Plans or approved. Instruments enclosures shall be NEMA rated for the installed location.
  - 2. Install level and plumb.
  - 3. All instruments shall be provided with floor stands or wall brackets as shown in installation details or as required for functional installation.
  - 4. Mounting stands shall be custom manufactured of aluminum channel with base plate unless otherwise noted in installation detail.
  - 5. Mounting channels (unistrut), and spacers shall be galvanized steel above ground outdoors and stainless steel below ground (wetwell), unless otherwise noted in installation details.
  - 6. All screws, bolts and anchors shall be stainless steel.
- C. Wiring and raceway installation methods:
  - 1. Terminal blocks shall be provided at all instrument cable junctions and all wires shall be identified at such junctions.
  - 2. Instrumentation wiring shall be run without splices between instruments, terminal boxes, or panels.

- D. Wiring, grounding, and shielding: The following practices shall be observed unless modified by manufacturer's standards.
1. Each electronic equipment chassis shall be grounded to power ground.
  2. Shielded twisted pair, shielded triad, or manufacturer supplied cables only shall be used for analog signals and communications signals.
  3. Drain wire of shielded cables used for analog inputs to the PLC shall be connected at the PLC unit only. Shield shall be isolated from ground at all other termination points including transmitters.
  4. Drain wire of shielded cables used for analog outputs from the PLC shall be connected at signal receiving device only. Shield shall be isolated from ground at all other termination points.
  5. If electrical interference noise is imposed on DC status and alarm signals, then they shall be re-routed or wire changed to shielded twisted pair cables.
  6. Each shield drain wire which is not connected to ground shall be cut off covered with a heat shrink insulating boot at cable jacket end. Shields shall be connected together at each transition from one cable to another for an effectively continuous shield circuit.

### 3.03 SUPPLIER SERVICES

- A. The Contractor shall be responsible for each supplier of equipment to provide the following minimum services for each type of instrument supplied. Each supplier shall provide a qualified instrumentation field technician to perform services listed herein. Contractor shall supply all calibration materials necessary to commission unit and shall not use any consumable materials that are intended to be furnished for the first period of use.
1. Advise and instruct Contractor on proper installation requirements.
  2. Inspect, calibrate, test, and place equipment in operation. Calibrate instruments to values as shown in the instrument index or as noted herein. If instrument spans are required to change (within instrument range) during startup for process reasons, the Contractor shall change them as directed by the Engineer.
  3. Programmable devices shall be programmed and tested prior to startup. Programming shall be adjusted or changed as directed by the Engineer at any time prior to final acceptance.
  4. Perform testing in the presence of Engineer.
  5. Visit the project site as often as required and spend as much time as necessary to ensure accurate and operational instrumentation.
  6. Provide training as specified in FIELD ASSISTANCE.
- B. The Contractor shall coordinate with each supplier of instrumentation to confirm that primary elements are provided in a timely manner, meeting critical path scheduling. The Contractor shall coordinate process connection size, equipment size, and material type when applicable and oversee the installation, calibration, and acceptance testing.

3.04 FIELD ASSISTANCE

- A. The instrument supplier shall provide a minimum of one (1) hour of field training to instruct Owner's personnel in the use, operation, calibration, programming, and maintenance on each type of "field" instrument.

3.05 SPARE PARTS

- A. Provide spare parts as described in each products section herein and specified in Electrical Specifications [Electrical General, Spare Parts].
- B. Contractor shall supply all calibration materials necessary to commission unit and shall not use any consumable materials that are intended to be handed over to the Owner as defined in the instrument specifications.

3.06 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

3.07 FINAL ACCEPTANCE

- A. Final Acceptance per Electrical Specifications [Electrical General].

END OF SECTION

**16940 INSTRUMENTATION INDEX**

DWG # P&ID	Tag No.	DESCRIPTION	Type	Specification Section	Min. NEMA Rating	Size	SP/ Range	Units	DWG. DET. Reference	Notes
I2	AIT 081	Analyzer Transmitter	Sulfite	16940-2.06 A	4X	-	-	-	Wall Mount	
I2	AIT 082	Analyzer Transmitter	Chlorine	16940-2.06 B	4X	-	2.000	PPM	Wall Mount	
I2	FIT 071	Flow Indicating Transmitter	Magnetic	16940-2.05 A	4X	12"	-	GPM	FVD/FLG	
I2	FIT 072	Flow Indicating Transmitter	Magnetic	16940-2.05 A	4X	8"	-	GPM	FMD/FLG	
I2	FS 073	Flow Switch	Mechanical	16940-2.05 C	4X	-	2.4	GPM	-	Eyewash/Shower
I2	LT 051	Level Transmitter	Submersible	16940-2.03 A	-	-	0-500	FT	WLT	Cable as required per plan
I2	PSH 161	Pressure Switch	Diaphragm	16940-2.04 C	4	-	20-200	PSI	PTD	
I2	PI 161	Pressure Gauge	Gauge	16940-2.04 D	4X	-	0-200	PSI	PGD	
I2	PIT 061	Pressure Indicating Transmitter	Gauge	16940-2.04 A	4X	-	0-200	PSI	PTD	Calibration Valve
I2	PI 061	Pressure Gauge	Gauge	16940-2.04 D	4X	-	0-200	PSI	PGD	
I2	PIT 062	Pressure Indicating Transmitter	Gauge	16940-2.04 A	4X	-	0-200	PSI	PTD	Calibration Valve
I2	PI 062	Pressure Gauge	Gauge	16940-2.04 D	4X	-	0-200	PSI	PGD	
I3	LT 251	Level Indicating Transmitter	Radar	16940-2.03 B	4X	-	0-20	FT	RTD	
I3	LT 351	Level Indicating Transmitter	Radar	16940-2.03 B	4X	-	0-20	FT	RTD	
I4	ZS 092 A	Door Switch	magnetic	16940-2.08 A	1	-	-	-	Door	
I4	ZS 092 B	Door Switch	magnetic	16940-2.08 A	1	-	-	-	Door	
I4	ZS 092 C	Door Switch	magnetic	16940-2.08 A	1	-	-	-	Rollup Door	
I4	ZS 092 D	Door Switch	magnetic	16940-2.08 A	1	-	-	-	Door	
I4	SS 097	Smoke Detector	photo	16940-2.08 C	1	-	-	-	Ceiling Mount	

## **APPENDIX**

- **Geotechnical Exploration, New York Well Building,  
Fair Oaks Water District, July 23, 2025 (ENGEO)**

Project No.  
**16778.000.000**

July 23, 2025

Mr. John Scroggs  
KASL Consulting Engineers  
7777 Greenback Lane, Suite 104  
Citrus Heights, CA 95304

Subject: New York Well Building, Fair Oaks Water District  
Fair Oaks, California

## GEOTECHNICAL REPORT UPDATE

- Reference:
1. ENGEO. 2019. Geotechnical Exploration, New York Well Building, Fair Oaks Water District. Fair Oaks, California. December 13, 2019. Project No. 16778.000.000.
  2. KASL Consulting Engineers. 2025. Plans for New York Well Equipping and Site Improvements. New York Well, Fair Oaks, California. June 9, 2025. Project No. C25WTNYWDE.

Dear Mr. Scroggs:

As requested, we prepared this geotechnical report update for the New York Well Building site in Fair Oaks, California. Our scope of the services included reviewing the above-referenced document, reviewing comments prepared by Fair Oaks District, and providing 2022 California Building Code (CBC) seismic design parameters in an update letter. For our use, we received New Work Well Phase 2 plans from KASL Consulting Engineers on July 14, 2025.

## PROJECT DESCRIPTION

The plans indicate the New York Well Building is to be located at the Fair Oaks Water District's New York Avenue Facility at 4301 New York Avenue in Fair Oaks, California. Proposed improvements will include an approximately 875-square-foot single-story CMU building to house the wellhead equipment, sodium hypochlorite and sodium bisulfite storage and feed equipment, and connection for standby generator for a new water supply well. A Caltrans Type 6A retaining wall is planned along the eastern perimeter. In addition, New York Avenue is to be widened by 4 feet.

The structure will be supported on 18-inch-deep shallow continuous footings with a slab-on-grade concrete floor. Maximum cuts of approximately 2 feet and approximately 3 feet of fill are anticipated for the new building pad.

## CONCLUSIONS AND RECOMMENDATIONS

Based on our review of the proposed improvements, the conclusions and recommendations in the referenced 2019 geotechnical report remain applicable for the project, unless superseded by the following updated recommendations.

## 2022 CBC SEISMIC DESIGN PARAMETERS

The 2022 California Building Code (CBC) utilizes seismic design criteria established in the ASCE/SEI Standard “Minimum Design Loads and Associated Criteria for Buildings and Other Structures,” (ASCE 7-16). We classified the site as Site Class D in accordance with Chapter 20 of ASCE 7-16 based on the subsurface conditions encountered in our borings.

ASCE 7-16 requires a site-specific ground-motion hazard analysis for Site Class D sites with a mapped  $S_1$  value greater than or equal to 0.2. However, Section 11.4.8 of ASCE 7-16 and Supplement No. 3 provide an exception to this requirement. A site-specific ground-motion hazard analysis is not required where the value of the parameter  $S_{M1}$  determined by Equation 11.4-2 and shown in Table 1 is increased by 50 percent for developing the mapped Risk-Targeted Maximum Considered Earthquake (MCE<sub>R</sub>) spectral response, calculating  $S_{D1}$ , and evaluating  $C_s$  in accordance with Chapter 12 of ASCE 7-16.

We provide the 2022 CBC seismic design parameters based on the USGS Seismic Design Maps in Table 1 below. When using this table, considerations should be given to exceptions in Section 11.4.8 of ASCE 7-16, as described in this report.

**TABLE 1: 2022 CBC Seismic Design Parameters, Latitude: 38.64276 Longitude: -121.27827**

PARAMETER	VALUE
Site Class	D
Mapped MCE <sub>R</sub> Spectral Response Acceleration at Short Periods, $S_s$ (g)	0.44
Mapped MCE <sub>R</sub> Spectral Response Acceleration at 1-second Period, $S_1$ (g)	0.22
Short-Period Site Coefficient, $F_a$	1.45
Long-Period Site Coefficient, $F_v$	2.16*
MCE <sub>R</sub> Spectral Response Acceleration at Short Periods, $S_{MS}$ (g)	0.64
MCE <sub>R</sub> Spectral Response Acceleration at 1-second Period, $S_{M1}$ (g)	0.48*
Design Spectral Response Acceleration at Short Periods, $S_{DS}$ (g)	0.43
Design Spectral Response Acceleration at 1-second Period, $S_{D1}$ (g)	0.32*
Mapped MCE Geometric Mean (MCE <sub>G</sub> ) Peak Ground Acceleration, PGA (g)	0.19
Site Coefficient, $F_{PGA}$	1.43
MCE <sub>G</sub> Peak Ground Acceleration adjusted for Site Class effects, $PGA_M$ (g)	0.27

\*The parameters above should only be used for calculation of  $T_s$ , determination of Seismic Design Category, and, when taking the exceptions under Items 1 and 2 of ASCE 7-16 Section 11.4.8. (Supplement Number 3 <https://ascelibrary.org/doi/epdf/10.1061/9780784414248.sup3>).

We recommend that we collaborate with the structural engineer of record to further evaluate the structural design from an earthquake engineering perspective to mutually decide if a site-specific ground-motion analysis would be beneficial for the project.

## CLOSING

We prepared this geotechnical report update for the sole use of KASL Consulting Engineers, and their consultants for design of the proposed project. We strive to perform our professional services in accordance with generally accepted principles and practices currently employed in the area; there

is no warranty, express or implied. The limitations in the referenced geotechnical report are also applicable to this document.

If you have any questions or comments regarding this letter, please call and we will be glad to discuss them with you.

Sincerely,

ENGEO Incorporated



Jack Yu

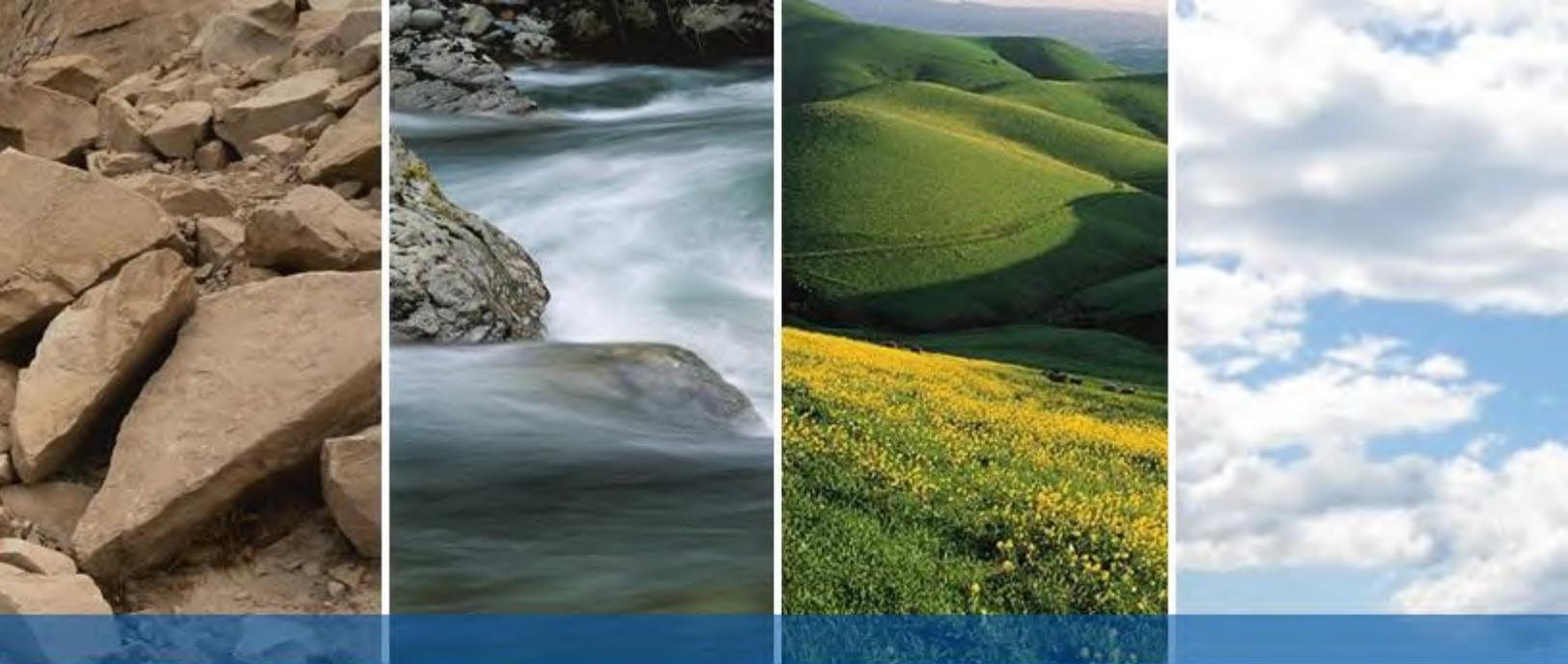
jy/kk/mg/jf

Attachment: 2019 ENGEO New York Well GEX



Mark Gilbert, GE





**NEW YORK WELL BUILDING, FAIR OAKS WATER DISTRICT**  
FAIR OAKS, CALIFORNIA

**GEOTECHNICAL EXPLORATION**

**SUBMITTED TO**  
Mr. John Scroggs  
KASL Consulting Engineers  
7777 Greenback Lane, Suite 104  
Citrus Heights, CA 95610

**PREPARED BY**  
ENGEO Incorporated

December 13, 2019

**PROJECT NO.**  
16778.000.000

Project No.  
**16778.000.000**

December 13, 2019

Mr. John Scroggs  
KASL Consulting Engineers  
7777 Greenback Lane, Suite 104  
Citrus Heights, CA 95610

Subject: New York Well Building, Fair Oaks Water District  
4301 New York Avenue  
Fair Oaks, California

## GEOTECHNICAL EXPLORATION

Dear Mr. Scroggs:

ENGEO prepared this geotechnical report for KASL Consulting Engineers as outlined in our agreement dated July 31, 2019. We characterized the subsurface conditions at the site to provide the enclosed geotechnical recommendations for design.

Our experience and that of our profession clearly indicate that the risk of costly design, construction, and maintenance problems can be significantly lowered by retaining the design geotechnical engineering firm to review the project plans and specifications and provide geotechnical observation and testing services during construction. Please let us know when working drawings are nearing completion, and we will be glad to discuss these additional services with you.

If you have any questions or comments regarding this report, please call and we will be glad to discuss them with you.

Sincerely,

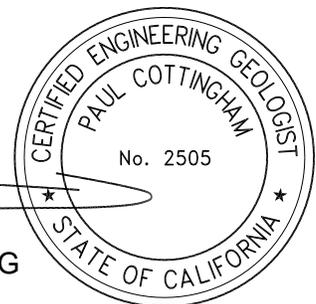
ENGEO Incorporated



Stephen Blakely



Paul Cottingham, CEG



Jonathan Boland, GE  
sb/pc/jb/jf



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## 1.0 INTRODUCTION

### 1.1 PURPOSE AND SCOPE

ENGEO prepared this geotechnical report for design of the New York Well Building in Fair Oaks, California. We prepared this report as outlined in our agreement dated July 31, 2019. KASL Consulting Engineers authorized ENGEO to conduct the following scope of services:

- Service plan development
- Subsurface field exploration
- Soil laboratory testing
- Data analysis and conclusions
- Report preparation

For our use, we received the following:

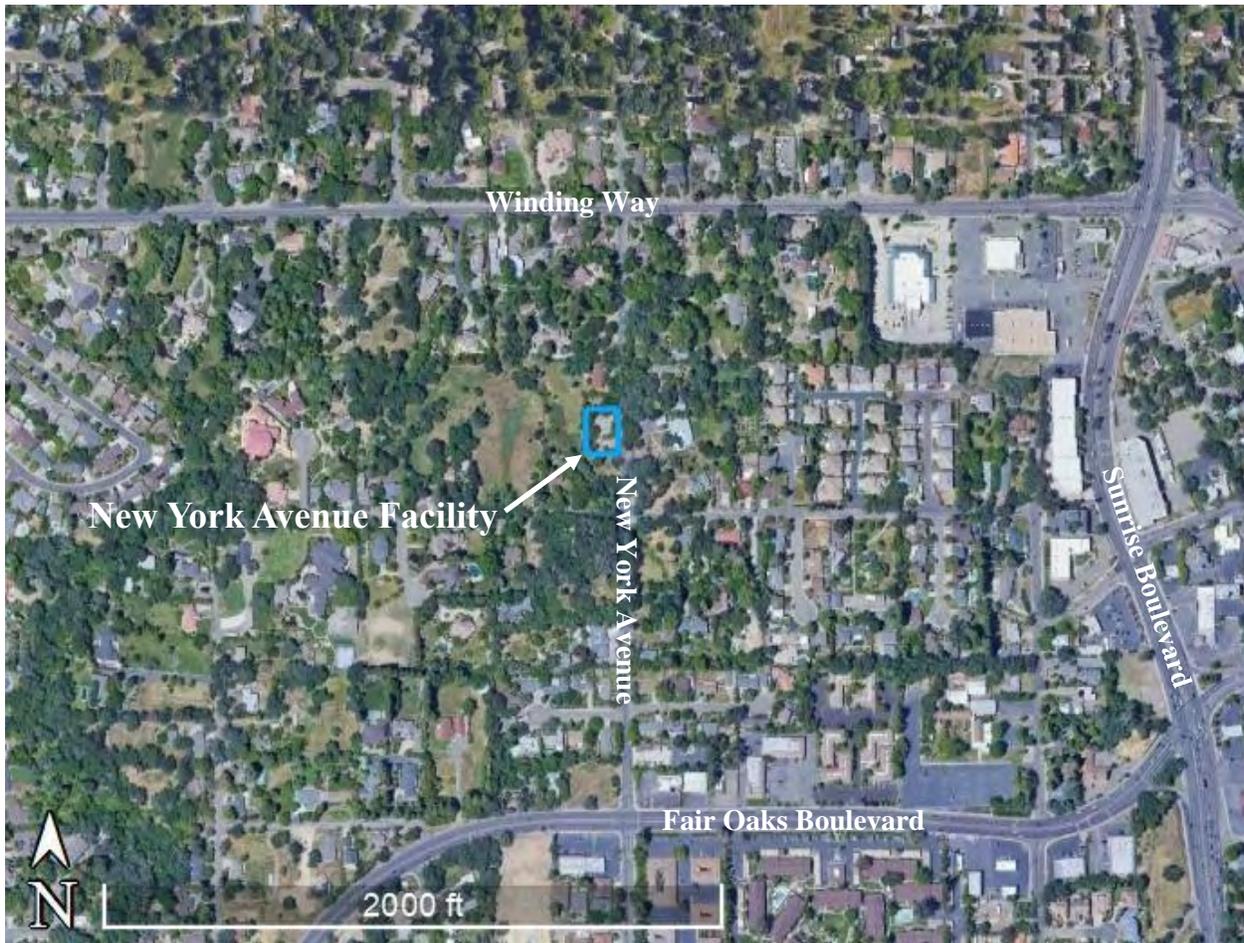
1. KASL Consulting Engineers, New York Well Site Plan, Fair Oaks Water District; dated October 4, 2019.
2. KASL Consulting Engineers, letter regarding Skyway Well and New York Well Projects, Fair Oaks Water District, dated July 16, 2019.

This report was prepared for the exclusive use of our client and their consultants for design of this project. In the event that any changes are made in the character, design or layout of the improvements, we must be contacted to review the conclusions and recommendations contained in this report to evaluate whether modifications are recommended. This document may not be reproduced in whole or in part by any means whatsoever, nor may it be quoted or excerpted without our express written consent.

### 1.2 PROJECT LOCATION

Exhibit 1.2-1 below displays a Site Vicinity Map. The New York Well Building is located at the Fair Oaks Water District's (FOWD) New York Avenue Facility at 4301 New York Avenue in Fair Oaks, California. The facility currently houses a water supply well, chemical building, electrical transformer, and electrical panels. The subject improvements will be located near the northwest corner of the property, north of the existing well. Access to the facility is provided via two gates on the west side of New York Avenue.

### EXHIBIT 1.2-1: Site Vicinity Map



### 1.3 PROJECT DESCRIPTION

The proposed improvements at the New York Avenue Facility include an approximately 875-square-foot single-story CMU building to house the wellhead equipment, sodium hypochlorite storage and feed equipment, and standby generator for a new water supply well. We understand the structure will be supported on shallow spread foundations and will include a concrete slab-on-grade concrete floor. Minor cuts or minor fills are anticipated for the new building pad.

The figure below shows an aerial view of the existing and proposed New York Avenue Facility improvements.

**EXHIBIT 1.3-1: Existing and Proposed Improvements**



**2.0 FINDINGS**

**2.1 FIELD EXPLORATION**

Our field exploration included drilling two borings to a maximum depth of approximately 15½ feet at the locations shown on Exhibit 2.1-1. We performed our field exploration on November 18, 2019. The locations and elevations of our explorations are approximate and were estimated from site landmarks; they should be considered accurate only to the degree implied by the method used.

**EXHIBIT 2.1-1: Boring Locations**



An ENGEO representative observed the drilling and logged the subsurface conditions at the exploration locations. We retained a truck-mounted Simco 2400 drill rig and crew to advance the borings using 4-inch-diameter solid flight auger methods to a maximum depth of 15½ feet below existing grade.

We obtained soil samples at various intervals in the borings using a standard penetration test (SPT) sampler and a Modified California Sampler. The standard penetration resistance blow counts were obtained by dropping a 140-pound hammer through a 30-inch free fall. The 2-inch O.D. split-spoon sampler was driven 18 inches and the number of blows was recorded for each 6 inches of penetration. In addition, 2.5-inch I.D. samples were obtained using a Modified California Sampler driven into the soil with the 140-pound hammer previously described. Unless otherwise indicated, the blows per foot recorded on the boring logs represent the accumulated number of blows to drive the last 1 foot of penetration; the blow counts have not been converted using any correction factors. When sampler driving was difficult, penetration was recorded only as inches penetrated for 50 hammer blows.

We used the field logs to develop the boring logs presented in Appendix A. The logs depict subsurface conditions at the exploration locations for the date of exploration; however, subsurface conditions may vary with time.

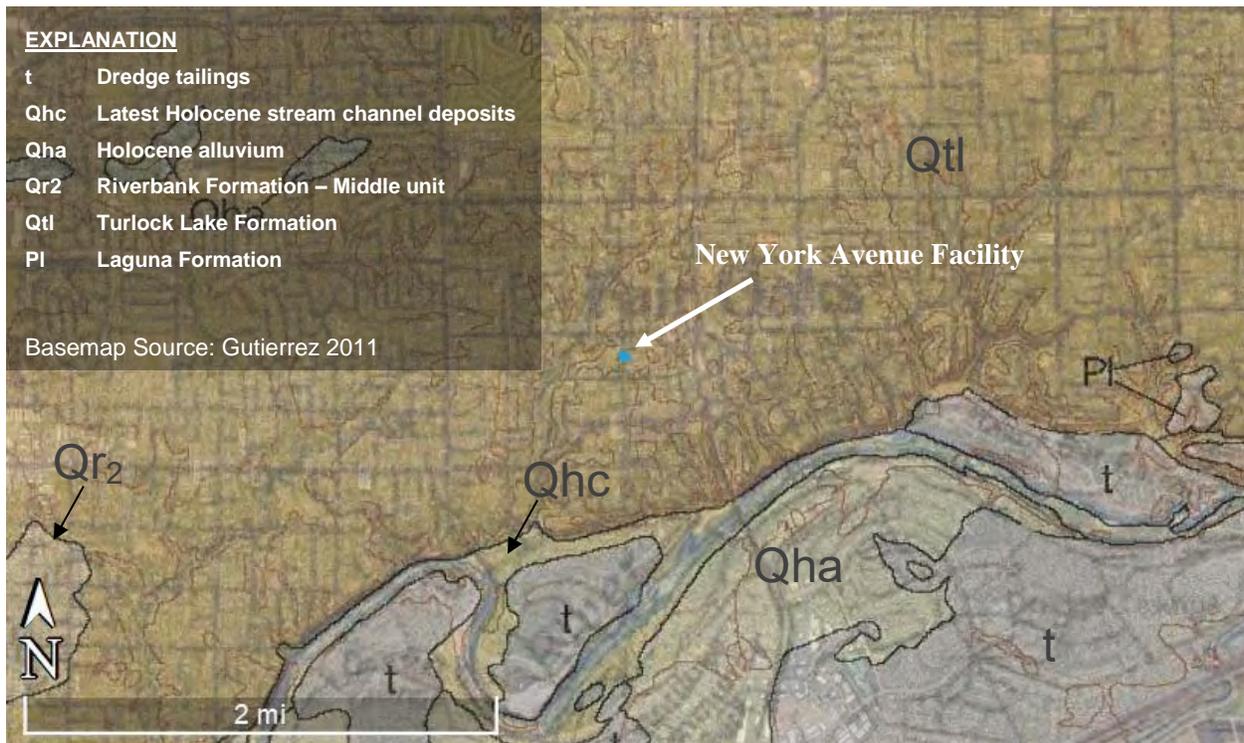
## 2.2 GEOLOGY AND SEISMICITY

### 2.2.1 Geology

The project is located within the Great Valley Geomorphic Province. The Great Valley is an elongate, northwest-trending structural trough bound by the Coast Ranges on the west and the Sierra Nevada on the east. The Great Valley has been and is presently being filled with sediments primarily derived from surrounding mountain ranges.

As shown in Exhibit 2.2.1-1 below, the site is underlain by early Pleistocene sediments of the Turlock Lake Formation (QtI). The Turlock Lake Formation consists of deeply weathered gravel, sand, and silt, and is older than 700,000 years (Helley and Harwood, 1985).

#### EXHIBIT 2.2.1-1: Regional Geology



### 2.2.2 Seismicity

The site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone and no known surface expression of active faults is believed to exist within the site. The site does lie within a seismically active region, as California has numerous faults that are known to be active. The following table summarizes the distances to mapped, active regional faults and estimated magnitudes within approximately 50 miles using the USGS Spatial Query tool that is based on USGS 2008 National Seismic Hazard Maps.

**TABLE 2.2.2-1: Active Faults Capable of Producing Significant Ground Shaking at the Site**

FAULT NAME	APPROXIMATE DISTANCE FROM SITE (MILES)	MAXIMUM MOMENT MAGNITUDE*
Great Valley 4a, Trout Creek	40	6.5
Great Valley 3, Mysterious Ridge	42	7.0
Great Valley 4b, Gordon Valley	42½	6.7
Great Valley 5, Pittsburg Kirby Hills	45	6.6

\* Average of Ellsworth and Hanks maximum magnitudes

### 2.3 SURFACE CONDITIONS

According to the New York Well Site Plan (KASL Consulting Engineers, dated October 4, 2019), the planned improvements are located on a relatively flat bench that gently slopes to the west from approximately Elevation 165 feet (no datum provided: 0 feet = Mean Sea Level) to approximately 161 feet. Site topography slopes steeply up from the bench in the east to approximately 174 at New York Avenue, and steeply down to the west to approximately Elevation 151. The facility includes an existing water supply well and 10-inch-diameter water supply pipe, a chemical building, transformer and electrical panels, paved driveways, a security fence, and landscape areas. The proposed well building is located in the paved parking area and adjacent landscape area northwest of the existing water well.

**PHOTO 2.3-1: View of New York Avenue Facility paved area north of existing well**



**PHOTO 2.3-2: New York Avenue Facility, showing bench with existing well and associated equipment in the background.**



### 2.4 SUBSURFACE CONDITIONS

Our subsurface explorations encountered fill generally composed of hard, sandy clay with gravel, and dense to very dense sand and gravel with varying fines content. The fill extended to depths of approximately 2½ to 8 feet below ground surface. The fill material included asphalt concrete fragments and angular gravel.

Below the fill, the native soil encountered in our subsurface explorations generally consisted of cemented, hard, lean clay overlying very dense silty sand with varying fines content. Boring 1-B2

was performed in the paved driveway area in the southeast corner of the proposed well building location. The pavement section at this location consisted of approximately 2 inches of asphalt concrete underlain by approximately 6 inches of aggregate base.

Consult the exploration logs in Appendix A for specific subsurface conditions at the exploration locations. The logs contain the soil type, color, consistency, and visual classification in general accordance with the Unified Soil Classification System. The logs graphically depict the subsurface conditions encountered at the time of the explorations.

**PHOTO 2.4-1: Pavement Section at 1-B2**



**PHOTO 2.4-2: Drilling Operations at 1-B2**



## 2.5 GROUNDWATER CONDITIONS

We did not observe static or perched groundwater in our subsurface explorations. We reviewed the Sustainable Groundwater Management Act (SGMA) Data Viewer (<https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels>), a website maintained by the State of California Department of Water Resources, for local groundwater levels. The data viewer plotted groundwater contours that indicated groundwater in the vicinity occurred at elevations of 40 to 50 feet in spring 2018 and 10 to 20 feet in fall 2018.

Fluctuations in groundwater level may occur due to variations in rainfall, irrigation practice, and other factors not evident at the time measurements were made.

## 2.6 LABORATORY TESTING

We performed laboratory tests on selected soil samples to evaluate some of their engineering properties. For this project, we performed moisture content, sieve analysis, expansion index, R-value, and limited corrosion testing. The laboratory test results are included on the borelogs in Appendix A. Individual test results are presented in Appendix B.

## 3.0 CONCLUSIONS

From a geotechnical engineering viewpoint, in our opinion, the proposed improvements may be designed as planned, provided the geotechnical recommendations in this report are properly incorporated into the design plans and specifications. We summarize our conclusions below.

### 3.1 EXISTING FILL

Our borings indicate that the New York Well Building location is underlain by approximately 2½ to 8 feet of existing fill. Based on the background information provided (Reference 2), we understand that the no documentation of the original fill placement is available.

Non-engineered fills can undergo excessive settlement, especially under new fill or building loads. Without proper documentation of existing fill placed on the site, we recommend complete removal and recompaction of the existing fill. Based on our exploration, the existing fill appears suitable for reuse as engineered fill. We present fill removal recommendations in Section 5.

### 3.2 EXPANSIVE SOIL

The fill encountered was generally composed of mixtures of medium plasticity clay, sand and gravel. The Expansion Index (EI) test results of 48 indicate that the tested sample is classified as “low” expansion potential, though very close to the “medium” category. Based on likely variability of the fill material, it is our opinion that medium expansion potential clays are likely onsite. Expansive soils change in volume with changes in moisture. They can shrink or swell and cause heaving and cracking of slabs-on-grade, pavements, and structures founded on shallow foundations. We provide recommendations to mitigate expansive soil in Section 4.2.

We have also provided specific grading recommendations for compaction of clay soil at the site in Section 4.5. The purpose of these recommendations is to reduce the swell potential of the clay by compacting the soil at a high moisture content and controlling the amount of compaction.

### 3.3 SEISMIC HAZARDS

Potential seismic hazards resulting from a nearby moderate to major earthquake can generally be classified as primary and secondary. The primary effect is ground rupture, also called surface faulting. The common secondary seismic hazards include ground shaking, and ground lurching. The following sections present a discussion of these hazards as they apply to the site. Based on topographic and lithologic data, the risk of regional subsidence or uplift, soil liquefaction, lateral spreading, landslides, tsunamis, flooding or seiches is considered low to negligible at the site.

#### 3.3.1 Ground Rupture

Since there are no known active faults crossing the property and the site is not located within an Earthquake Fault Special Study Zone, it is our opinion that ground rupture is unlikely at the subject property.

#### 3.3.2 Ground Shaking

An earthquake of moderate to high magnitude generated within the Northern California region could cause considerable ground shaking at the site, similar to that which has occurred in the

past. To mitigate the shaking effects, structures should be designed using sound engineering judgment and the applicable California Building Code (CBC) requirements, as a minimum.

### 3.4 SOIL CORROSION POTENTIAL

We obtained representative soil samples and submitted to a qualified analytical lab for determination of pH, minimum resistivity, sulfate content, and chloride content. The results are included in Appendix B and summarized in the table below.

**TABLE 3.4-1: Corrosivity Test Results**

SAMPLE LOCATION	DEPTH (FEET)	PH <sup>1</sup>	MINIMUM RESISTIVITY <sup>1</sup> (OHMS-CM)	CHLORIDE <sup>2</sup> (PPM)	SULFATE <sup>3</sup> (PPM)
1-B1	0.5	5.67	8,840	1.7	8.8
1-B2	3.0	6.96	2,140	2.4	27.0

(1) Per CA DOT Test #643; (2) Per CA DOT Test #422; (3) Per CA DOT Test #417

The 2019 CBC references the 2014 American Concrete Institute Manual, ACI 318-14, Section 19.3.1 for concrete durability requirements. ACI Table 19.3.1.1 provides exposure categories and classes and Table 19.3.2.1 provides requirements for concrete in contact with soil based upon the exposure class. In accordance with these ACI tables, the soils are categorized as being within S0 sulfate exposure class. Considering a S0 sulfate exposure class, the code requires a minimum compressive strength of 2,500 psi. It should be noted, however, that the project's design requirements for concrete may result in more stringent concrete specifications.

Laboratory tests on representative soil samples from the site indicate a chloride concentration in soil of less than 50 ppm. ACI Table 19.3.1.1 provides exposure categories for corrosion protection of reinforcement and references sources of chlorides from deicing chemicals, salt, brackish water, and seawater. Typical chloride concentrations for seawater are about 19,200 ppm and for brackish water may be in the range of 500 to 5,000 ppm. Since the chloride test results from the site are substantially lower than that of seawater or brackish water, we recommend an exposure class of C0 or C1 depending on the location of the structural element (i.e. protected from moisture or exposed to moisture).

The resistivity measurements indicate the soils are classified in a range of moderately to highly corrosive according to the National Association of Corrosion Engineers' 2006 *Corrosion Basics an Introduction* interpretation of resistivity.

If desired to investigate this further, we recommend a corrosion consultant be retained to evaluate if specific corrosion recommendations are advised for the project.

### 3.5 2019 CBC SEISMIC DESIGN PARAMETERS

The 2019 CBC utilizes design criteria set forth in the 2016 ASCE 7 Standard. Based on the subsurface conditions encountered, we characterized the site as Site Class D in accordance with the 2019 CBC. We provide the 2019 CBC seismic design parameters in Table 3.5-1 below, which include design spectral response acceleration parameters based on the mapped Risk-Targeted Maximum Considered Earthquake (MCER) spectral response acceleration parameters.

**TABLE 3.5-1: 2019 CBC Seismic Design Parameters, Latitude: 38.642756 Longitude: -121.278272**

PARAMETER	VALUE
Site Class	D
Mapped MCE <sub>R</sub> Spectral Response Acceleration at Short Periods, S <sub>S</sub> (g)	0.44
Mapped MCE <sub>R</sub> Spectral Response Acceleration at 1-second Period, S <sub>1</sub> (g)	0.22
Site Coefficient, F <sub>A</sub>	1.45
Site Coefficient, F <sub>V</sub>	Refer to ASCE Section 11.4.8*
MCE <sub>R</sub> Spectral Response Acceleration at Short Periods, S <sub>MS</sub> (g)	0.64
MCE <sub>R</sub> Spectral Response Acceleration at 1-second Period, S <sub>M1</sub> (g)	Refer to ASCE Section 11.4.8*
Design Spectral Response Acceleration at Short Periods, S <sub>DS</sub> (g)	0.43
Design Spectral Response Acceleration at 1-second Period, S <sub>D1</sub> (g)	Refer to ASCE Section 11.4.8*
Mapped MCE Geometric Mean (MCE <sub>G</sub> ) Peak Ground Acceleration, PGA (g)	0.19
Site Coefficient, F <sub>PGA</sub>	1.43
MCE <sub>G</sub> Peak Ground Acceleration adjusted for Site Class effects, PGAM (g)	0.27

MCE<sub>R</sub> = Risk-Targeted Maximum Considered Earthquake

MCE = Maximum Considered Earthquake

\* A site-specific seismic hazard analysis is required to obtain these parameters unless the exception discussed in Section 11.4.8 is met. Under this exception, refer to ASCE 7-16 Table 11.4-2, Site Class D, to obtain Site Coefficient, F<sub>V</sub>.

## 4.0 EARTHWORK RECOMMENDATIONS

The relative compaction and optimum moisture content of soil and aggregate base referred to in this report are based on the most recent ASTM D1557 test method. Compacted soil is not acceptable if it is unstable. It should exhibit only minimal flexing or pumping, as observed by an ENGEO representative.

The term “moisture condition” in this report refers to adjusting the moisture content of the soil by either drying if too wet or adding water if too dry.

We define “structural areas” as any area sensitive to settlement of compacted soil. These areas include, but are not limited to building pads, sidewalks, pavement areas, and retaining walls.

### 4.1 EXISTING FILL REMOVAL

Remove existing fill to competent native soil, as evaluated by ENGEO. Fill should be removed to a least 5 feet beyond the building footprint. The proposed building footprint is underlain by approximately 2½ to 8 feet of fill, with the depth of fill increasing to the west. The lateral extent and depth of fill is expected to vary. Consult the exploration logs in Appendix B for fill depths at specific locations.

### 4.2 EXPANSIVE SOIL MITIGATION

To reduce the risk of structural damage associated with the expansive soil conditions, we recommend constructing the upper 2 feet of the building pad with fill that has low expansion potential. We define low expansion potential soil as having an Expansion Index (EI) of less than 50. We should observe earthwork operations and perform confirmation EI testing during construction of the building pad.

### 4.3 ACCEPTABLE FILL

In general, we anticipate the onsite soil should be suitable as fill material provided it is processed to remove concentrations of organic material, debris, and particles greater than 6 inches in maximum dimension. Imported fill should also meet the above requirements and have an Expansion Index of less than 50.

### 4.4 OVER-OPTIMUM SOIL MOISTURE CONDITIONS

The contractor should anticipate encountering excessively over-optimum (wet) soil moisture conditions during winter or spring grading, or during or following periods of rain. Wet soil can make proper compaction difficult or impossible. Wet soil conditions can be mitigated by:

1. Frequent spreading and mixing during warm dry weather.
2. Mixing with drier materials.
3. Mixing with a lime, lime-flyash, or a cement product; or
4. Stabilizing with aggregate, geotextile stabilization fabric, or both.

Options 3 and 4 should be evaluated by ENGEO prior to implementation.

### 4.5 PAD PREPARATION

The building pad should be cleared of surface and subsurface deleterious materials, including organics, buried utilities and irrigation lines, debris and tree roots, and existing fill. After clearing and existing fill removal (discussed in Section 4.1), perform subgrade scarification and compaction prior to fill placement, following cutting operations, and in areas left at grade as follows.

1. Scarify to a depth of at least 10 inches;
2. Moisture condition soil to at least 3 percentage points above the optimum moisture content;  
**and**
3. Compact the subgrade to at 87 to 92 percent relative compaction.

After the subgrade soil has been moisture conditioned and compacted, place and compact acceptable fill as follows:

1. Spread fill in loose lifts that do not exceed 8 inches in thickness;
2. Moisture condition lifts to at least 3 percentage points above the optimum moisture content;  
**and**
3. Compact fill to a minimum of 87 to 92 percent relative compaction.

### 4.6 UNDERGROUND UTILITY TRENCH BACKFILL

Place and compact utility trench backfill in structural areas as follows:

1. Trench backfill should have a maximum particle size of 6 inches.

2. Moisture condition trench backfill to at least 2 percentage points above the optimum moisture content. Moisture condition backfill outside the trench.
3. Place fill in loose lifts not exceeding 12 inches.
4. Compact fill to a minimum of 87-92 percent relative compaction (ASTM D1557).

Jetting of backfill is not an acceptable means of compaction. We may allow thicker loose lift thicknesses based on acceptable density test results, or for the first lift of fill over pipe bedding. The contractor is responsible for conducting trenching and shoring in accordance with CALOSHA requirements. Project consultants involved in utility design should specify pipe-bedding materials.

#### 4.7 SLOPE GRADIENTS

Construct final slope gradients to 2:1 (horizontal:vertical) or flatter. The contractor is responsible to construct temporary construction slopes in accordance with CALOSHA requirements.

#### 4.8 SURFACE DRAINAGE

The project civil engineer is responsible for designing surface drainage improvements. With regard to geotechnical engineering issues, we recommend that finish grades be sloped away from the building and pavements to the maximum extent practical. The latest California Building Code Section 1804.4 specifies minimum slopes of 5 percent away from foundations. Where site conditions restrict meeting this slope requirement, we recommend that specific drainage requirements be developed. As a minimum, we recommend the following:

1. Discharge roof downspouts into closed conduits and direct away from the foundation to appropriate drainage devices.
2. Do not allow water to pond near foundations, pavements, or exterior flatwork.

### 5.0 FOUNDATION RECOMMENDATIONS

We developed foundation recommendations using data obtained from our field exploration, laboratory test results, and engineering analysis.

#### 5.1 SHALLOW FOUNDATIONS

Provided the pad is graded as detailed in Section 4.5, the proposed well building can be supported on continuous or isolated spread footings bearing in competent native soil or compacted fill. We provide minimum footing dimensions as follows in the Table 5.1-1 below.

**TABLE 5.1-1: Minimum Footing Dimensions**

FOOTING TYPE	*MINIMUM DEPTH (INCHES)	MINIMUM WIDTH (INCHES)
Continuous	12	12
Isolated	12	18

\* below lowest adjacent pad grade

Minimum footing depths shown above are taken from lowest adjacent pad grade. The cold joint between the exterior footing and slab-on-grade should be located at least 4 inches above adjacent exterior grade.

Design foundations recommended above for a maximum allowable bearing pressure of 2,500 pounds per square foot (psf) for dead-plus-live loads. Increase this bearing capacity by one-third for the short-term effects of wind or seismic loading.

The maximum allowable bearing pressure is a net value; the weight of the footing may be neglected for design purposes. Footings located adjacent to utility trenches should have their bearing surfaces below an imaginary 1:1 (horizontal:vertical) plane projected upward from the bottom edge of the trench to the footing.

### 5.1.1 Reinforcement

The structural engineer should design footing reinforcement to support the intended structural loads without excessive settlement. Reinforce continuous footings with top and bottom steel to provide structural continuity and to permit spanning of local irregularities. At a minimum, design continuous footings to structurally span a clear distance of 5 feet.

### 5.1.2 Foundation Lateral Resistance

Lateral loads may be resisted by friction along the base and by passive pressure along the sides of foundations. The passive pressure is based on an equivalent fluid pressure in pounds per cubic foot (pcf). We recommend the following allowable values for design:

- Passive Lateral Pressure: 300 pcf
- Coefficient of Friction: 0.35

The above allowable values include a factor of safety of 1.5. Increase the above values by one-third for the short-term effects of wind or seismic loading.

Passive lateral pressure should not be used for footings on or above slopes.

## 6.0 SLABS-ON-GRADE

### 6.1 INTERIOR CONCRETE FLOOR SLABS

#### 6.1.1 Minimum Design Section

We recommend the following minimum design:

1. Provide a minimum concrete thickness of 5 inches.
2. Place minimum steel reinforcing of No. 3 rebar on 18-inch centers each way within the middle third of the slab to help control the width of shrinkage cracking that inherently occurs as concrete cures.

The structural engineer should provide final design thickness and additional reinforcement, as necessary, based on anticipated structural loads.

### 6.1.2 Slab Moisture Vapor Reduction

When buildings are constructed with concrete slab-on-grade, water vapor from beneath the slab will migrate through the slab and into the building. This water vapor can be reduced but not stopped. Vapor transmission can negatively affect floor coverings and lead to increased moisture within a building. When water vapor migrating through the slab would be undesirable, we recommend the following to reduce, but not stop, water vapor transmission upward through the slab-on-grade.

1. Construct a moisture retarder system directly beneath the slab on-grade that consists of the following:
  - a. Vapor retarder membrane sealed at all seams and pipe penetrations and connected to all footings. Vapor retarders shall conform to Class A vapor retarder in accordance with ASTM E 1745, latest edition, "Standard Specification for Plastic Water Vapor Retarders used in Contact with Soil or Granular Fill under Concrete Slabs". The vapor retarder should be **underlain by**
  - b. 4 inches of clean crushed rock. Crushed rock should have 100 percent passing the ¾-inch sieve and less than 5 percent passing the No. 4 Sieve.
2. Use a concrete water-cement ratio for slabs-on-grade of no more than 0.50.
3. Provide inspection and testing during concrete placement to check that the proper concrete and water cement ratio are used.
4. Moist cure slabs for a minimum of 3 days or use other equivalent curing specified by the structural engineer.

The structural engineer should be consulted as to the use of a layer of clean sand or pea gravel (less than 5 percent passing the U.S. Standard No. 200 Sieve) placed on top of the vapor retarder membrane to assist in concrete curing.

### 6.1.3 Subgrade Modulus for Structural Slab Design

Provided the site earthwork is conducted in accordance with the recommendations of this report, a subgrade modulus of 200 psi/in can be used for structural slab design.

## 7.0 PAVEMENT DESIGN

### 7.1 ASPHALT CONCRETE

We obtained a representative bulk sample of the near-surface soil from Boring 1-B1 and performed an R-value test to provide data for pavement design. The results of the test are included in Appendix B and indicate an R-value of 32, which we judged to be appropriate for design.

Using estimated traffic indices for various pavement loading requirements, we developed the following recommended pavement sections using Topic 633 of the Caltrans Highway Design Manual (including the asphalt factor of safety) presented in the table below.

**TABLE 6.1-1: Flexible Pavement Design**

TRAFFIC INDEX (TI)	R-VALUE OF 32 (UNTREATED SUBGRADE)	
	AC (INCHES)	AB (INCHES)
4.0	2.5	4
5.0	3	5
6.0	3	8

Notes: AC is asphalt concrete  
AB is aggregate base Class 2 Material with minimum R = 78

The civil engineer should determine the appropriate traffic indices based on the estimated traffic loads and frequencies.

## 7.2 SUBGRADE AND AGGREGATE BASE COMPACTION

Compact finish subgrade and aggregate base in accordance with Section 4. Aggregate Base should meet the requirements for ¾-inch maximum Class 2 AB in accordance with Section 26-1.02B of the latest Caltrans Standard Specifications.

## 8.0 CONSTRUCTION MONITORING

Our experience and that of our profession clearly indicate that the risk of costly design, construction, and maintenance problems can be significantly lowered by retaining the design geotechnical engineering firm to:

1. Review the final grading and foundation plans and specifications prior to construction to evaluate whether our recommendations have been implemented, and to provide additional or modified recommendations, as needed. This also allows us to check if any changes have occurred in the nature, design or location of the proposed improvements and provides the opportunity to prepare a written response with updated recommendations.
2. Perform construction monitoring to check the validity of the assumptions we made to prepare this report. Earthwork operations should be performed under the observation of our representative to check that the site is properly prepared, the selected fill materials are satisfactory, and that placement and compaction of the fills has been performed in accordance with our recommendations and the project specifications. Sufficient notification to us prior to earthwork is important.

If we are not retained to perform the services described above, then we are not responsible for any party's interpretation of our report (and subsequent addenda, letters, and verbal discussions).

## 9.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

This report presents geotechnical recommendations for design of the improvements discussed in Section 1.3 for the subject project. If changes occur in the nature or design of the project, we should be allowed to review this report and provide additional recommendations, if any. It is the responsibility of the owner to transmit the information and recommendations of this report to the appropriate organizations or people involved in design of the project, including but not limited to developers, owners, buyers, architects, engineers, and designers. The conclusions and

recommendations contained in this report are solely professional opinions and are valid for a period of no more than 2 years from the date of report issuance.

We strived to perform our professional services in accordance with generally accepted geotechnical engineering principles and practices currently employed in the area; no warranty is expressed or implied. There are risks of earth movement and property damages inherent in building on or with earth materials. We are unable to eliminate all risks; therefore, we are unable to guarantee or warrant the results of our services.

This report is based upon field and other conditions discovered at the time of report preparation. We developed this report with limited subsurface exploration data. We assumed that our subsurface exploration data are representative of the actual subsurface conditions across the site. Considering possible underground variability of soil and groundwater, additional costs may be required to complete the project. We recommend that the owner establish a contingency fund to cover such costs. If unexpected conditions are encountered, ENGEO must be notified immediately to review these conditions and provide additional and/or modified recommendations, as necessary.

Our services did not include excavation sloping or shoring, soil volume change factors, flood potential, or a geohazard exploration. In addition, our geotechnical exploration did not include work to determine the existence of possible hazardous materials. If any hazardous materials are encountered during construction, the proper regulatory officials must be notified immediately.

This document must not be subject to unauthorized reuse, that is, reusing without written authorization of ENGEO. Such authorization is essential because it requires ENGEO to evaluate the document's applicability given new circumstances, not the least of which is passage of time.

Actual field or other conditions will necessitate clarifications, adjustments, modifications or other changes to ENGEO's documents. Therefore, ENGEO must be engaged to prepare the necessary clarifications, adjustments, modifications or other changes before construction activities commence or further activity proceeds. If ENGEO's scope of services does not include on-site construction observation, or if other persons or entities are retained to provide such services, ENGEO cannot be held responsible for any or all claims arising from or resulting from the performance of such services by other persons or entities, and from any or all claims arising from or resulting from clarifications, adjustments, modifications, discrepancies or other changes necessary to reflect changed field or other conditions.

We determined the lines designating the interface between layers on the exploration log using visual observations. The transition between the materials may be abrupt or gradual. The exploration log contains information concerning samples recovered, indications of the presence of various materials such as clay, sand, silt, rock, existing fill, etc., and observations of groundwater encountered. The field log also contains our interpretation of the subsurface conditions between sample locations. Therefore, the logs contain both factual and interpretative information. Our recommendations are based on the contents of the final log, which represents our interpretation of the field log.

## SELECTED REFERENCES

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Helley and Harwood, 1985, Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California; 1:62,500 scale.

KASL Consulting Engineers, New York Well Site Plan, Fair Oaks Water District; dated October 4, 2019.

KASL Consulting Engineers, letter regarding Skyway Well and New York Well Projects, Fair Oaks Water District, dated July 16, 2019.

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## **APPENDIX A**

### **BORING LOG KEY EXPLORATION LOGS**

# KEY TO BORING LOGS

MAJOR TYPES		DESCRIPTION	
COARSE-GRAINED SOILS MORE THAN HALF OF MAT'L LARGER THAN #200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LESS THAN 5% FINES	GW - Well graded gravels or gravel-sand mixtures GP - Poorly graded gravels or gravel-sand mixtures
		GRAVELS WITH OVER 12 % FINES	GM - Silty gravels, gravel-sand and silt mixtures GC - Clayey gravels, gravel-sand and clay mixtures
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LESS THAN 5% FINES	SW - Well graded sands, or gravelly sand mixtures SP - Poorly graded sands or gravelly sand mixtures
		SANDS WITH OVER 12 % FINES	SM - Silty sand, sand-silt mixtures SC - Clayey sand, sand-clay mixtures
FINE-GRAINED SOILS MORE THAN HALF OF MAT'L SMALLER THAN #200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50 % OR LESS		ML - Inorganic silt with low to medium plasticity CL - Inorganic clay with low to medium plasticity OL - Low plasticity organic silts and clays
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50 %		MH - Elastic silt with high plasticity CH - Fat clay with high plasticity OH - Highly plastic organic silts and clays
	HIGHLY ORGANIC SOILS		PT - Peat and other highly organic soils

For fine-grained soils with 15 to 29% retained on the #200 sieve, the words "with sand" or "with gravel" (whichever is predominant) are added to the group name.

For fine-grained soil with >30% retained on the #200 sieve, the words "sandy" or "gravelly" (whichever is predominant) are added to the group name.

## GRAIN SIZES

U.S. STANDARD SERIES SIEVE SIZE				CLEAR SQUARE SIEVE OPENINGS			
	200	40	10	4	3/4 "	3"	12"
SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

### RELATIVE DENSITY

<u>SANDS AND GRAVELS</u>	BLOWS/FOOT (S.P.T.)
VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

### CONSISTENCY

<u>SILTS AND CLAYS</u>	<u>STRENGTH*</u>
VERY SOFT	0-1/4
SOFT	1/4-1/2
MEDIUM STIFF	1/2-1
STIFF	1-2
VERY STIFF	2-4
HARD	OVER 4

### MOISTURE CONDITION

DRY	Dusty, dry to touch
MOIST	Damp but no visible water
WET	Visible freewater

### LINE TYPES

—————	Solid - Layer Break
-----	Dashed - Gradational or approximate layer break

### GROUND-WATER SYMBOLS

	Groundwater level during drilling
	Stabilized groundwater level

### SAMPLER SYMBOLS

	Modified California (3" O.D.) sampler
	California (2.5" O.D.) sampler
	S.P.T. - Split spoon sampler
	Shelby Tube
	Dames and Moore Piston
	Continuous Core
	Bag Samples
	Grab Samples
NR	No Recovery

(S.P.T.) Number of blows of 140 lb. hammer falling 30" to drive a 2-inch O.D. (1-3/8 inch I.D.) sampler

\* Unconfined compressive strength in tons/sq. ft., asterisk on log means determined by pocket penetrometer



# LOG OF BORING 1-B1

LATITUDE: 38.642861

LONGITUDE: -121.278318

Geotechnical Exploration  
New York Well Building  
Fair Oaks, CA  
16778.000.000

DATE DRILLED: 11/18/2019  
HOLE DEPTH: Approx. 15½ ft.  
HOLE DIAMETER: 4.0 in.  
SURF ELEV (WGS 84): Approx. 162 ft.

LOGGED / REVIEWED BY: S. Blakely / PC  
DRILLING CONTRACTOR: West Coast Exploration  
DRILLING METHOD: Solid Flight Auger  
HAMMER TYPE: 140 lb. Rope and Cathead

Depth in Feet	Elevation in Feet	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits			Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
							Liquid Limit	Plastic Limit	Plasticity Index				
	160		SANDY CLAY WITH GRAVEL (CL), dark yellowish brown, hard, slightly moist, medium plasticity, low toughness, approximately 25% fine- to coarse-grained sand, approximately 15% fine to medium angular gravel, contains asphalt, trace wood [Fill] R-Value = 32			50/6				62	5.4		4.5+
	5		SILTY GRAVEL WITH SAND (GM), very dark grayish brown, dense, slightly moist, approximately 30% fine- to coarse-grained sand, fine to medium angular gravel, approximately 10% fines [Fill]			42					5		
	155		SANDY CLAY WITH GRAVEL (CL), dark yellowish brown, hard, slightly moist, medium plasticity, approximately 25% fine- to coarse-grained sand, approximately 15% fine to medium angular gravel, contains asphalt, trace wood [Fill]			47					2.9		
	10		SANDY LEAN CLAY (CL), dark yellowish brown, hard, moist, medium plasticity, approximately 30% fine- to medium-grained sand, 10% fine gravel [Native]			50/6				56	10.6		4.5+
	150		SILTY SAND (SC-SM), reddish brown, very dense, moist, fine- to medium-grained sand, 30% fines			64/5					9.6		4.5+
	15		Bottom of boring at 15½ feet. No groundwater encountered.										4.5+



# LOG OF BORING 1-B2

LATITUDE: 38.642817

LONGITUDE: -121.278244

Geotechnical Exploration  
New York Well Building  
Fair Oaks, CA  
16778.000.000

DATE DRILLED: 11/18/2019  
HOLE DEPTH: Approx. 14½ ft.  
HOLE DIAMETER: 4.0 in.  
SURF ELEV (WGS 84): Approx. 162 ft.

LOGGED / REVIEWED BY: S. Blakely / PC  
DRILLING CONTRACTOR: West Coast Exploration  
DRILLING METHOD: Solid Flight Auger  
HAMMER TYPE: 140 lb. Rope and Cathead

Depth in Feet	Elevation in Feet	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits			Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
							Liquid Limit	Plastic Limit	Plasticity Index				
			2" Asphalt Concrete										
			6" Aggregate Base										
	160		SANDY LEAN CLAY WITH GRAVEL (CL), dark yellowish brown, hard, moist, medium plasticity, low toughness, approximately 25% fine- to medium-grained sand, approximately 15% fine to medium angular gravel [Fill] Expansion Index = 48			57/6							4.5+
5			LEAN CLAY (CL), olive brown, hard, moist, strong cementation, iron oxide staining [Native] grades to yellowish red			60/6				30.9			4.5+
	155		grades to 92% fines			50/4			92	21.3			
10			SILTY SAND (SM), dark yellowish brown, very dense, moist, fine- to medium-grained sand, moderate cementation, approximately 40% low plasticity fines, no HCl reaction			58/6				13.8			4.5+
	150					55/5				15.9			
			Bottom of boring at 14½ feet. No groundwater encountered.										4.5+



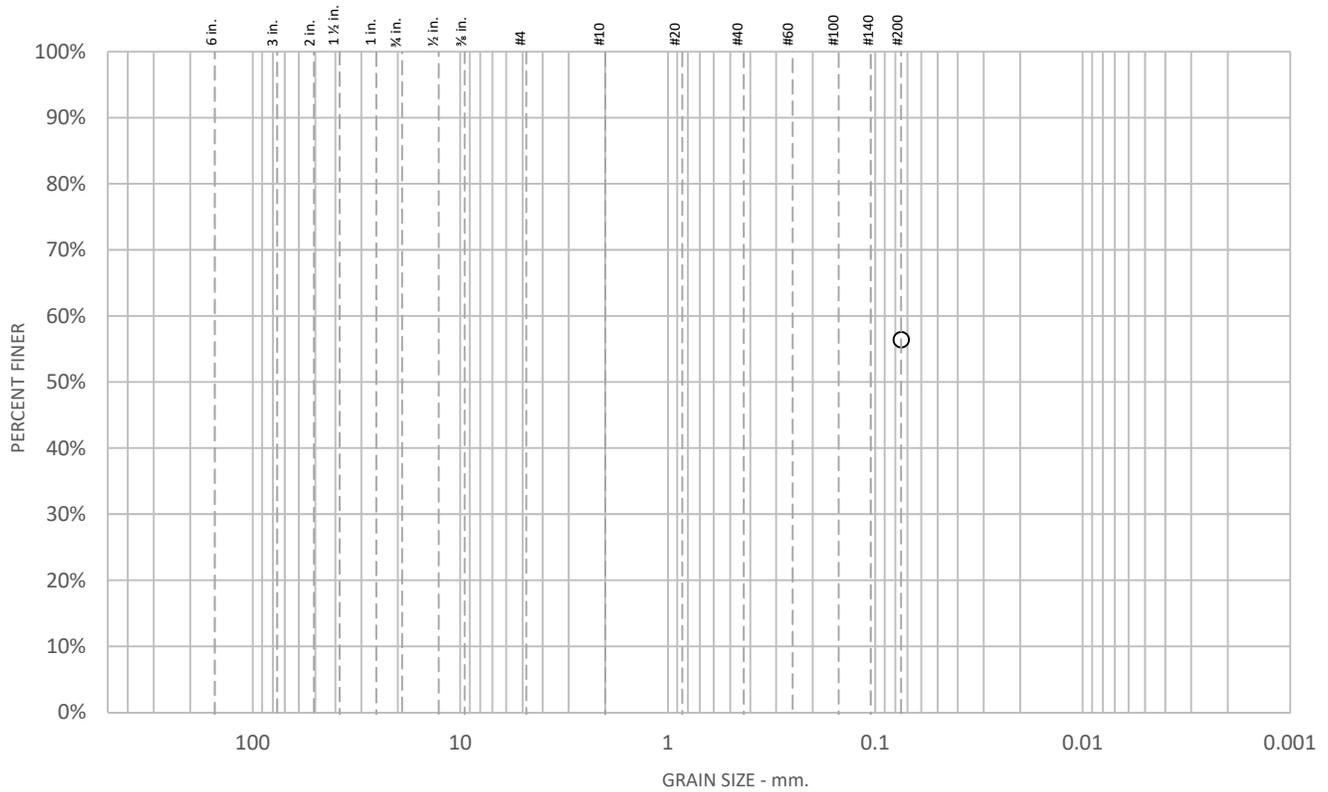
## **APPENDIX B**

### **LABORATORY TEST DATA**

**Sieve Analysis  
Expansion Index  
R-Value Test Report  
Moisture Content  
Analytical Results of Soil Corrosion**



# Particle Size Distribution Report



% +75mm	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						56.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	56.4		

\* (no specification provided)

**Soil Description**  
See exploration logs

**Atterberg Limits**  
PL =                      LL =                      PI =

**Coefficients**  
D<sub>90</sub> =                      D<sub>85</sub> =                      D<sub>60</sub> =  
D<sub>50</sub> =                      D<sub>30</sub> =                      D<sub>15</sub> =  
D<sub>10</sub> =                      C<sub>u</sub> =                      C<sub>c</sub> =

**Classification**  
USCS =

**Remarks**  
ASTM D1140, Method B  
Soak time = 180 min  
Dry sample weight = 210.8 g

<b>Sample Number:</b> 1-B1 @ 10.5 <b>Client:</b> KASL Consulting Engineers <b>Project:</b> New York Well, Fair Oaks Water District <b>Project location:</b> Fair Oaks, CA	<b>Project Number:</b> 16778.000.000 PH001 <b>Date:</b> 11/22/2019	
--	---	--

**Tested By:** R. Montalvo                      **Checked By:** M. Gilbert

**Test Location:** 2213 Plaza Drive, Rocklin, CA 95765



# EXPANSION INDEX TEST REPORT

## ASTM D4829

SAMPLE ID	SOIL DESCRIPTION	SAMPLE LOCATION	INITIAL DRY DENSITY (pcf)	INITIAL MOISTURE CONTENT (%)	FINAL MOISTURE CONTENT (%)	EXPANSION INDEX
1-B2@1 Bulk	See exploration logs	1-B2@1Bulk	102.5	12.2	28.4	48

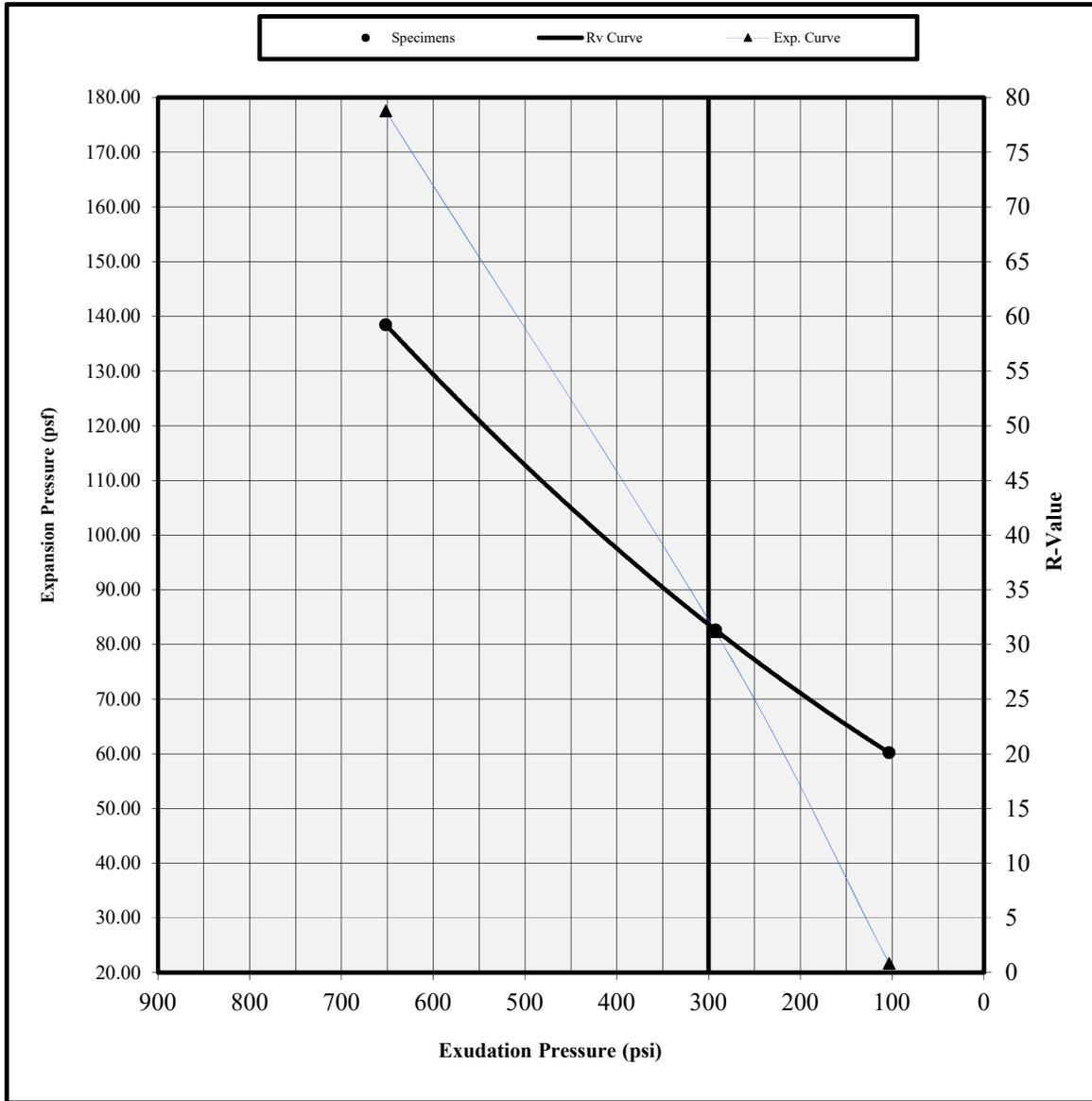
**TABLE 1: CLASSIFICATION OF EXPANSIVE SOIL**  
ASTM D4829

EXPANSION INDEX	POTENTIAL EXPANSION
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High



**CLIENT: KASL Consulting Engineers**  
**PROJECT NAME: New York Well, Fair Oaks Water District GEX**  
**PROJECT NO: 16778.000.000**  
**PROJECT LOCATION: 1-B2@1Bulk**  
**REPORT DATE: 11/25/2019**  
**TESTED BY: R. Montalvo**  
**REVIEWED BY: M. Gilbert**

**R VALUE TEST REPORT  
CTM-301**



**Sample ID/Location: 1-B1@0**

**Description: Yellowish brown clayey SAND**

Test remarks:

Specimen	Specimen 1	Specimen 2	Specimen 3
Exudation Pressure (p.s.i.)	652	292	103
Expansion dial (0.0001")	41	19	5
Expansion Pressure (p.s.f.)	178	82	22
Resistance Value, "R"	59	31	20
% Moisture at Test	11.4	12.9	15.6
Dry Density at Test, p.c.f.	120.6	117.9	111.0
"R" Value at Exudation Pressure of 300 psi.	32		
Expansion Pressure (psf) at Exudation Pressure of 300 psi.	84		

**PROJECT NAME: New York Well, Fair Oaks Water District**  
**PROJECT NUMBER: 16778.000.000**  
**CLIENT: KASL Consulting Engineers**  
**PHASE NUMBER: 001**

**DATE: 11/26/19**



Tested by: R. Montalvo

Reviewed by: M. Gilbert

Lab Address: 2213 Plaza Drive, Rocklin, CA 95765

# MOISTURE CONTENT DETERMINATION

ASTM D2216

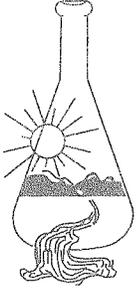
BORING/SAMPLE ID	1-B1@0.5	1-B1@3.5	1-B1@5.5	1-B1@10.5	1-B1@15	1-B2@3	1-B2@5.5	1-B2@10
DEPTH (ft)	0.5	3.5	5.5	10.5	15	3	5.5	10
Method A or B	B	B	B	B	B	B	B	B
%MOISTURE	5.4	5.0	2.9	10.6	9.6	30.9	21.3	13.8

BORING/SAMPLE ID	1-B2@14							
DEPTH (ft)	14							
Method A or B	B							
%MOISTURE	15.9							

<p><b>PROJECT NAME:</b> New York Well, Fair Oaks Water District</p> <p><b>PROJECT NUMBER:</b> 16778.000.000</p> <p><b>CLIENT:</b> KASL Consulting Engineers</p> <p><b>PHASE NUMBER:</b> 1</p>	<p><b>DATE:</b> 11/22/19</p> 
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Tested by: R. Montalvo

Reviewed by: N. Broussard



# Sunland Analytical

11419 Sunrise Gold Circle, #10  
Rancho Cordova, CA 95742  
(916) 852-8557

Date Reported 11/27/2019  
Date Submitted 11/21/2019

To: Stephen Blakely  
Engeo, Inc.  
2213 Plaza Dr.  
Rocklin, CA 95765

From: Gene Oliphant, Ph.D. \ Randy Horney  
General Manager \ Lab Manager

The reported analysis was requested for the following location:  
Location : 16778.000.001 PH001 Site ID : 1-B1@0.5.  
Thank you for your business.

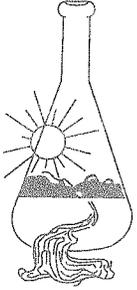
\* For future reference to this analysis please use SUN # 81016-169229.

-----  
EVALUATION FOR SOIL CORROSION

Soil pH	5.67		
Minimum Resistivity	8.84	ohm-cm (x1000)	
Chloride	1.7	ppm	00.00017 %
Sulfate	8.8	ppm	00.00088 %

#### METHODS

pH and Min. Resistivity CA DOT Test #643  
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m



# Sunland Analytical

11419 Sunrise Gold Circle, #10  
Rancho Cordova, CA 95742  
(916) 852-8557

Date Reported 11/27/2019  
Date Submitted 11/21/2019

To: Stephen Blakely  
Engeo, Inc.  
2213 Plaza Dr.  
Rocklin, CA 95765

From: Gene Oliphant, Ph.D. \ Randy Horney  
General Manager \ Lab Manager

The reported analysis was requested for the following location:  
Location : 16778.000.001 PH001 Site ID : 1-B2@3.0.  
Thank you for your business.

\* For future reference to this analysis please use SUN # 81016-169230.

-----  
EVALUATION FOR SOIL CORROSION

Soil pH	6.96		
Minimum Resistivity	2.14	ohm-cm (x1000)	
Chloride	2.4 ppm	00.00024	%
Sulfate	27.0 ppm	00.00270	%

#### METHODS

pH and Min.Resistivity CA DOT Test #643  
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

