AGENDA ITEM EXECUTIVE SUMMARY

Agenda Item:	Wastewater Treatment Plant – Solids Handling Improvements
Presenter & Title:	Bob VanGyseghem, Superintendent of Water and Wastewater.
Date:	1/15/2020

Please Check Appropriate Box:

X	Committee of the Whole Meeting		Special Committee of the Whole Meeting
X	City Council Meeting		Special City Council Meeting
	Public Hearing		Other -

Associated Strategic Plan Goal/Objective: EMS-II

Estimated Cost: $669,900.00	Budgeted? __X_ Yes ____ No	Other Funding? ____ Yes ____ No

Executive Summary:

The Fiscal Year 20 Capital Budget has funds allocated for the replacement and installation of six (6) pumps throughout the Wastewater Treatment Plant, four (4) solids flow meters, and a polymer feed unit. Staff combined these items into one bid package. The project was advertised in the Daily Herald and on the City web site. Four bids were received on December 23, 2019 with the low bid submitted by Mechanical Inc. in the amount of $609,000.00 Mechanical Inc. was the mechanical contractor during the 2004 Phase II expansion to the Wastewater Treatment Plant. Staff is recommending that a 10% contingency be included in the overall not-to-exceed amount to account for any unforeseen field changes that may occur. Any field changes (Change Orders) must be approved by the City Administrator to be applied to the contingency.

Attachments: *(please list)*

- Resolution
- Bid Summary

Voting Requirements:

This motion requires __6_ affirmative votes for passage.

The Mayor may vote on three occasions: (a) when the vote of the aldermen or trustees has resulted in a tie; (b) when one half of the aldermen or trustees elected have voted in favor of an ordinance, resolution, or motion even though there is no tie votes; or (c) when a vote greater than a majority of the corporate authorities is required by state statute or local ordinance to adopt an ordinance, resolution, or motion.

Recommendation / Suggested Action: *(how item should be listed on agenda)*

Staff requests that the City Council authorize the City Administrator to enter into a contract with Mechanical Inc. at a cost of $609,000.00 and allow the City Administrator to approve up to $60,900.00 in change orders for a total not-to-exceed amount of $669,900.00

RESOLUTION NO. 2020-09

RESOLUTION AUTHORIZING EXECUTION OF
Contract with Mechanical Inc.

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF GENEVA, KANE COUNTY, ILLINOIS, as follows:

SECTION 1: That the City Administrator is hereby authorized to execute, on behalf of the City of Geneva, a contract with Mechanical Inc., for Solids Handling Improvements at the Wastewater Treatment Plant.

SECTION 2: This Resolution shall become effective from and after its passage as in accordance with law.

PASSED by the City Council of the City of Geneva, Kane County, Illinois, this ____ day of _____, 2020

AYES: __ NAYS: __ ABSENT: __ ABSTAINING: __ HOLDING OFFICE: __

Approved by me this ____ day of _____, 2020.

_____
Mayor

ATTEST:

_____
City Clerk

City of Geneva

Summary of Bids

Name of Project: Interim Solids Handling Improvements

Recorded By: Bob Van Gyseghem

Opened By: Rita Kruse

Date/Time: 12/23/2019 10:00 AM

Approved Engineer Estimate/ Budget :

CONTRACTOR NAME	BID PRICE	BID BOND % OF PRICE	TYPE OF PAYMENT FOR BID BOND	REMARKS	ADDENDUM
Mechanical Inc.	**$609,000.00**	10%	Bond		
Dahme Mechanical Industries, Inc.	**$612,499.99**	10%	Bond		
Independent Mechanical Industries Inc	**$660,410.00**	10%	Bond		
AMS Mechanical Systems, Inc.	**$708,913.00**	10%	Bond		

SECTION 00500
AGREEMENT

THIS AGREEMENT is dated as the 27 day of January in the year 2020 by and between the **City of Geneva** (hereinafter called OWNER), and (hereinafter called CONTRACTOR). Mechanical, Inc.

OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

Article 1. WORK

CONTRACTOR shall complete all WORK as specified or indicated in the Contract Documents. WORK is generally described as follows:

Article 2. ENGINEER

The City of Geneva, Illinois (hereinafter called OWNER), will assume all duties and responsibilities and will have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the WORK in accordance with the Contract Documents.

Article 3. CONTRACT TIME

All WORK shall be completed within the Contract Times indicated on the Bid Form.

3.1 Liquidated Damages. OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss if the WORK is not completed within the time specified in Article 3 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by OWNER if the WORK is not completed on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER **two hundred fifty dollars and zero cents ($250.00) for each day that expires after the time specified on the Bid Form for Substantial Completion until the WORK is fully operational and tested. The CONTRACTOR shall pay the OWNER an additional two hundred fifty dollars and zero cents ($250.00) for each day that expires after the time specified on the Bid Form for Final Completion until WORK is accepted by OWNER.** At the option of the OWNER damage amounts may be deducted, on a monthly basis, from the contract balance.

3.2 The contract time may be changed only by a change order. For each change order, CONTRACTOR shall submit to the OWNER for review, sufficient reason for delay to enable the OWNER to ascertain the necessity and reasonableness of the delay, and the allow ability and eligibility of delay proposed.

Article 4. CONTRACT PRICE

OWNER shall pay CONTRACTOR for performance of the WORK in accordance with the Contract Documents in current funds as follows:

4.1 Payment shall be made on the basis of the monthly estimates of partial completion, approved by the OWNER, except as otherwise provided in the detailed specifications for each class of WORK.

4.2 The contract price may be changed only by a change order. For each change order, CONTRACTOR shall submit to the OWNER for review, sufficient cost and pricing data to enable the OWNER to ascertain the necessity and reasonableness of costs and amounts proposed, and the allow ability and eligibility of costs proposed.

Article 5. PAYMENT PROCEDURES

CONTRACTOR shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by OWNER as provided in the General Conditions.

5.1 Progress Payments. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment, on or about the second Wednesday of each month during construction as provided below. All progress payments will be on the basis of the progress of the WORK estimated by the OWNER.

5.1.1 Prior to Substantial Completion progress payments will be in an amount equal to 90% of the WORK completed, and 90% of materials and equipment not incorporated in the WORK but delivered and suitably stored, less in each case the aggregate of payments previously made.

5.1.2 Upon Substantial Completion and thereafter, OWNER shall pay an amount sufficient to increase total payments to CONTRACTOR to 95% of the Contract Price, less such amounts as OWNER shall determine in accordance with Paragraph 14.07 of the General Conditions.

5.2 Final Payment. Upon final completion and acceptance of the WORK in accordance with Paragraph 14.07 of the General Conditions, OWNER shall pay the remainder of the Contract Price as provided in said Paragraph 14.07.

Article 6. CONTRACTOR'S REPRESENTATIONS

In order to induce OWNER to enter into this Agreement CONTRACTOR makes the following representation:

6.1 CONTRACTOR has familiarized himself with the nature and extent of the Contract Documents, WORK, locality, and with all local conditions and federal, state and local laws, ordinances, rules and regulations that in any manner may affect cost, progress or performance of the WORK.

6.2 CONTRACTOR has studied carefully all available reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the WORK which were relied upon by OWNER in the preparation of the Drawings and Specifications and which have been identified in the Supplementary Conditions.

6.3 CONTRACTOR has made or caused to be made examinations, investigations and tests and studies of such reports and related data in addition to those referred to in Paragraph 6.2 as he deems necessary for the performance of the WORK at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents; and no additional examinations, investigations, tests, reports or similar data are or will be required by CONTRACTOR for such purposes.

6.4 CONTRACTOR has correlated the results of all such observations, examinations, investigations, tests, reports and data with the terms and conditions of the Contract Documents.

6.5 CONTRACTOR has given OWNER written notice of all conflicts, errors or discrepancies that he has discovered in the Contract Documents and the written resolution thereof by OWNER is acceptable to CONTRACTOR.

6.6 CONTRACTOR warrants that no person or selling agency has been employed or retained to solicit or secure the contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee. For breach or violation of this warranty, the OWNER shall have the right to annul the contract without liability or in its discretion to deduct from the contract price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.

6.7 The award or execution of all subcontracts by a prime CONTRACTOR and the procurement and negotiation procedures used by such prime CONTRACTOR in awarding or executing such subcontracts shall comply with:

6.7.1 All provisions of federal, State and local law,

6.7.2 All provisions of Illinois Administrative Code Title 35 Section 365.620 with respect to fraud and other unlawful or corrupt practices;

6.7.3 All provisions of Illinois Administrative Code Title 35 Section 365.620 with respect to access to facilities, records and audit or records; and

6.7.4 The provision requiring a certification of compliance with federal Executive Order 12549 regarding debarment, suspension and other responsibility matters.

6.8 CONTRACTOR shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. CONTRACTOR shall carry out applicable requirements of 40 CFR Part 33 in the award and administration of contracts. Failure by the CONTRACTOR to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies.

Article 7. CONTRACT DOCUMENTS

The Contract Documents which comprise the entire agreement between OWNER and CONTRACTOR are attached to this Agreement, made a part hereof and consist of the following:

7.1 Invitation to Bid.
7.2 Instructions to Bidders.
7.3 Bid Form.
7.4 This Agreement.
7.5 Exhibits to this Agreement.
7.6 Contract, Payment and Performance Bonds
7.7 Notice of Award.
7.8 Notice to Proceed.
7.9 General Conditions.
7.10 Supplementary Conditions.
7.11 Specifications (Divisions 1 through 16).

7.12 Drawings (as listed on the Index of Drawings on the Cover Sheet).
7.13 All issued Addenda.

7.14 Any modification, including Change Orders, duly delivered after execution of Agreement.

There are no Contract Documents other than those listed above in this Article 7. The Contract Documents may only be altered, amended or repealed pursuant to Section 3.04 of the General Conditions.

Article 8. MISCELLANEOUS

8.1 Terms used in this Agreement which are defined in Article 1 of the General Conditions shall have the meanings indicated in the General Conditions.

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

8.3 OWNER and CONTRACTOR each binds himself, his partners, successors, assigns and legal representatives to the other party hereto, his partners, successors, assigns and legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents.

8.4 All claims, counter-claims, disputes and other matters in question between the OWNER and the CONTRACTOR arising out of or relating to this sub-agreement or the breach of it will be decided by arbitration if the parties mutually agree, or in a court of competent jurisdiction within the State of Illinois.

Article 9. OTHER PROVISIONS

IN WITNESS WHEREOF, the parties hereto have signed this Agreement in triplicate. One counterpart each has been delivered to OWNER and CONTRACTOR. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR.

This Agreement shall become effective on January 27, 2020

OWNER

by _____

(Corporate Seal)

Attested

by _____ City Clerk

(City Seal)

Address for Giving Notices

City of Geneva
1800 South Street
Geneva, IL 60134

CONTRACTOR

by _____

(Corporate Seal)

Attested

by _____

"OFFICIAL SEAL"
ELEANOR MARY CARR
Notary Public, State of Illinois
My Commission Expires 4-4-21

(Notary Seal)

Address for Giving Notices

END OF SECTION 00500

City of Geneva, Illinois

Wastewater Treatment Facility
Interim Solids Improvements

EXECUTED SET NO.: _____

ACKNOWLEDGED BY (Initial and Date):

City of Geneva: _____

Mechanical, Inc.: _____

BID SET

21 NOVEMBER 2019

CDM Smith

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CERTIFICATIONS PAGE

I hereby certify that the Specification Sections listed were prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Illinois.



R Eric Compton, P.E.

Date: 21 November 2019

Responsible for Division 0, Division 1 Except 01171, Division 11, Division 15
License Number: 062-052176



Eugenio J Triana, P.E.

Date: 21 November 2019

Responsible for Division 13
License Number: 062-071617



Michael E. Kahn, P.E.

Date: 21 November 2019

Responsible for Section 01171 and Division 16
License Number: 062-062262

END OF SECTION

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SECTION 00030
ADVERTISEMENT FOR BIDS

Notice is hereby given by the City of Geneva (City) that Sealed Bids will be received for the following Project:

City of Geneva, Illinois
Wastewater Treatment Facility Interim Solids Improvements

Receipt of Bids

Sealed proposals submitted in duplicate in a sealed envelope with the words "Wastewater Treatment Facility Interim Solids Improvements" will be received by the City of Geneva, Illinois until **10:00 A.M., Monday, December 23, 2019** at the office of the City Administrator, 22 South First Street, Geneva, IL 60134, at which time they will be publicly opened and read aloud.

Bidders will be required to comply with the President's Executive Order No. 11246, as amended. The requirements for bidders and contractors under this order are explained in 41 CFR 60-4.

Work Description

The Work generally consists of the following:

1. Raw Sewage Pumping Station: Replace three pump discharge isolation gate valves with plug valves.

2. Grit and Blower Building: Provide primary sludge system flow meter.

3. Bioreactor Trains 1 and 2: Provide one motor operator (actuator) each at Train 1 and Train 2 on existing Recycled Activated Sludge (RAS) piping slide gate that currently is manually operated.

4. RAS/WAS Pumping Station:
   a. Replace in kind three submersible RAS pumps.
   b. Provide Waste Activated Sludge (WAS) flow meter.

5. Centrifuge Building:
   a. Replace in kind two Thickened Waste Activated Sludge (TWAS) progressing cavity pumps.
   b. Provide TWAS flow meter.
   c. Provide Digested Sludge flow meter.
   d. Replace Centrifuge 2 polymer feed system.

6. Digester Control Building: Replace in kind Digested Sludge Recirculation Pump No. 2.

Document Inspection & Procurements

Bidding Documents may be viewed on the City of Geneva Web Site, www.geneva.il.us or at the following location:

City of Geneva Public Works
1800 South Street
Geneva, IL 60134
630-232-1551

Bidding Documents are available for purchase during normal business hours at the office of CDM Smith Inc., 125 South Wacker Drive, Suite 700, Chicago, IL 60606 (telephone 312-346-5000). A complete set of paper and electronic copies of the Bidding Documents may be purchased for $100 per set with full-size Drawings, or $50 per set with half-size Drawings. Electronic copies of the Bidding Documents are available at no cost. All fees for copies of the Bidding Documents are non-refundable, and cover costs of copying, handling, and mailing. Payment shall be in cash or by bank or certified check payable to CDM Smith Inc.

Bid Form

Bids shall be submitted on the forms provided in the Bidding Documents and in accordance with the Instructions to Bidders.

Bonds

Each bid shall be accompanied by a bid bond payable to the order of the City of Geneva, Illinois, in an amount not less than ten (10) percent of the amount of the bid, excluding alternates, as a guaranty that the Bidder will execute the contract, if it is awarded, in conformity with the bid form.

The successful Bidder will be required to furnish Performance and Payment Bonds on forms provided in the Specifications and Contract Documents in an amount equal to 100 percent of the contract price.

Wage Rates

To the extent as required by law, Contractors shall comply with the Illinois Prevailing Wage Act, 820 ILCS 130/.01 (the "Act") and the current City of Geneva Ordinance with rates to be paid, in effect at the time work is performed in the County where the work is performed. The successful Bidder is responsible for posting and issuing current rates to its employees and subcontractors. Current rates are available through the Illinois Department of Labor's website at http://labor.illinois.labor.gov/. The successful Bidder and each subcontractor shall submit monthly, in person, by mail, or electronically, a certified payroll to the City of Geneva. The certified payroll shall consist of records of all laborers, mechanics, and other workers employed by them on the project. The records shall include each worker's name, address, telephone number (when available), the last four digits of the worker's social security number, classification or classifications, the hourly wages paid in each period, the number of hours worked each day, and the starting and ending times of work each day. The certified payroll shall be accompanied by a statement signed by the Bidder or subcontractor which avers that:

> Such records are true and accurate;
>
> The hourly rate paid to each worker is not less than the general prevailing rate of hourly wages required; and the Bidder or subcontractor is aware that filing a certified payroll that he or she knows to be false is a Class B misdemeanor. The City of Geneva is required to keep the certification records submitted for a period of not less than five years. Furthermore, these records, except an employee's address, telephone number, and social security number, shall be made available in accordance with the Freedom of Information Act.

CONTRACTORS MUST ATTEND A MANDATORY PRE-BID CONFERENCE at **10:00 A.M., Monday, December 9, 2019** at the City of Geneva Wastewater Treatment Facility, 602 Crissey Avenue, Geneva, Illinois 60134 to discuss the Bidding Documents and to familiarize themselves with the site conditions. **CONTRACTORS WHO DO NOT ATTEND THE PRE-BID CONFERENCE WILL BE DISQUALIFIED FROM THE BIDDING PROCESS.**

Rejection of Bids

The Owner expressly reserves the right to reject any or all bids and to accept any bid that appears to be in the best interest of the Owner. The Owner expressly reserves the right to waive any informalities or technical irregularities in a bid if to do so is in the best interest of the Owner.

Dated this 21st day of November 2019
City of Geneva, Illinois

Bob VanGyseghem
Superintendent of Water and Wastewater

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SECTION 00050
BIDDER CERTIFICATION

The following affidavit must be completed, notarized and submitted with the bid package in compliance with Article 33 E of the "Criminal Code of 1961."

I (*Name*) Gary Statdfield, do hereby certify that:

1. I am (*Position*) Vice President of (*Firm Name and Address*) Mechanical, Inc. 2279 Yellow Creek Road, Freeport IL and have authority to execute this certification on behalf of the firm;

2. The above referenced firm is not barred from bidding on this contract as a result of a violation of either Section 33E-3, Bid-Rigging, or Section 33E-4, Bid Rotating, as set forth in Article 33E of the "Criminal Code of 1961."

Signature Gary Statdfield

Date 12/23/19



Corporate Seal

(where appropriate)

REQUIRED NOTARIZATION

On this 23rd day of Dec., 2019, before me appeared (*Name*) Gary Statdfield to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (*Name of Firm*) Mechanical, Inc. to execute the affidavit and did so at his or her free act and deed.

Signature of Notary Public Eleanor Carr

Commission Expires 4/4/21

Notary Seal

END OF SECTION 00050

"OFFICIAL SEAL"
ELEANOR MARY CARR
Notary Public, State of Illinois
My Commission Expires 4-4-21

SECTION 00100
INSTRUCTIONS TO BIDDERS

1. Defined Terms.

   1.1 Terms used in these Instructions to BIDDERS which are defined in the Standard General Conditions of the Construction Contract, NSPE-ACEC Document 1910-8, CSI 56465 (1996 edition) have the meanings assigned to them in the General Conditions. The term "SUCCESSFUL BIDDER" means the lowest, qualified, responsible BIDDER to whom OWNER (on the basis of OWNER'S evaluation as hereinafter provided) makes an award.

2. Copies of Bidding Documents.

   2.1 Complete sets of the Bidding Documents are available as indicated in the Notice or Invitation to Bid.

   2.2 Complete sets of Bidding Documents shall be used in preparing BIDS; OWNER assumes no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

   2.3 OWNER in making copies of Bidding Documents available on the above terms does so only for the purpose of obtaining BIDS on the WORK and does not confer a license or grant for any other use.

3. Qualification of BIDDERS.

   3.1 To demonstrate qualifications to perform the WORK, each BIDDER must be prepared to submit within five days of OWNER'S request written evidence of the types set forth in the Supplementary Conditions, such as financial data, previous experience and evidence of authority to conduct business in the jurisdiction where the Project is located. Each BID must contain evidence of BIDDER'S qualification to do business in the state where the Project is located or covenant to obtain such qualification prior to award of the contract.

4. Examination of Contract Documents and Site.

   4.1 Before submitting a BID, each BIDDER must (a) examine the Contract Documents thoroughly, (b) visit the site to familiarize himself with local conditions that may in any manner affect cost, progress of performance of the WORK, (c) familiarize himself with federal, state and local laws, ordinances, rules and regulations that may in any manner affect cost, progress or performance of the WORK; (d) study and carefully correlate BIDDER'S observations with the Contract Documents; and, (e) notify the OWNER of all conflicts, errors, ambiguities or discrepancies which Bidder has discovered in or between the Contract Documents and such other related documents.

   4.2 Each BIDDER shall be responsible for inspecting the site and for reading and being thoroughly familiar with the CONTRACT DOCUMENTS. The failure or omission of any BIDDER to do

any of the forgoing shall in no way relieve any BIDDER from any obligation in respect to his BID.

4.3 BIDDERS must satisfy themselves of the accuracy of the estimated quantities in the BID Schedule by examination of the site and a review of the drawings and specifications including ADDENDA. After BIDS have been submitted, the BIDDER shall not assert that there was a misunderstanding concerning the quantities of WORK or the nature of the WORK to be done.

4.4 The OWNER shall provide BIDDERS, prior to BIDDING, all information that is pertinent to, and delineates and describes, the land owned and rights-of-way acquired or to be acquired.

4.5 When requested, OWNER will provide each BIDDER access to the site to conduct such investigations and tests, as each BIDDER deems necessary for submission of his BID.

4.6 The lands upon which the WORK is to be performed, rights-of-way for access thereto and other lands designated for use by CONTRACTOR in performing the WORK are identified in the Supplementary Conditions, General Requirements or Drawings.

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

4.8 The submission of a BID will constitute an incontrovertible representation by the BIDDER that he has complied with every requirement of this Article 4 and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the WORK.

5. Interpretations.

5.1 All questions about the meaning or intent of the CONTRACT DOCUMENTS shall be submitted to CDM Smith by email. Reference the Project name in the subject line. Direct all questions to both of the following individuals at the email addresses listed:

Michael Cho Email: chom@cdmsmith.com
Eric Compton Email: comptonre@cdmsmith.com

5.2 Clarifications or interpretations considered necessary by the OWNER or ENGINEER will be issued by Addenda at least five days before the bid opening date, sent by email to all parties recorded by OWNER as having received the Bidding Documents. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

5.3 Pre-Bid Conference: A MANDATORY pre-bid conference will be held in accordance with the Invitation to Bid.

6. Bid Security.

6.1 Bid Security shall be made payable to the City of Geneva, in an amount of ten percent (10%) of the BIDDER'S maximum BID price and in the form of a certified or bank check or a BID BOND issued by a Surety meeting the requirements of Paragraph 5.1 of the General Conditions.

6.2 Attorneys-in-fact who sign BID BONDS or payment BONDS and performance BONDS must file with each BOND a certified and effective dated copy of their power of attorney.

6.3 The BID Security of the SUCCESSFUL BIDDER will be retained until such BIDDER has executed Agreements and furnished the required Contract Security, whereupon it will be returned; if the SUCCESSFUL BIDDER fails to execute and deliver the Agreement and furnish the required Contract Security within 15 days of the Notice of Award, OWNER may annul the Notice of Award and the BID Security of that BIDDER will be forfeited. The BID Security of any BIDDER whom OWNER believes to have a reasonable chance of receiving the award may be retained by OWNER until the earlier of the seventh day after the "effective date of the Agreement" (which term is defined in the General Conditions) by OWNER to CONTRACTOR and the required Contract Security is furnished or the sixty-first day after the BID opening. BID Security of other BIDDERS will be returned within seven days of the BID opening.

7. Contract Time.

7.1 The number of days within which, or the date by which, the WORK is to be completed (Contract Time) is set forth in the BID Form.

8. Liquidated Damages.

8.1 Provisions for liquidated damages, if any, are set forth in the Agreement.

9. Substitute Material and Equipment.

9.1 The Contract, if awarded, will be on the basis of material and equipment described in the Drawings or specified in the Specifications without consideration of possible substitute or "or-equal" items. Whenever it is indicated in the Drawings or specified in the Specifications that a substitute or "or-equal" item of material or equipment may be furnished or used by CONTRACTOR if acceptable to OWNER, application for such acceptance will not be considered by OWNER until after the "effective date of the Agreement". The procedure for submittal of any such application by CONTRACTOR and consideration by OWNER is set forth in paragraphs 6.5 of the General Conditions that may be supplemented in the General Requirements.

10. Subcontractors, etc.

10.1 If the Supplementary Conditions require the identity of certain Subcontractors and other persons and organizations to be submitted to OWNER in advance of the Notice of Award, the apparent SUCCESSFUL BIDDER, and any other BIDDER so requested, will within seven days after the day of the BID opening submit to OWNER a list of all Subcontractors and other persons and organizations (including those who are to furnish the principal items of material and equipment) proposed for those portions of the WORK as to which such identification is so required. An

experience statement shall accompany such list with pertinent information as to similar projects and other evidence of qualification for each such Subcontractor, person and organization if requested by OWNER. If OWNER after due investigation has reasonable objections to any proposed Subcontractor, other person or organization, either may before giving the Notice of Award request the apparent SUCCESSFUL BIDDER to submit an acceptable substitute without an increase in BID price. If the apparent SUCCESSFUL BIDDER declines to make any such substitution, the contract shall not be awarded to such BIDDER, but his declining to make any such substitution will not constitute grounds for sacrificing his BID Security. Any Subcontractor, other person or organization so listed and to whom OWNER does not make written objection prior to the giving of the Notice of Award will be deemed acceptable to OWNER.

10.2 No CONTRACTOR shall be required to employ any Subcontractor, other person or organization against which he has reasonable objection.

11. Bid Form.

11.1 All BIDS must be made on the attached BID forms. All blank spaces for BID prices must be filled in, in ink or typewritten, and the BID forms must be fully completed and executed when submitted. Only one copy of the BID forms is required. The BID Forms are attached hereto. Additional copies may be obtained from OWNER.

11.2 BID Forms must be completed in ink or by typewriter. The BID price of each item on the forms must be stated where indicated.

11.3 BIDS by corporations must be executed in the corporate name by the president or a vice-president or other corporate officer (accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown below the signature.

11.4 BIDS by partnerships must be executed in the partnership name and signed by a partner, whose title must appear under the signature and the official address of the partnership must be shown below the signature.

11.5 All names must be typed or printed below the signature.

11.6 The BID shall contain an acknowledgment of receipt of all addenda (the numbers of which shall be filled in on the BID Forms).

11.7 The address to which communications regarding the BID is to be directed must be shown.

12. Submission of Bids.

12.1 BIDS shall be submitted at the time and place indicated in the "Invitation to BID" and shall be included in an opaque sealed envelope, marked with the Project title and name and address of the BIDDER and accompanied by the BID Security and other required documents. If the BID is sent

through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face thereof.

12.2 By submission of the BID, each BIDDER and, in the case of a joint bid, each party thereto certifies as to his or her own organization, that in connection with the BID:

12.2.1 The prices in the BID have been arrived at independently, without consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other BIDDER or with any other competitor;

12.2.2 Unless otherwise required by law, the prices quoted in the BID have not knowingly been disclosed by the BIDDER, prior to opening, directly or indirectly to any other BIDDER or to any competitor; and,

12.2.3 No attempt has been made or will be made by the BIDDER to induce any other person or firm to submit or not to submit a BID for the purpose of restricting competition.

12.3 Each person signing the BID shall certify that:

12.3.1 He or she is the person in the BIDDER'S organization responsible within that organization for the decision as to the prices being BID and that he or she has not participated, and will not participate, in any action contrary to 12.2(A) through 12.2(C) above; or

12.3.2 He or she is not the person in the BIDDER'S organization responsible within that organization for the decision as to the prices being BID, but that he or she has been authorized to act as agent certifying that the persons determining the prices have not participated, and will not participate, in any action contrary to 12.2(A) through 12.2(C) above, and as their agent shall so certify; and shall also certify that he or she has not participated, and will not participate, in any action contrary to 12.2(A) through 12.2(C) above.

12.4 All BID packages shall consist of Bid Form and all required attachments. Failure to submit a complete package may result in the BID being deemed incomplete.

12.5 The CONTRACTOR shall warrant that no person or selling agency has been employed or retained to solicit or secure the contract upon an agreement or understanding for a commission, percentage, brokerage or contingent fee. For breech or violation of this warranty, the OWNER shall have the right to annul the contract without liability or in its discretion to deduct from the contract price or consideration or otherwise recover, the full amount of such commission, percentage, brokerage or contingent fee.

13. Modification and Withdrawal of Bids.

13.1 Any BID may be modified or withdrawn prior to the time indicated in the Advertisement for BIDS for the opening of bids or authorized postponement thereof. Any BID received after the time and date specified shall not be considered. No BIDDER may withdraw a BID within 7 days after the actual date of the opening thereof. Should there be reasons why the contract cannot be awarded within the specified period; the time may be extended by mutual agreement between the OWNER and the BIDDER.

13.2 If, within twenty-four hours after BIDS are opened, any BIDDER files a duly signed written notice with OWNER and promptly thereafter demonstrates to the reasonable satisfaction of OWNER that there was a material and substantial mistake in the preparation of his BID, that BIDDER may withdraw his BID and the BID Security will be returned. Thereafter, that BIDDER will be disqualified from further bidding on the WORK.

14. Opening of BIDS.

14.1 BIDS will be opened publicly. When BIDS are opened publicly, they will be read aloud, and an abstract of the amounts of the Base BIDS and major alternates (if any) will be made available after the opening of BIDS.

15. BIDS to Remain Open.

15.1 All BIDS shall remain open for sixty days after the day of the BID opening, but OWNER may, in his sole discretion, release any BID and return the BID Security prior to that date.

16. Award of Contract.

16.1 OWNER reserves the right to reject any and all BIDS, to waive any and all informalities and to negotiate contract terms with the SUCCESSFUL BIDDER, and the right to disregard all nonconforming, non-responsive or conditional BIDS. Discrepancies between words and figures will be resolved in favor of words. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

16.2 In evaluating BIDS, OWNER shall consider the qualifications of the BIDDERS, whether or not the BIDS comply with the prescribed requirements, and alternates and unit prices if requested in the Bid Forms. It is OWNER'S intent to accept alternates (if any are accepted) in the order in which they are listed in the Bid Form, but OWNER may accept them in any order or combination.

16.3 OWNER may consider the qualifications and experience of Subcontractors and other persons and organizations (including those who are to furnish the principal items of material or equipment) proposed for those portions of the WORK as to which the identity of Subcontractors and other persons and organizations must be submitted as provided in the Supplementary Conditions. Operating costs, maintenance considerations, performance data and guarantee of materials and equipment may also be considered by OWNER.

16.4 OWNER may conduct such investigations as he deems necessary to assist in the evaluation of any BID and to establish the responsibility, qualifications and financial ability of the BIDDERS, proposed Subcontractors and other persons and organizations to do the WORK in accordance with the Contract Documents to OWNER'S satisfaction within the prescribed time.

16.5 OWNER reserves the right to reject the BID of any BIDDER who does not pass any such evaluation to OWNER'S satisfaction.

16.6 A conditional or qualified BID will not be accepted.

16.7 If the contract is to be awarded it will be awarded to the low, responsive, responsible BIDDER whose evaluation by OWNER indicates that the award will be in the best interests of the Project.

16.8 If the contract is to be awarded, OWNER will give the SUCCESSFUL BIDDER a Notice of Award within sixty days after the day of the BID opening.

17. Performance and Payment Bonds.

17.1 In addition to the requirements set forth in paragraph 5.1 of the General Conditions and the Supplementary Conditions, a performance bond and a payment bond, each in the amount of one hundred percent (100%) of the Contract Price, with a corporate surety approved by the Owner, will be required for the faithful performance of the contract. When the SUCCESSFUL BIDDER delivers the executed Agreement to OWNER it shall be accompanied by the required Performance and Payment Bonds.

18. Signing of Agreement

18.1 When OWNER gives a Notice of Award to the SUCCESSFUL BIDDER, at least three unsigned counterparts of the Agreement and all other Contract Documents will accompany it. Within days thereafter as defined on Bid Form CONTRACTOR shall sign and deliver at least three counterparts of the Agreement to OWNER with all other Contract Documents attached. In a timely fashion, OWNER will deliver all fully signed counterparts to CONTRACTOR.

END OF SECTION 00100

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SECTION 00300
BID FORM

1. Proposal of (*Name and Address of Bidder*) Mechanical, Inc.
   2279 Yellow Creek Road
   Freeport IL 61032
   for the improvement designated below.

   Work covered by Contract Documents includes, but is not necessarily limited to, the following:

   1. Raw Sewage Pumping Station: Replace three pump discharge isolate gate valves with plug valves.
   2. Grit and Blower Building: Provide primary sludge system flow meter.
   3. Bioreactor Train 1 and 2: Provide one motor operator each at Train 1 and Train 2 on existing RAS line slide gate – currently manually operated.
   4. RAS/WAS Pumping Station:
      A. Replace in kind three submersible RAS pumps.
      B. Provide WAS flow meter.
   5. Centrifuge Building:
      A. Replace two TWAS progressing cavity pumps.
      B. Provide TWAS flow meter.
      C. Provide digested sludge flow meter.
      D. Replace Centrifuge 2 polymer feed system.
      E. Install Owner provided basket strainer.
   6. Digester Control Building: Replace in kind Digested Sludge Recirculation Pump No. 2.

2. The Project is located at the Geneva Wastewater Treatment Facility, 602 Crissey Avenue, Geneva, IL 60134.

3. The Bidder shall fill in the Lump Sum Price for each Item of Work indicated in the following table for a responsive bid. The Total Amount for each Item shall incorporate all Work required for the listed Description, inclusive of all labor, materials, overhead, profit, insurance and incidentals required to complete the Work.

Base Bid Items:

Item No.	Description	Unit	Quantity	Unit Price	Total Amount
1	Raw Sewage Pumping Station – All Work	Lump Sum	1	36,299.00	36,299.00
2A	Grit and Blower Building – All Work Except Item 2B and Controls/System Integration	Lump Sum	1	9,421.00	9,421.00
2B	Grit and Blower Building – All Electrical Work	Lump Sum	1	4,000.00	4,000.00

Item No.	Description	Unit	Quantity	Unit Price	Total Amount
3A	Bioreactor Trains 1 and 2 RAS Slide Gate Actuators – All Work Except Item 3B and Controls/System Integration	Lump Sum	1	22,714.00	22,714.00
3B	Bioreactor Trains 1 and 2 RAS Slide Gate Actuators – All Electrical Work	Lump Sum	1	40,000	40,000.00
4A	RAS/WAS Pumping Station – All Work Except Item 4B and Controls/System Integration	Lump Sum	1	125,279.00	125,279.00
4B	RAS/WAS Pumping Station – All Electrical Work	Lump Sum	1	9,000.00	9,000.00
5A	Centrifuge Building – All Work Except Item 5B and Controls/System Integration	Lump Sum	1	162,926.00	162,926.00
5B	Centrifuge Building – All Electrical Work	Lump Sum	1	24,000.00	24,000.00
6A	Digester Control Building – All Work Except Item 6B and Controls/System Integration	Lump Sum	1	62,361.00	62,361.00
6B	Digester Control Building – All Electrical Work	Lump Sum	1	3,000.00	3,000.00
7	Controls/System Integration – All Work	Lump Sum	1	110,000.00	110,000.00
				Total Base Bid Amount	609,000.00

4. In submitting this Proposal, the undersigned acknowledges receipt of the following addenda: 1 , _____ , _____ , _____ , _____ , _____.

5. In submitting this Proposal, the undersigned declares that the only persons or parties interested in the Proposal as principals are those named herein and that the Proposal is made without collusion with any person, firm or corporation.

6. The undersigned further declares that he has carefully examined the Proposal, Plans, Specifications, Agreement and Contract Bond included in the Specifications and Special Provisions, and that he has inspected in detail the site of the proposed work, and that he has familiarized himself with all of the

local conditions affecting the Contract and the detailed requirements of construction, and understands that in making this proposal, he waives all right to plead any misunderstanding regarding the same.

7. The undersigned further understands and agrees that, if this proposal is accepted, he is to furnish and provide all necessary machinery, tools, apparatus and other means of construction, and to do all of the work, and to furnish all of the materials specified in the contract, except such materials as are to be furnished by the Owner in the manner and at the time therein prescribed, and in accordance with the requirements therein set forth.

8. The undersigned further agrees to execute a contract for this work and present the same to the Owner within fifteen days after the date of Notice of Award. of the contract,

9. The undersigned further agrees that he and his surety will execute and present within fifteen days after the date of Notice of Award of contract, a contract bond satisfactory to and in the form prescribed by the Owner, in the penal sum of the full amount of the contract, guaranteeing the faithful performance of the work in accordance with the terms of the contract.

10. The undersigned further agrees to begin work not later than ten days after the date of Notice to Proceed. unless otherwise authorized or directed by the Owner and to prosecute the work in such manner and with sufficient materials, equipment, and labor as will insure its completion within the time limit specified herein, it being understood and agreed that the completion within the time limit is an essential part of the contract.

11. **The undersigned agrees to Substantial Completion of the work for the City of Geneva within 224 days after the date of Notice to Proceed and Final Completion within 254 days after the date of Notice to Proceed.,** unless additional time shall be granted by the OWNER in accordance with the provisions of the specifications. In case of failure to complete the work within the time named herein or within such extra time as may have been allowed by extensions, the undersigned agrees that the Owner shall withhold, from such sums as may be due him under the terms of this contract, the costs set forth in the specifications, which costs shall be considered and treated not as a penalty, but as damages due the Owner from the undersigned by reason of inconvenience to the Owner. The added cost of Engineering and supervision, additional finance charges, and other items which have caused an expenditure of Owner's funds resulting from the failure of the undersigned to complete the work within the time specified in the contract can constitute such damages.

12. Provisions for Liquidated Damages are set forth in the Agreement.

13. If this proposal is accepted and the undersigned shall fail to execute a Contract and Contract Bond as required herein, it is hereby agreed that the amount of the bond, check or draft shall become the property of the Owner and shall be considered as payment of damages due to delay and other causes suffered by Owner because of the failure to execute said Contract and Contract Bond; otherwise said bond, check or draft shall be returned to the undersigned.

14. By submission of the Bid, each bidder certifies, and in the case of a joint bid each party thereto certifies as to his own organization, that in connection with the bid.

A. The prices in the bid have been arrived at independently, without consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor.

B. Unless otherwise required by law, the prices which have been quoted in the bid have not knowingly been disclosed by the bidder, prior to opening, directly or indirectly to any other bidder or to any competitor; and

C. No attempt has been made or will be made by the bidder to induce any other person or firm to submit or not to submit a bid for the purpose of restricting competition.

15. Each person signing the bid shall certify that:

A. He is the person in the bidder's organization responsible for the decision as to the prices being bid and that he has not participated, and will not participate, in any action contrary to subsection (12) above; or

B. He is not the person in the bidder's organization responsible for the decision as to the prices being bid, but that he has been authorized to act as agent for the persons responsible for such decision in certifying that such persons have not participated, and will not participate, in any action contrary to subsection (12) above, and as their agent shall so certify. He shall also certify that he has not participated, and will not participate, in any action contrary to subsection (12) above.

16. The undersigned herein agrees that **at least 51% of the contracted work** will be completed by the General Contractor. Subcontractors may be used as long as their portion of the contracted work is the minority share of the project in cost.

BID SECURITY

ATTACH BID BOND HERE.

IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the PROJECT is located.

AIA® Document A310™ – 2010

Bid Bond

CONTRACTOR:
Mechanical Incorporated
2279 Yellow Creek Road
Freeport, IL 61032

SURETY:
Fidelity & Deposit Company of Maryland
1299 Zurich Way
Schaumburg, IL 60196

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification,

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

OWNER:
City of Geneva
22 South First Street
Geneva, IL 60134

BOND AMOUNT: Ten Percent of Bid (10% of Bid)

PROJECT: City of Geneva
Wastewater Treatment Facility Interim
Solids Improvements

Project Number, if any-

The Contractor and Suretv are bound to the owner in the amount set forth above- for the payment. of which the Contractor and Suretv bind themselves, their heirs, executors, administrators, successors and assigns. jointly and severally., as provided herein. I'c conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents. with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or (2) pays to the Owner the difference., not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void. otherwise to remain in full force with effect. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid- Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) days in the aggregate beyond the time for acceptance of bids specified in the bid documents. and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) day s

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor arid the term owner shall be deemed to be Contractor.

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

Signed and sealed this 11th day of December, 2019

Eleanor Carr
(Witness)

Mechanical Incorporated
(Principal) (Seal)

(Title)

Tina Stout
(Witness)

Fidelity & Deposit Company of Maryland
(Surety) (Seal)

Stephanie Ambom
(Title) Attorney in Fact

Init.
/

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ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Illinois, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Illinois (herein collectively called the "Companies"), by **Robert D. Murray, Vice President**, in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint **David L. TOWNSEND, Judith L. ZIER, Julie A. TRESEMER, Robert W. SNYDER, Joseph J, CLINTON, III, Rebecca NORWOOD, Stephanie AMBORN and Priscilla LUGO, all of Rockford, Illinois,** its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings,** and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said **ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND**, this 25th day of November, A.D. 2019.

ATTEST:
ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By: Robert D. Murray
Vice President

By: Dawn E. Brown
Secretary

State of Maryland
County of Baltimore

On this 25th day of November, A.D. 2019, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **Robert D. Murray, Vice President and Dawn E. Brown, Secretary** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, deposeth and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

Constance A. Dunn, Notary Public
My Commission Expires: July 9, 2023

ATTORNEY-IN-FACT AFFIDAVIT

STATE OF ILLINOIS

COUNTY OF STEPHENSON

Before me, a Notary Public, personally came Stephanie Amborn, known to me, and known to be the Attorney-in-Fact of Fidelity & Deposit Company of Maryland, which executed the attached bond as surety, who deposed and said that his signature and the corporate seal of said Fidelity & Deposit Company of Maryland were affixed by order and authority of said Company's Board of Directors, and that the execution of the attached bond is the free act and deed of Fidelity & Deposit Company of Maryland.

Given under my hand and seal this 11th day of December, 2019.

Notary Public

"OFFICIAL SEAL"
KAREN D. POAHA
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 06/28/2020

(If an Individual) Signature of Bidder: _____ (SEAL)

Business Address: _____

_____

_____

(If a Co-partnership) Firm Name _____ (SEAL)

Signature of Bidder: _____

Business Address: _____

_____

_____

(Insert Names and addresses

of all members of the Firm) _____

_____

_____

_____

_____

_____

_____

_____

_____

(If a Corporation) Corporate Name: Mechanical, Inc.

(SEAL) CORPORATE SEAL

Signature

President

Attested by:

Secretary

Business Address: 2279 Yellow Creek Road
Freeport IL 61032

(Insert Names of Officers)

President: Brian Helm

Secretary: Craig Buikema

Treasurer: Craig Buikema

CERTIFICATE OF NON-DISQUALIFICATION

UNDER IL. COMPILED STATUTES, CH. 720, SEC. 33E-11

The undersigned, upon being first duly sworn, hereby certifies to the City of Geneva, and Kane County, Illinois, that

Mechanical, Inc.

(Contractor)

is not barred from contracting with any unit of State or local government, as a result of a violation of Ch. 720, Sec. 33E-4 of the Illinois Revised Statutes.

Mechanical, Inc.

Name of Contractor

Gary Statdfield

Signature

Gary Statdfield

Print/Type Name

Vice President

Title

Subscribed and sworn to before me this 23rd day of December, 20 19.

"OFFICIAL SEAL"
ELEANOR MARY CARR
Notary Public, State of Illinois
My Commission Expires 4-4-21

Eleanor Carr

Notary Public

4/4/21

Commission Expires

Notary Seal

NOTE TO BIDDER: Anyone who makes a false statement, material to this Certification, commits a Class 3 Felony under Ch. 720, Sec. 33E-11(b) of the Illinois Complied Statutes.

CERTIFICATE OF COMPLIANCE OF

ILLINOIS COMPILED STATUTES CH. 65, SEC. 11-42.1

The undersigned, upon being first duly sworn, hereby certifies to the City of Geneva, and Kane County, Illinois, that

Mechanical, Inc.

(Contractor)

is not currently delinquent in the payment of any tax administered by or owed to the Illinois Department of Revenue, or otherwise in default upon any such tax as defined under Chapter 65, Section 11-42.1, Illinois Compiled Statutes.

Mechanical, Inc.

Name of Contractor

Gary Statdfield

Signature

Gary Statdfield

Print/Type Name

Vice President

Title

Subscribed and sworn to before me this 23rd day of Dec., 2019.

"OFFICIAL SEAL"
ELEANOR MARY CARR
Notary Public, State of Illinois
My Commission Expires 4-4-21

Eleanor Carr

Notary Public

4/4/21

Commission Expires

Notary Seal

CERTIFICATE OF COMPLIANCE WITH SAFETY STANDARDS

The undersigned, upon being first duly sworn, hereby certifies to the City of Geneva, and Kane County, Illinois, that

Mechanial, Inc.

(Contractor)

shall comply with all local, state and federal safety standards.

Mechanical, Inc.

Name of Contractor

Gary Statdfield

Signature

Gary Statdfield

Print/Type Name

Vice President

Title

Subscribed and sworn to before me this 23rd day of Dec., 2019.

"OFFICIAL SEAL"
ELEANOR MARY CARR
Notary Public, State of Illinois
My Commission Expires 4-4-21

Eleanor Carr

Notary Public

4/4/21

Commission Expires

Notary Seal

CERTIFICATE OF COMPLIANCE WITH PREVAILING WAGE RATE ACT

The undersigned, upon being first duly sworn, hereby certifies to the City Geneva and Kane County, Illinois, that all work under this contract shall

comply with the Illinois Prevailing Wage Act, 820 ILCS 130/.01, et. seq, (the "Act") and

current City ordinance, to the extent required by law. Contractors shall submit monthly certified payroll records to the City.

The undersigned, upon being first duly sworn, hereby certifies to the City of Geneva, and Kane County, Illinois, that the bidder will file their substance abuse prevention plan.

Name of Contractor Mechanical, Inc.

By: Gary Stillfield

State of Illinois),

ss.

County of Stephenson)

Subscribed and sworn to Eleanor Carr

before me this 23rd day

of Dec., 2019.

"OFFICIAL SEAL"
ELEANOR MARY CARR
Notary Public, State of Illinois
My Commission Expires 4-4-21

Notary Public

END OF SECTION 00300

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City of Geneva
Wastewater Treatment Facility Interims Solids Improvements

ADDENDUM NO. 1
DECEMBER 17, 2019

Bidders on this Project are hereby notified that this Addendum shall be attached to and made a part of the Bidding and Contract Documents for the above named Project.

The items included in this Addendum are issued to add to, modify, and clarify the Bidding and Contract Documents. These items shall have full force and effect as the Bidding and Contract Documents, and the costs involved shall be included in the appropriate bid item and the total bid amount. Bids, to be submitted on the specified bid date, shall conform to the additions and revisions included herein.

Please acknowledge receipt of this addendum by signing below and emailing a copy of this signed page as indicated below. Bidders shall also acknowledge receipt of this Addendum on the Bid Form. Failure to do so may subject the Bidder to disqualification.

Received by:

Company: Mechanical, Inc.

Printed Name of Representative: Jesse Arndt, Estimating Manager

Signature of Representative: _____

Date: 12/20/19

Please scan and email back to:
Eric Compton

Email: comptonre@cdmsmith.com
Tel: 312-780-7719

LICENSED PROFESSIONAL ENGINEER
R ERIC COMPTON
062-052176
STATE OF ILLINOIS

12/17/2019
EXP. 11/30/2021

Certificate of Registration

STATE BOARD OF ELECTIONS

Registration No. 12280

Mechanical, Inc.

2279 Yellow Creek Road
P.O. Box 690
Freeport IL 61032

Information for this business last updated on:

Wednesday, January 4, 2017

Certificate produced on Wednesday, January 04, 2017 at 10:40 AM

Registered
SEAL OF THE STATE BOARD OF ELECTIONS ILLINOIS
Business

MECHANICAL, INC.

Action by Directors in Lieu of Annual Meeting

January 31, 2018

The undersigned, being all of the Directors of Mechanical, Inc., an Illinois Corporation, hereby consent to the adoption of the following resolution in lieu of an annual meeting of the Board of Directors and hereby waive all notice required to be given in connection therewith:

RESOLVED: That each of the following persons is elected to the office set forth after his name, to serve until his successor shall have been duly elected and qualified or until his death or until he shall resign or shall have been removed from office:

NAME	
Brian L. Helm	President
Gary E. Statdfield	Vice President
Matthew J. Huenefeld	Vice President
Jeffory E. McCoy	Vice President
Craig A. Buikema	Secretary
Craig A. Buikema	Treasurer

BE IT FURTHER RESOLVED: That the Directors authorize any of the above listed officers of the corporation to execute bids and construction contracts on behalf of the Corporation.

Dated at Freeport, Illinois, this 31st day of January, 2018.

Robert L. Helm, Director

Bruce J. Helm, Director

Dennis J. Feltmeyer, Director

SECTION 00500
AGREEMENT

THIS AGREEMENT is dated as the 27 day of January in the year 2020 by and between the **City of Geneva** (hereinafter called OWNER), and (hereinafter called CONTRACTOR). Mechanical, Inc.

OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

Article 1. WORK

CONTRACTOR shall complete all WORK as specified or indicated in the Contract Documents. WORK is generally described as follows:

Article 2. ENGINEER

The City of Geneva, Illinois (hereinafter called OWNER), will assume all duties and responsibilities and will have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the WORK in accordance with the Contract Documents.

Article 3. CONTRACT TIME

All WORK shall be completed within the Contract Times indicated on the Bid Form.

3.1 Liquidated Damages. OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss if the WORK is not completed within the time specified in Article 3 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by OWNER if the WORK is not completed on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER **two hundred fifty dollars and zero cents ($250.00) for each day that expires after the time specified on the Bid Form for Substantial Completion until the WORK is fully operational and tested. The CONTRACTOR shall pay the OWNER an additional two hundred fifty dollars and zero cents ($250.00) for each day that expires after the time specified on the Bid Form for Final Completion until WORK is accepted by OWNER.** At the option of the OWNER damage amounts may be deducted, on a monthly basis, from the contract balance.

3.2 The contract time may be changed only by a change order. For each change order, CONTRACTOR shall submit to the OWNER for review, sufficient reason for delay to enable the OWNER to ascertain the necessity and reasonableness of the delay, and the allow ability and eligibility of delay proposed.

Article 4. CONTRACT PRICE

OWNER shall pay CONTRACTOR for performance of the WORK in accordance with the Contract Documents in current funds as follows:

4.1 Payment shall be made on the basis of the monthly estimates of partial completion, approved by the OWNER, except as otherwise provided in the detailed specifications for each class of WORK.

4.2 The contract price may be changed only by a change order. For each change order, CONTRACTOR shall submit to the OWNER for review, sufficient cost and pricing data to enable the OWNER to ascertain the necessity and reasonableness of costs and amounts proposed, and the allow ability and eligibility of costs proposed.

Article 5. PAYMENT PROCEDURES

CONTRACTOR shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by OWNER as provided in the General Conditions.

5.1 Progress Payments. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment, on or about the second Wednesday of each month during construction as provided below. All progress payments will be on the basis of the progress of the WORK estimated by the OWNER.

5.1.1 Prior to Substantial Completion progress payments will be in an amount equal to 90% of the WORK completed, and 90% of materials and equipment not incorporated in the WORK but delivered and suitably stored, less in each case the aggregate of payments previously made.

5.1.2 Upon Substantial Completion and thereafter, OWNER shall pay an amount sufficient to increase total payments to CONTRACTOR to 95% of the Contract Price, less such amounts as OWNER shall determine in accordance with Paragraph 14.07 of the General Conditions.

5.2 Final Payment. Upon final completion and acceptance of the WORK in accordance with Paragraph 14.07 of the General Conditions, OWNER shall pay the remainder of the Contract Price as provided in said Paragraph 14.07.

Article 6. CONTRACTOR'S REPRESENTATIONS

In order to induce OWNER to enter into this Agreement CONTRACTOR makes the following representation:

6.1 CONTRACTOR has familiarized himself with the nature and extent of the Contract Documents, WORK, locality, and with all local conditions and federal, state and local laws, ordinances, rules and regulations that in any manner may affect cost, progress or performance of the WORK.

6.2 CONTRACTOR has studied carefully all available reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the WORK which were relied upon by OWNER in the preparation of the Drawings and Specifications and which have been identified in the Supplementary Conditions.

6.3 CONTRACTOR has made or caused to be made examinations, investigations and tests and studies of such reports and related data in addition to those referred to in Paragraph 6.2 as he deems necessary for the performance of the WORK at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents; and no additional examinations, investigations, tests, reports or similar data are or will be required by CONTRACTOR for such purposes.

6.4 CONTRACTOR has correlated the results of all such observations, examinations, investigations, tests, reports and data with the terms and conditions of the Contract Documents.

6.5 CONTRACTOR has given OWNER written notice of all conflicts, errors or discrepancies that he has discovered in the Contract Documents and the written resolution thereof by OWNER is acceptable to CONTRACTOR.

6.6 CONTRACTOR warrants that no person or selling agency has been employed or retained to solicit or secure the contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee. For breach or violation of this warranty, the OWNER shall have the right to annul the contract without liability or in its discretion to deduct from the contract price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.

6.7 The award or execution of all subcontracts by a prime CONTRACTOR and the procurement and negotiation procedures used by such prime CONTRACTOR in awarding or executing such subcontracts shall comply with:

6.7.1 All provisions of federal, State and local law,

6.7.2 All provisions of Illinois Administrative Code Title 35 Section 365.620 with respect to fraud and other unlawful or corrupt practices;

6.7.3 All provisions of Illinois Administrative Code Title 35 Section 365.620 with respect to access to facilities, records and audit or records; and

6.7.4 The provision requiring a certification of compliance with federal Executive Order 12549 regarding debarment, suspension and other responsibility matters.

6.8 CONTRACTOR shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. CONTRACTOR shall carry out applicable requirements of 40 CFR Part 33 in the award and administration of contracts. Failure by the CONTRACTOR to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies.

Article 7. CONTRACT DOCUMENTS

The Contract Documents which comprise the entire agreement between OWNER and CONTRACTOR are attached to this Agreement, made a part hereof and consist of the following:

7.1 Invitation to Bid.
7.2 Instructions to Bidders.
7.3 Bid Form.
7.4 This Agreement.
7.5 Exhibits to this Agreement.
7.6 Contract, Payment and Performance Bonds
7.7 Notice of Award.
7.8 Notice to Proceed.
7.9 General Conditions.
7.10 Supplementary Conditions.
7.11 Specifications (Divisions 1 through 16).

7.12 Drawings (as listed on the Index of Drawings on the Cover Sheet).
7.13 All issued Addenda.

7.14 Any modification, including Change Orders, duly delivered after execution of Agreement.

There are no Contract Documents other than those listed above in this Article 7. The Contract Documents may only be altered, amended or repealed pursuant to Section 3.04 of the General Conditions.

Article 8. MISCELLANEOUS

8.1 Terms used in this Agreement which are defined in Article 1 of the General Conditions shall have the meanings indicated in the General Conditions.

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

8.3 OWNER and CONTRACTOR each binds himself, his partners, successors, assigns and legal representatives to the other party hereto, his partners, successors, assigns and legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents.

8.4 All claims, counter-claims, disputes and other matters in question between the OWNER and the CONTRACTOR arising out of or relating to this sub-agreement or the breach of it will be decided by arbitration if the parties mutually agree, or in a court of competent jurisdiction within the State of Illinois.

Article 9. OTHER PROVISIONS

IN WITNESS WHEREOF, the parties hereto have signed this Agreement in triplicate. One counterpart each has been delivered to OWNER and CONTRACTOR. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR.

This Agreement shall become effective on January 27, 2020

OWNER

by _____

(Corporate Seal)

Attested

by _____ City Clerk

(City Seal)

Address for Giving Notices

City of Geneva
1800 South Street
Geneva, IL 60134

CONTRACTOR

by _____

(Corporate Seal)

Attested

by _____

"OFFICIAL SEAL"
ELEANOR MARY CARR
Notary Public, State of Illinois
My Commission Expires 4-4-21

(Notary Seal)

Address for Giving Notices

END OF SECTION 00500

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SECTION 00510
NOTICE OF AWARD

Date: February 3, 2020

To: Mechanical Inc.

2279 E Yellow Road

Freeport, IL 61032

Project: City of Geneva – Wastewater Treatment Facility Interim Solids Improvements

The OWNER has considered the BID submitted by you for the above described WORK in response to its Advertisement for Bids and Information for Bidders.

You are hereby notified that your bid has been accepted for items in the amount of:
Six Hundred Nine Thousand Dollars.
($609,000.00).
You are required by the Information for Bidders to execute the Agreement and furnish the required CONTRACTOR'S PERFORMANCE BOND, PAYMENT BOND and CERTIFICATES OF INSURANCE within ten (10) calendar days from the date of this Notice of Award.

If you fail to execute said agreement and to furnish said BONDS within ten (10) days from the date of this Notice, OWNER will be entitled to consider all of your rights arising out of the OWNER'S acceptance of your BID as abandoned, and as a forfeiture of your BID BOND. The OWNER will be entitled to any other rights as may be granted by law.

You are required to return an acknowledged copy of this NOTICE OF AWARD to the OWNER.

Dated this **3rd** day of **February**, 2020

City of Geneva, Illinois

City Administrator

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE OF AWARD is hereby acknowledged by Mechanical Inc. this the _____ day of _____, 2020.

_____

(Name) _____

(Title) _____

SECTION 00520
NOTICE TO PROCEED

Date: _____, 20___

To: _____

_____

_____

_____

Project: City of Geneva – Wastewater Treatment Facility Interim Solids Improvements

Owner: City of Geneva, Illinois

You are hereby notified that the contract time for the above referenced project commences to run on _____, 20___. On this date you are to start performing your obligations under the Contract Documents. In accordance with Article 3 of the Agreement the dates of Substantial Completion shall be _____, 20___, and Final Completion shall be _____, 20___.

You are required to return an acknowledged copy of this NOTICE TO PROCEED to the OWNER.

Dated this _____ day of _____, 20___

City of Geneva, Illinois

_____

City Administrator

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged by _____ this the ____ day of _____, 20___.

_____

(Name) _____

(Title) _____

END OF SECTION 00520

SECTION 00530
CHANGE ORDER

Change Order No: _____

Date: _____ Date of Agreement: _____, 20___

Project: City of Geneva – Wastewater Treatment Facility Interim Solids Improvements

Owner:	City of Geneva	Contractor:	_____
	1800 South Street		_____
	Geneva, Illinois 60134		_____

The following changes are hereby made to the CONTRACT DOCUMENTS:

Justification:

Original Contract Price	$_____
Amount of Previous Change Order(s)	$_____
Current Contract Price adjusted by Previous Change Order(s)	$_____
Change in Contract Price Due to this Change Order	$_____
Contract Price Including this Change Order	$_____

Change to Contract Time	_____	Calendar Days
The Contract Time will be adjusted by	_____	Calendar Days
The date for completion of all work will be	_____	Calendar Days

Approvals:

_____	_____
(Contractor)	*City of Geneva*

END OF SECTION 00530

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PERFORMANCE BOND

Bond No.: 9323692

CONTRACTOR:
(Name, legal status and address)
Mechanical Incorporated
P. O. Box 690
2279 Yellow Creek Rd.
Freeport, IL 61032

SURETY:
(Name, legal status and principal place of business)
Fidelity & Deposit Co. of Maryland
1299 Zurich Way
Schaumburg, IL 60196

OWNER:
(Name, legal status and address)
City of Geneva
1800 South Street
Geneva, IL 60134

CONSTRUCTION CONTRACT
Date: January 27, 2020
Amount: $ 609,000.00
Description:
(Name and location)
City of Geneva
Wastewater Treatment Facility Interim Solids Improvements

BOND
Date: February 5, 2020
(Not earlier than Construction Contract Date)
Amount: $ 609,000.00
Modifications to this Bond: [ ] None [X] See Section 16

CONTRACTOR AS PRINCIPAL
Company: *(Corporate Seal)*
Mechanical Incorporated
Signature:
Name and Title: Brian Helm, President

SURETY
Company: *(Corporate Seal)*
Fidelity & Deposit Company of Maryland
Signature:
Name and Title: Judith L. Zier, Attorney-In-Fact

(Any additional signatures appear on the last page of this Performance Bond.)

(FOR INFORMATION ONLY (Name, address and telephone)
AGENT or BROKER:
Gallagher
2900 W. Pearl City Rd. Ste. 101
Freeport, IL 61032

OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party:)

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

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

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

.1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's

notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

.2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

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

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3. 1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

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

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

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

§ 5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

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

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

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

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

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

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

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

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

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

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

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

§ 1 1 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default

or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

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

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

§ 14 **Definitions**

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

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

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

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

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

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

§ 16 Modifications to this bond are as follows:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		**SURETY**	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:		Name and Title:	
Address:		Address:	

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PAYMENT BOND

Bond No.: 9323692

CONTRACTOR:
(Name, legal status and address)
Mechanical Incorporated
P. O. Box 690
2279 Yellow Creek Rd
Freeport, IL 61032

SURETY:
(Name, legal status and principal place of business)
Fidelity & Deposit Company of Maryland
1299 Zurich Way
Schaumburg, IL 60196

OWNER:
(Name, legal status and address)
City of Geneva
1800 South Street
Geneva, IL 60134

CONSTRUCTION CONTRACT
Date: January 27, 2020
Amount: $ 609,000.00
Description:
(Name and location)
City of Geneva
Wastewater Treatment Facility Interim Solids Improvements

BOND
Date: February 5, 2020
(Not earlier than Construction Contract Date)

Amount: $ 609,000.00
Modifications to this Bond: [X] None [ ] **See Section 18**

CONTRACTOR AS PRINCIPAL
Company: **(Corporate Seal)**
Mechanical Incorporated

Signature:
Name and Title: Brian Helm, President

SURETY
Company: **(Corporate Seal)**
Fidelity & Deposit Company of Maryland

Signature:
Name and Title: Judith L. Zier, Attorney-in-Fact

(Any additional signatures appear on the last page of this Payment Bond.)

(FOR INFORMATION ONLY — Name, address and telephone)
AGENT or BROKER:
Gallagher
2900 W. Pearl City Rd. Ste. 101
Freeport, IL 61032
Telephone Number: 815-235-7194

OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party:)

§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

§ 2 If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Section 13) of claims, demands, liens or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials

or equipment furnished for use in the performance of the Construction Contract and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety.

§ 4 When the Owner has satisfied the conditions in Section 3, the Surety shall promptly and at the Surety's expense defend, indemnify and hold harmless the Owner against a duly tendered claim, demand, lien or suit.

§ 5 The Surety's obligations to a Claimant under this Bond shall arise after the following:

§ 5.1 Claimants, who do not have a direct contract with the Contractor,

.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

.2 have sent a Claim to the Surety (at the address described in Section 13).

§ 5.2 Claimants, who are employed by or have a direct contract with the Contractor, have sent a Claim to the Surety (at the address described in Section 13).

§ 6 If a notice of non-payment required by Section 5. 1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnished a written notice of non-payment under Section 5. 1. 1.

§ 7 When a Claimant has satisfied the conditions of Sections 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

§ 7. 1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

§ 7.2 Pay or arrange for payment of any undisputed amounts.

§ 7.3 The Surety's failure to discharge its obligations under Section 7.1 or Section 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Section 7.1 or Section 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

§ 8 The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Section 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

§ 9 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

§ 10 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, or give notice on behalf of, Claimants or otherwise have any obligations to Claimants under this Bond.

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

§ 12 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Section 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 13 Notice and Claims to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

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

§ 15 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

§ 16 Definitions

§ 16.1 Claim. A written statement by the Claimant including at a minimum:

.1 the name of the Claimant;

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

.3 a copy of the agreement or purchase order pursuant to which labor, materials or equipment was furnished for use in the performance of the Construction Contract;

.4 a brief description of the labor, materials or equipment furnished;

.5 the date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;

.6 the total amount earned by the Claimant for labor, materials or equipment furnished as of the date of the Claim;

.7 the total amount of previous payments received by the Claimant; and

.8 the total amount due and unpaid to the Claimant for labor, materials or equipment furnished as of the date of the Claim.

§ 16.2 Claimant. An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment' 'that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

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

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

§ 16.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 17 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 18 Modifications to this bond are as follows:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		**SURETY**	
Company:	**(Corporate Seal)**	**Company:**	**(Corporate Seal)**
Signature:		**Signature:**	
Name and Title:		Name and Title:	
Address:		Address:	

ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Illinois, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Illinois (herein collectively called the "Companies"), by **Robert D. Murray, Vice President,** in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint **David L. TOWNSEND, Judith L. ZIER, Julie A. TRESEMER, Robert W. SNYDER, Joseph J, CLINTON, III, Rebecca NORWOOD, Stephanie AMBORN and Priscilla LUGO, all of Rockford, Illinois,** its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings,** and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said **ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND**, this 25th day of November, A.D. 2019.

ATTEST:
ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By: Robert D. Murray
Vice President

By: Dawn E. Brown
Secretary

State of Maryland
County of Baltimore

On this 25th day of November, A.D. 2019, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **Robert D. Murray, Vice President and Dawn E. Brown, Secretary** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, deposeth and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

Constance A. Dunn, Notary Public
My Commission Expires: July 9, 2023

ATTORNEY-IN-FACT AFFIDAVIT

STATE OF ILLINOIS

COUNTY OF STEPHENSON

Before me, a Notary Public, personally came Judith L. Zier, known to me, and known to be the Attorney-in-Fact of Fidelity & Deposit Company of Maryland, which executed the attached bond as surety, who deposed and said that his signature and the corporate seal of said Fidelity & Deposit Company of Maryland were affixed by order and authority of said Company's Board of Directors, and that the execution of the attached bond is the free act and deed of Fidelity & Deposit Company of Maryland.

Given under my hand and seal this 5th day of February, 2020.

Laura J. Koon

Notary Public

"OFFICIAL SEAL"
LAURA J. KOON
Notary Public, State of Illinois
My Commission Expires 10-25-21

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SECTION 00630
INSURANCE

CONTRACTOR's Liability Insurance

The Contractor agrees that he will before the time of beginning work hereunder, take out and keep in force at all times for the duration of all work agreed to be done hereunder, policies of insurance with minimum limits as required under this Article with an insurer approved by the City of Geneva. This insurance shall cover all operations under this Contract, whether such operations be by himself or by any subcontractor or materialmen or anyone directly employed by them.

Limits of liability for insurance required shall provide coverage for not less than following amounts or greater where required by laws and regulations:

Workers' Compensation, etc. under Paragraphs 5.04, Article A, Items 1 and 2

1.)	State:	Statutory
2.)	Applicable Federal (Longshoreman's)	Statutory
3.)	Employer's Liability:	
	Each Accident	$500,000.00
	Disease (policy limit)	$500,000.00
	Disease (each employee)	$500,000.00

CONTRACTOR's General Liability Insurance under paragraphs 5.04 Article A, Items 3 through 5 of General Conditions (including Premises – Operations; Independent CONTRACTOR's Protection; Products and Completed Operations; Broad Form Property Damage).

General Aggregate (except products-completed operations)	$2,000,000.00
Products (completed operations aggregate)	$2,000,000.00
Personal/Advertising Injury (per person/organization)	$1,000,000.00
Each Occurrence (Bodily Injury and Property Damage)	$1,000,000.00
Fire Damage (Any One Fire)	$50,000.00
Limit per Person Medical Expense (Any One Person)	$5,000.00

Property Damage Liability Insurance will provide Coverage for Explosion, Collapse and Underground Damages.

Umbrella Liability (General Aggregate)	$5,000,000.00
Umbrella Liability (Each Occurrence)	$5,000,000.00
Comprehensive Motor Vehicle Liability under Paragraph 5.04, Article A, Item 6 of General Conditions (Combined Single Limit for Bodily Injury and Property Damage Liability, Each Accident)	$1,000,000.00

Add the following new Paragraphs at the end of Paragraph 5.04.B:

8. Additional liability coverage for OWNER and ENGINEER shall be provided as follows:

With respect to insurance required by paragraphs 5.04.A.3 through 5.04.A.6 inclusive, include as additional insureds the City of _____.

9. The commercial general liability shall be endorsed as primary and non-contributory in favor of the additional insureds. A waiver of subrogation shall apply in favor of the above listed additional insureds on the general liability and worker's compensation policies for this project.

10. The Contractual Liability coverage required by Paragraph 5.04 Article B, Item 4 of the General Conditions shall provide coverage for not less than the following amounts.

1.)	General Aggregate	$2,000,000.00
2.)	Each Occurrence (Bodily Injury and Property Damage)	$1,000,000.00

Add the following new Paragraph 5.04.C:

5.04.C: The CONTRACTOR shall in all respects comply with any and all statutes and ordinances which impose any duty or obligation upon either the CONTRACTOR or the City of St. Charles with respect to the performance of any part of the work hereby undertaken by the CONTRACTOR and the CONTRACTOR agrees to do and perform any and all acts required by any statutes or ordinances to be performed by either the CONTRACTOR or the City of Geneva with respect to such work. The Contractor hereby agrees to hold the City of Geneva its employees and agents, harmless and to indemnify them against and to reimburse them for any loss, damage, costs or expenses, together with reasonable attorney's fees, which they might or may incur by reason of failure of the CONTRACTOR to observe and comply with any and all such statutes and ordinances.

5.04.D: The CONTRACTOR shall also indemnify and hold harmless the City of Geneva, and its agents from and against any and all claims and demands whatsoever, including cost, litigation expenses, counsel fees and liabilities incurred in connection therewith, arising out of injury to, or death of, any person or persons whatsoever, or damage to property of any kind by whomsoever owned, caused in whole or in part by the acts or omissions of the CONTRACTOR any Subcontractor, the CONTRACTOR's material men, or any other person directly or indirectly employed by them, or any of them, while engaged in the performance of the work or any activity associated therewith or relative thereto.

5.04.E: Applicable to All Policies

1. All policies shall be written with insurance companies licensed to do business in the State of Illinois and having a rating of not less than A VI, according to the latest edition of the A.M. Best Co.

2. Certificate of insurance evidencing the required coverages shall be submitted to the OWNER prior to commencing work on the project.

3. To the extent of CONTRACTOR's indemnification liability herein, the CONTRACTOR shall include the City of Geneva, their officers, agents and employees as insured to the extent of CONTRACTOR's indemnification herein on General Liability, Automotive Liability and Excess Liability insurance policies. The insurance coverage shall be written with insurance companies acceptable to the City of Geneva. All insurance premiums shall be paid without cost to the City of Geneva. The CONTRACTOR shall furnish the City of Geneva with a Certificate of Insurance attesting to the respective insurance coverage for the full contract term. The CONTRACTOR shall submit satisfactory proof of insurance simultaneously with the execution of this supplement.

4. The City of Geneva shall receive written notice of cancellation or reduction in coverage of any insurance policy thirty (30) days prior to the effective date of cancellation or reduction.

5. Provided that the CONTRACTOR maintains a financial rating of 5A2, as issued by Dunn and Bradstreet, Inc., at all time during the term of the Supplement, the CONTRACTOR may utilize a plan of self-insurance certified by the Department of Insurance, State of Illinois and the Illinois Industrial Commission for the minimum coverage required under Paragraph 5.04.A.7 above, provided that the CONTRACTOR maintains said limits at all times during the supplement period and retains a current and viable certificate of self insurance from the State of Illinois and immediately provides a copy of said Certificate to the City of Geneva. All insurance provided to the OWNER is primary and non-contributory with any insurance or self-insurance program maintained by the OWNER.

5.06: Property Insurance

1. Property insurance to the full insurable value of the work will be provided by the CONTRACTOR.
2. Such coverage shall be written on an “All Risk” Completed Value form.
3. The deductible under this policy shall be the responsibility of the CONTRACTOR.
4. The Named Insured shall include the Owner.

END OF SECTION 00630

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 2/5/2020

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

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

PRODUCER Cottingham & Butler Matt Murray 800 Main St. Dubuque IA 52001	**CONTACT NAME:** **PHONE (A/C, No, Ext):** 563-587-5000 **FAX (A/C, No):** 563-583-7339 **E-MAIL ADDRESS:**
INSURED HELGRO1 Mechanical, Inc. 2279 Yellow Creek Road Freeport IL 61032	**INSURER(S) AFFORDING COVERAGE** — **NAIC #** **INSURER A :** Travelers Property Casualty Company of America — 25674 **INSURER B :** The Travelers Indemnity Company — 25658 **INSURER C :** Berkley Assurance Company — 39462 **INSURER D :** **INSURER E :** **INSURER F :**

COVERAGES **CERTIFICATE NUMBER:** 1662394801 **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	X **COMMERCIAL GENERAL LIABILITY** CLAIMS-MADE [X] OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: POLICY [X] PRO-JECT [ ] LOC OTHER:			VTJEXGL-132J2474-19	10/1/2019	10/1/2020	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG [ ]	$ 2,000,000 $ 500,000 $ $ 2,000,000 $ 4,000,000 $ 4,000,000 $
A	**AUTOMOBILE LIABILITY** X ANY AUTO OWNED AUTOS ONLY [ ] SCHEDULED AUTOS HIRED AUTOS ONLY [ ] NON-OWNED AUTOS ONLY			VTC2JCAP-132J2486-19	10/1/2019	10/1/2020	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident) [ ]	$ 2,000,000 $ $ $ $
A	X **UMBRELLA LIAB** X OCCUR **EXCESS LIAB** [ ] CLAIMS-MADE [ ] DED [ ] RETENTION $			CUP-9N817526-19-25	10/1/2019	10/1/2020	EACH OCCURRENCE AGGREGATE [ ]	$ 5,000,000 $ 5,000,000 $
A A B	**WORKERS COMPENSATION AND EMPLOYERS' LIABILITY** Y / N ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? [N] N / A **(Mandatory in NH)** If yes, describe under DESCRIPTION OF OPERATIONS below			VTWXJUB-1C030050-19 UB-2N39664A-19-25-V UB9K593005-19-25-G	10/1/2019 10/1/2019 10/1/2019	10/1/2020 10/1/2020 10/1/2020	X PER STATUTE [ ] OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	 $ 1,000,000 $ 1,000,000 $ 1,000,000
C C	Pollution Professional			PCAB-5009807-1019 PCAB-5009807-1019	10/1/2019 10/1/2019	10/1/2020 10/1/2020	Per Claim Limit Per Claim Limit	5,000,000 5,000,000

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

The City of Geneva, Owner, Engineer are additional insured on the General Liability and Auto Liability policies on a primary, non-contributory basis per written contract between the named insured and the certificate holder that requires such a status subject to the terms and conditions of the endorsement attached to the policy. The General Liability and Workers Compensation policies includes a waiver of subrogation in favor of the additional insureds per written contract between the named insured and the certificate holder that requires such a status subject to the terms and conditions of the endorsement attached to the policy. Mechanical, Inc. is self-insured on the Medical Expense.

CERTIFICATE HOLDER

City of Geneva
1800 South Street
Geneva IL 60134

CANCELLATION

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

AUTHORIZED REPRESENTATIVE

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SECTION 01000
GENERAL REQUIREMENTS

1. INTENT

The City of Geneva intends to enter into an agreement with a Contractor to perform Wastewater Treatment Facility Interim Solids Improvements beginning in calendar year 2020.

2. SCOPE OF WORK

The Contractor shall be responsible for all services required herein to be performed and shall provide and furnish all labor, materials, necessary tools, equipment and supplies, vehicles and transportation services required to perform and complete the Work.

The Work generally consists of the following:

1. Raw Sewage Pumping Station: Replace three pump discharge isolation gate valves with plug valves.
2. Grit and Blower Building: Provide primary sludge system flow meter.
3. Bioreactor Train 1 and 2: Provide one motor operator each at Train 1 and Train 2 on existing RAS line slide gate – currently manually operated.
4. RAS/WAS Pumping Station:
   A. Replace in kind three submersible RAS pumps.
   B. Provide WAS flow meter.
5. Centrifuge Building:
   A. Replace two TWAS progressing cavity pumps.
   B. Provide TWAS flow meter.
   C. Provide digested sludge flow meter.
   D. Replace Centrifuge 2 polymer feed system.
   E. Install Owner provided basket strainer.
6. Digester Control Building: Replace in kind Digested Sludge Recirculation Pump No. 2.

All work shall be performed by experienced personnel directly employed by the Contractor.

3. CONTRACT PERIOD

As indicated on Bid Form.

4. COMPLIANCE WITH APPLICABLE LAWS, ORDINANCES AND REGULATIONS

The Contractor shall comply with all applicable Federal, State, and Local laws, ordinances, rules and regulations during the term of the contract.

5. NO-ASSIGNMENT

The Contractor shall not assign or subcontract this contract or the work hereunder, or any part thereof, to any other person, firm or corporation without prior consent of the City.

6. SAFETY, ACCIDENT PREVENTION AND NOTIFICATION

The Contractor shall be responsible for initiation, maintaining, and supervising all safety precautions and programs in connection with the work of this contract. In the event of accidents of any kind that involve the general public and/or private or public property in Geneva, the Contractor shall immediately notify the City of Geneva.

7. PREVAILING WAGES

Please be aware of the following two requirements of the Illinois Department of Labor for the Contractor and every Subcontractor working on public improvement projects in Illinois. There will be no exception to these Public Acts under this contract. Starting from the date the Notice to Proceed is issued, the Contractor and the Subcontractor will submit certified payroll records every calendar month for work done under this contract as stated below.

A. CERTIFIED PAYROLL REQUIREMENTS (PUBLIC ACT 94-0515): Effective August 10, 2005, Contractors and Subcontractors on public works projects must submit certified payroll records on a monthly basis to the public body in charge of the construction project, along with a statement affirming that such records are true and accurate, that the wages paid to each worker are not less than the required prevailing wage rate and that the Contractor is aware that filing records he or she knows to be false is a Class B misdemeanor.

   The certified payroll records must include for every worker employed on the public works project the name, address, telephone number, job classification, hourly wage paid in each pay period, number of hours worked each day, and starting and ending time of work each day. These certified payroll records are considered public records, and public bodies must make these records available to the public under the Freedom of Information Act, with the exception of the employee's address, telephone number, and social security number **(Do Not Submit)**.

B. INCREASED PENALTIES FOR PREVAILING WAGE VIOLATION (PUBLIC ACT 94-0488): Effective January 1, 2006, penalties for violations of the Prevailing Wage Act will be 50% of the underpaid amounts for second or subsequent violations. An additional penalty of 5% of the underpayment penalty must be paid to workers for each month the wages remain unpaid.

For violations that occur after January 1, 2006, the debarment period – during with Contractors are ineligible for public works contracts – increases from 2 years to 4 years if two notices of violation are issued/serious violations occur within a 5-year period. In addition, a new monetary penalty of $5,000 may be assessed against Contractors who retaliate against employees who report violations or file complaints under the Prevailing Wage Act.

For information regarding current prevailing wage rates, please refer to the Illinois Department of Labor's website at: http://www.state.il.us/Agency/IDOL/rates/Rates.htm. All contractors and subcontractors rendering services under this contract shall comply with all requirements of the Act, including but not limited to, all wage, notice and record keeping duties.

8. FREEDOM OF INFORMATION ACT

Contractor acknowledges that the Freedom of Information Act, 5 ILCS 140/1 et seq. (the "Act") places an obligation on the City of Geneva to produce certain records that may be in the possession of the Contractor. Contractor shall comply with the record retention and documentation requirements of the Local Records Retention Act 5 ILCS 140/1 et seq. and the Freedom of Information Act (complying in all respects as if the Contractor was, in fact, the City). Upon notice from the City, Contractor shall review its records promptly and produce to the City within two business days of said notice from the City the required documents which are responsive to a request under the Act. If additional time is necessary to comply with the request, the Contractor may request the City to extend the time to do so, and the City will, if time and a basis for extension under the Act permits, consider such extensions. In the event Contractor fails to produce the requested records or fails to produce the requested records within the time period required above and the City is assessed a fine, fee or penalty for failure to timely comply with the Act do to Contractor's actions, Contractor shall reimburse City for all fines, fee or penalties, including reasonable attorney's fees, paid by the City.

9. ADDITIONAL REQUIREMENTS

A. WORKING HOURS:
   a. The maximum working hours per City ordinance are as follows:
   b. 7:00 AM to 8:00 PM Monday through Friday.
   c. 8:00 AM to 4:00 PM Saturday if approved by Superintendent.
   d. No work is allowed on Sundays or Holidays.

B. JOB SITE DAILY CLEANUP: Contractor shall maintain a clean work site and at the end of each day shall make sure all debris and scrap materials no longer needed for the work are properly removed and disposed of.

C. DISPOSAL OF WASTE: Contractor shall be responsible for all disposal of waste as applicable.

D. EQUIPMENT STORAGE / PARKING: Contractor shall be responsible for the proper safe and adequate storage of all materials and equipment. All staging locations for equipment and materials must be approved by the City.

E. WATER: In locations where public water supply is available, the Contractor may be allowed to use water without charge for construction purposes. The express approval of the Owner shall be obtained before water is used. Waste of water shall be sufficient cause for withdrawing the privilege of unrestricted use. Hydrants shall be operated only under supervision of the Owner's personnel.

10. FIELD INCONSISTENCIES / VERIFICATION

The information provided is based on the best available information. Some inconsistencies may occur based on actual field conditions. If inconsistencies occur the Contractor shall immediately notify Public Works. Contractor shall continue operations under contract and does not need to not wait for City personnel to respond.

11. SUBMITTALS FOR PAYMENT

A. Submit Applications for Payment to the Engineer in accordance with the schedule established by Conditions of the Contract and Agreement between Owner and Contractor.

B. The accepted Schedule of Values shall be used as the basis for the Contractor's Application for Payment.

C. Submit Application for Payment, with itemized data typed on 8-1/2-in by 11-in or 8-1/2-in by 14-in white paper continuation sheets.

D. Provide itemized data on continuation sheet:

E. Format, schedules, line items and values: Those of the Schedule of Values accepted by the Engineer.

a. Application Form:

i. Fill in required information, including that for Change Orders executed prior to date of submittal of application.

ii. Fill in summary of dollar values to agree with respective totals indicated on continuation sheets.

iii. Execute certification with signature of a responsible officer of Contract firm.

b. Continuation Sheets:

i. Fill in total list of all scheduled component items of Work, with item number and scheduled dollar value for each item.

ii. Fill in dollar value in each column for each scheduled line item when work has been performed or products stored:
1. Round off values to nearest dollar, or as specified for Schedule of Values.

iii. List each Change Order executed prior to date of submission, at the end of the continuation sheets:
1. List by Change Order Number and description, as for an original component item of work.

iv. To receive approval for payment on component material stored on site, submit copies of the original paid invoices with the Application for Payment.

END OF SECTION 01000

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SECTION 01014
CONSTRUCTION SEQUENCE

PART 1 GENERAL

1.01 SITE CONDITIONS

A. Areas of construction under this Contract shall be coordinated with the Plant Operating Personnel and accomplished in a logical order to maintain the process flow through the plant and to allow construction to be completed within the time allowed by Contract Documents. Coordinate the activities with the other contractors, if any, to allow orderly and timely completion of all the work.

B. When access through construction areas must be disrupted, provide alternate acceptable access for the plant operators or other contractors.

C. Coordinate the activities in the interface or common areas with other contractors and the Plant Operating Personnel.

D. Various interconnections within the plant will depend on the closure of various valves and gates. Many of these valves and gates are old and may not seal properly. Coordinate with the Plant Operating Personnel prior to attempting any such closure.

E. Various interconnections within the plant may require temporary partial power shutdown. Make every effort necessary to minimize the shutdown time and coordinate with the Plant Operating Personnel and/or utility authorities prior to attempting any such power shutdown.

F. **When the work requires an existing facility to be taken out of operation, temporarily or permanently, notify the Plant Operating Personnel a minimum of 2 weeks in advance.**

1.02 CONSTRUCTION CONSTRAINTS

A. The following is a list of constraints to consider in developing the overall plan of construction. This list is not intended to release the Contractor from the responsibility to coordinate the work in any manner which will ensure project completion within the time allowed. The following areas are not necessarily listed in their required sequence of construction. A suggested sequence within each area, where necessary, is included.

B. Primary Treatment Facilities

1. Raw Sewage Pumping Station / Headworks
    a. **Shutdown of Raw Sewage Pumping Station following the additional constraints listed herein is allowed only after July 1 and prior to August 30.**
    b. Raw Sewage Pumping Station includes wet pit and dry pit pumps. As shown on Process Flow Diagram, both sets of pump discharge to Influent Flow Metering Structure. At point of entry to Flow Metering Structure, discharge line from wet pit pumps is above discharge line from dry pit pumps. Isolation of discharge line from dry pit pumps as necessary for valve installation on individual pump discharge piping requires temporary isolation of discharge lines from both sets of pumps at the Influent Flow Metering Structure. **Plugging of both discharge lines – and associated full**

pumping shutdown – is allowed for no more than two hours. There shall be no exception to this limitation.

c. **Raw Sewage Pumping Station – Dry Pit Pumps Only – may be shut down for no more than 6 hours**.

C. Secondary Treatment Facilities

1. RAS/WAS Pumping Station
   a. RAS Pumps Replacement: pumping station wet well must remain in service at all times. Sequence the Work such that at least one RAS pump remains in service at all times; continuous operation of RAS pumping is required.
   b. As required for WAS Flow Meter installation, WAS pumping system may be shut down for no more than 8 hours.

D. Solids Handling Facilities

1. Primary Sludge Pumping Station
   a. As required for Primary Sludge Flow Meter installation, primary sludge pumping system may be shut down for no more than 8 hours.

2. TWAS Pumping Station
   a. Sequence the Work such that one TWAS pump remains in service at all times.
   b. As required for TWAS Flow Meter installation, TWAS pumping system may be shut down for no more than 8 hours.

3. Digester Recirculation Pump Station
   a. Two sludge recirculation pumps must remain in service at all times.

4. Secondary Digester
   a. As required for Digested Sludge Flow Meter installation, digested sludge system may be shut down for no more than 8 hours.

E. Owner-Provided Basket Strainer

1. Isolate plant water line supplying basket strainer by utilization of nearest upstream valve.

2. As require for basket strainer installation, plant water system downstream of basket strainer may be shut down for no more than 4 hours.

F. Electrical System

1. In general, the location of existing electrical facilities as shown on the Drawings is approximate. This information has been obtained from previous contract documents, and the Owner does not guarantee either the correctness of locations or the extent of such locations.

2. The partial start-up and operation of certain parts of the plant may require some, but not all, MCC's and equipment to be placed in operation. Owner may occupy or operate these facilities before the entire work is ready for acceptance. Such action by the Owner or plant personnel shall not constitute acceptance of the entire area.

3. Unless otherwise indicated on the Drawings or in the Specifications, the Contractor shall maintain in service all electric utilities including, power, lighting, control, and communications, and any other surface or subsurface structure or facility of any nature that may be affected by the work. The Contractor may arrange with the Owner to temporarily disconnect facilities for convenience of performing the work. The cost of disconnecting and restoring such utilities shall be borne by the Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01014

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SECTION 01171
ELECTRIC MOTORS TO 250 HP

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Random wound, NEMA frame motors up to 250 Hp furnished under other Sections shall comply with the requirements listed in this Section.

B. Motors connected to Variable Frequency Drive Controllers shall be designed for inverter duty.

1.02 RELATED WORK

A. Section 16120 – Wires and Cables (600 Volt maximum): for termination of power and control cables.

B. Section 16950 – Electrical System Testing and Settings: for field commissioning.

1.03 SUBMITTALS

A. Submit motor nameplate data and test characteristics per NEMA Standard MG1-12.54 "Report of Test Form for Routine Tests on Induction Motors" in accordance with Section 01300 – Submittals, including:

1. Efficiency at 1/2, 3/4 and full load.

2. Power factor at 1/2, 3/4 and full load.

3. Motor outline, dimensions and weight.

4. Descriptive bulletins, including full description of insulation system.

5. Bearing design data.

6. Special features (i.e., space heaters, temperature detectors, etc.).

1.04 REFERENCE STANDARDS

A. American Bearing Manufacturers Association (ABMA)

1. ANSI/ABMA 7 – Shaft and Housing Fits for Metric Radial Ball and Roller Bearings (Except Tapered Roller Bearings) Conforming to Basic Boundary Plans

2. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings

3. ABMA 11 – Load Ratings and Fatigue Life for Roller Bearings

B. American National Standards Institute (ANSI)

1. ANSI/NCSL Z540-1 – Calibration Laboratories and Measuring and Test Equipment, General Requirements

C. American Society for Testing Materials (ASTM)

1. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) apparatus

D. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 1 – Recommended Practice – General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation

2. IEEE 43 – Recommended Practice for Testing Insulation Resistance of Rotating Machinery

3. IEEE 85 – Test Procedures for Airborne Sound Measurements on Rotating Electric Machinery

4. IEEE 112 – Standard Test Procedure for Polyphase Induction Motors and Generators

5. IEEE 792 – Recommended Practice for the Evaluation of the Impulse Voltage Capability of Insulation Systems for AC Electric Machinery Employing Form – Wound Stator Coils

6. IEEE 841 – Standard for Petroleum and Chemical Industry – Severe Duty Squirrel Cage Induction Motors – Up to and Including 500 HP

E. International Organization for Standardization (ISO)

1. ISO 10012-1 – Quality assurance requirements for measuring equipment

2. ISO 1940-1 – Mechanical Vibration, Balance Quality Requirements of Rigid Rotors

3. ISO 1940-2 – Determination of Permissible Residual Unbalance

4. ISO 10816-1 – Mechanical Vibration, Evaluation of Machine Vibration by Measurements on Non-Rotating Parts - Part 1: General Requirements

5. ISO 9001 – Quality Management Systems - Requirements

F. National Electrical Manufacturers Association (NEMA)

1. NEMA MG1 – Motors and Generators

2. NEMA MG2 – Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators

3. NEMA MG3 – Sound Level Prediction for Installed Rotating Electrical Machines

4. NEMA MG10 – Energy Management Guide for selection and use of Polyphase Motors

G. National Fire Protection Association (NFPA)

1. NFPA 70 – National Electric Code

H. Underwriters Laboratories (UL)

1. UL 674 – Motors and Generators, Electric, for Use in Hazardous Locations, Class I - Groups C and D, Class II - Groups E, F and G.

I. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Motors shall be listed under UL recognized component file as applicable.

B. The motor manufacturer shall maintain a documented ISO 9001 quality assurance program implementing suitable procedures and controls to monitor all aspects of production and testing.

C. Motor manufacturer shall maintain authorized service centers capable of providing training, parts, and emergency maintenance and repairs.

D. Electric motors driving identical machines shall be identical.

1.06 SYSTEM DESCRIPTION

A. To assure unity of responsibility, the motors shall be furnished and coordinated by the manufacturer of the driven equipment. The Contractor shall assume responsibility for the satisfactory installation and operation of the entire system as specified.

B. When electrically driven equipment differs from that indicated, adjust the motor size, wiring and conduit systems, disconnect devices, and circuit protection to accommodate the equipment actually installed, without additional cost.

1.07 DELIVERY, STORAGE AND HANDLING

A. Motors shall be shipped fully assembled with the driven equipment. Provide storage and handling per motor manufacturer’s installation instructions and Section 01600 – Delivery, Storage and Handling.

B. When furnished, energize motor space heaters to prevent moisture condensation throughout the storage and construction period. Perform periodic motor insulation resistance tests per manufacturer's storage recommendation.

C. Maintain the bearings during storage and construction, and periodically rotate the motor shaft according to manufacturer's instructions.

1.08 PROJECT/SITE REQUIREMENTS

A. Power supply: 208, 240, or 480 VAC, three phase, 60 hertz as indicated for 1/2 Hp and above; 120, 208, or 240 VAC single phase, 60 hertz for less than 1/2 Hp.

B. Environmental Requirements: unless otherwise stated, suitable for continuous duty operation without derating under the following service conditions:

1. Environment: Wastewater treatment plant indoor or outdoor applications involving severe duty conditions such as high humidity or chemical laden, corrosive or salty atmospheres.

2. Area classification: as indicated on the drawings.

3. Minimum outdoor ambient temperature: -26 degrees F.

4. Maximum ambient temperature: 111 degrees F.

5. Altitude: up to 735 feet above sea level.

C. Coordination:

1. Coordinate motor installation and equipment layout with conduit and wiring, piping, other machinery equipment, and adjacent surfaces. Maintain required access clearances for cooling air, conduit box, lubrication and coupling.

2. Coordinate size and location of concrete pads for motors and equipment soleplates.

3. Coordinate voltage and current ratings of motors and accessories such as space heaters with power supply characteristics, and overcurrent and overload protective devices per the NEC.

4. Coordinate winding and bearing protective devices with ratings and characteristics of monitoring equipment circuits to which they connect. Coordinate control sequences and temperature setpoints.

1.09 MAINTENANCE (NOT USED)

1.10 WARRANTY

A. Warranties: in accordance with Section 01740 – Warranties and Bonds but extended as follows:

1. Inverter duty motors: warranted for 36 months on inverter power.

2. Severe duty motors: warranted for 60 months on sine wave power.

1.11 DEFINITIONS

A. Definition of terms used in this specification shall be in accordance with NEC Article 100, ANSI/IEEE Standard 100, and UL Standards Glossary.

B. Definitions of Enclosure Types for Motors

1. ODP – Open Drip-Proof

2. TEFC – Totally-Enclosed, Fan-Cooled

3. TEAO – Totally-Enclosed, Air Over

4. TEXP – Totally-Enclosed, Explosion-Proof

5. IP-22 – Open Drip-Proof

6. IP-44 – Totally-Enclosed

7. IP-54 – Splash Proof

8. IP-55 – Washdown

PART 2 PRODUCTS

2.01 GENERAL

A. Torque output: minimum performance characteristics for locked rotor and breakdown torque with rated voltage and frequency applied as defined by NEMA MG1, to accelerate and operate the load throughout its operating speed range, including conditions imposed by reduced voltage starting methods.

B. Motors shall deliver the specified performance at rated load under the combinations of voltage and frequency variations and voltage unbalance specified in NEMA MG1.

C. Horsepower rating: sized for operation within the full load nameplate rating without applying the service factor, throughout the full range of mechanical or hydraulic operating condition.

D. Service Factor: 1.15 service factor on sine wave power and 1.0 service factor on VFD power in a 40 degree C ambient.

E. Specific motor application data such as Hp, rpm, enclosure type, etc., is specified under the detailed driven mechanical equipment specification.

F. Enclosures: conform to one of the following NEMA standard enclosure designs as specified under the detailed driven mechanical equipment specification. If no enclosure type is specified, provide TEFC enclosures:

1. Open Drip Proof (ODP)

2. Totally Enclosed Fan Cooled (TEFC)

3. Totally Enclosed Explosion Proof (TEXP)

G. Nameplates: engraved or embossed on stainless steel fastened to the motor frame with stainless steel screws or drive pins with information per NEMA MG1.

2.02 SINGLE-PHASE MOTORS

A. Application: motors smaller than 1/2 Hp shall be 115/230 or 208 Volts single phase, continuous heavy duty, reversible, capacitor start. Small fan motors may be split-phase or shaded pole type if such are standard for the equipment. Wound rotor or commutator type single-phase motors are not acceptable unless their specific characteristics are necessary for the application.

B. Overload protection: provide internal automatic thermal overloads unless otherwise noted.

C. Insulation: Class F or better, with Class B temperature rise, 1.15 service factor. Locked rotor current shall not be greater than specified in NEMA Standard MG1, Design "N".

D. Enclosure: provide fully gasketed, totally-enclosed air over or fan cooled in conformance with NEMA Standard MG1. Small fan motors may be open type if suitably protected from moisture, dripping water and lint accumulation.

E. Washdown duty: Where motor is installed in wet or corrosive areas routinely exposed to washdowns, high humidity or caustic chemicals, provide stainless steel, paint free washdown motors with Inpro bearing isolators, stainless steel T-type condensation drains, nitrile conduit box gasket, and corrosion resistant fans.

F. Bearings: sealed ball bearings permanently lubricated for 10 years normal use, furnished with shaft slinger.

G. Class 1, Division 1 and 2 locations: Single phase motors installed in Class 1, Division 1 and 2 locations shall be explosion proof, marked with a T3B temperature code label, and UL listed for use in Class 1, Division 1, Groups C & D, and Class II, Groups E, F, & G hazardous location. The temperature code marking shall appear on the nameplate.

2.03 THREE-PHASE INDUCTION MOTORS

A. Applications

1. Energy efficiency: meet or exceed requirements of NEMA MG1 Part 12 for NEMA Premium Efficient motors, for 1 Hp and larger. Where State Energy Codes or Utility Company Energy Rebate Programs dictate higher efficiencies than those listed, comply with the more stringent standard.

2. Severe duty: Motors installed in process areas and wet or corrosive locations shall be of a type designated by the manufacturer as "Corro Duty," "Mill and Chemical," "Severe Duty," or similar quality designation. Motors shall also comply with IEEE 841.

3. Class 1, Division 2 locations: Motors in Class 1, Division 2 locations shall be marked with a temperature code label suitable for use in the hazardous area classification where installed. Motors shall also comply with IEEE 841 severe duty requirements, with the following additional requirements:
   a. The Class, Group and Temperature Code shall be one of the following:
      1) Class I Group D - T2B (260°C)
      2) Class I Group D, Class II Groups F and G - T3B (165°C)
      3) Class I Groups C and D, Class II Groups F and G - T3C (160°C)
   b. Thermostats: Where winding thermostats are used to obtain surface temperature limitation, the thermostats shall be connected in series with the starter holding coil (stop button). Winding temperature detectors and switches shall be UL listed for use in Class 1, Division 1 locations.
   c. The exposed surface of motor condensation heaters shall not exceed 80 percent of the nameplate temperature code value.
   d. Ventilation fan shall be constructed of corrosion-resistant, non-sparking material such as bronze.

4. Class 1, Division 1 locations: Motors installed in Class 1, Division 1 locations shall be explosion proof, temperature code T3C (160°C), listed for use in Class 1, Division 1, Group C & D locations in accordance with UL 674. The operating temperature or

temperature range marking shall appear on the nameplate, indicating the maximum temperature for all conditions including overload, locked rotor and single-phasing.

5. Inverter Duty: Motors connected to Variable Frequency Drive Controllers shall be designed for inverter duty and shall comply with the following:
   a. Definite purpose: Motors operated on variable frequency drives shall be designed specifically for inverter duty, per NEMA MG1, Part 31, and comply with IEEE 841. Motors shall be designed for constant or variable torque over the speed range required by the driven equipment application. Motors shall be capable of across the line starting at the motor minimum terminal voltage with an acceptable maximum locked rotor current.
   b. Torsional critical speed: first or second torsional shall not be encountered within the operating speed range. Rotors shall be stiff shaft design, statically and dynamically balanced with the first lateral critical speed at least 15% above the maximum running speed.
   c. Cooling provisions: maintain temperature rises at design levels while operating throughout the speed range. Ventilation system shall be designed for maximum heat transfer including larger fans or auxiliary cooling fans to maintain proper low speed cooling.
   d. Inverter grade insulation system: minimum Class F or better insulation materials with additional phase insulating material, extra end-turn bracing and Class H spike resistant wire. The resultant system shall withstand up to 2000-volt transients without premature motor failure and have no cable limitations in motor application.
   e. Motor shaft currents: insulate the ODE bearing and provide a shaft grounding strap. Insulate bearing probes to prevent shorting out bearing insulation.

B. Construction

1. Stator core: built up, fully processed, high grade, low loss silicon steel laminations keyed or dovetailed to the stator frame and securely held in place at each end.

2. Stator winding: assembled using random wound copper coils. A split component epoxy insulation system shall be used in order to provide high resistance to moisture and other contaminates.

3. Insulation: manufacturer's premium grade non-hygroscopic, chemical and humidity resistant insulation system consisting of Class F or H materials, operated at Class B temperature rise, with at least one impregnation cycle using solventless resin, and multiple additional dip and bake cycles using polyester varnish.

4. Motor leads: non-wicking type, minimum Class F temperature rating and permanently numbered for identification.

5. Rotor shaft: forged or rolled steel, accurately machined, smoothly finished, with sufficient strength to withstand all stresses resulting from normal operation at any speed up to and including a 25 percent overspeed condition. Coordinate shaft end details with driven equipment coupling.

6. Rotor core: solid, built-up stack of fully processed and coated, high-grade, low-loss silicon steel laminations, with die cast aluminum or fabricated copper bars or their respective

alloys. Rotors on frames 213T and above shall be keyed to shaft and rotating assembly dynamically balanced.

7. Cooling fan: corrosion-resistant, bi-directional, keyed, clamped and shouldered on the shaft.

8. Rotor assembly: coated with a corrosion resistant epoxy insulating varnish or other protective coating, thermally stable, statically and dynamically balanced. Balance weights shall be securely attached to the rotor resistance ring by welding or similar permanent method.

C. Bearings

1. Horizontal Bearings
   a. Bearings: anti-friction open or single-shield, vacuum-degassed steel ball or roller bearings, electric motor quality. Metric size bearings are not acceptable.
   b. Maximum bearing temperature rise: 50 degrees C for two pole motors, 45 degrees C for all other motors, measured at rated load by RTD or thermocouple at bearing outer race.
   c. Lubrication: factory lubricated with a premium moisture resistant polyurea thickened grease containing rust inhibitors and suitable for operation over temperatures from -30 to 150 degrees C. with standard lube and relief fittings for re-greasing external lubrication while machine is in operation. Motors shall be NEMA size 140 frame motors and smaller than may be permanently lubricated.
   d. Minimum Rated fatigue life: L10 life of 100,000 hours per ABMA 9 or ABMA 11 for direct coupled applications and 26,000 hours for belted applications based on NEMA belting application limits per NEMA MG1. Severe duty motors shall have increased bearing life of 150,000 hours for direct coupled applications and 50,000 hours for NEMA belted applications per IEEE 841.
   e. Shaft seals: prevent grease leakage and the entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest. Severe duty motors shall have improved sealing per IEEE 841.

2. Vertical Bearings
   a. Bearings: manufacturer's standard design, constructed with thrust bearings on top to allow inspection and/or replacement without requiring complete disassembly of motor, of type and size to satisfy thrust loading requirements, rated for an in-service B-10 life of 8800 hours per ABMA, designed to support the weight of the rotor plus, if required, the weight of the rotating driven equipment parts and the hydraulic thrust created by the driven equipment, with a 40 degrees C maximum temperature rise. Metric bearings are not acceptable.
   b. Coordinate all thrust conditions, including shutoff, and shaft requirements with the manufacturer of the driven equipment.
   c. Normal thrust applications: use grease lubricated deep-groove ball type thrust bearings only on normal thrust design motors, capable of handling thrust loads in either direction.
   d. High thrust applications: use single or multiple angular contact ball bearings. Anti-friction thrust bearings shall be designed for an L10 life of 100,000 hours including rotor weight. For applications with higher thrust loads which cannot meet the L10 life, spring loaded spherical roller thrust bearings may be used.

e. Guide bearings: deep-groove ball type located at the bottom of the motor, capable of withstanding all stresses incident to the normal operation of the unit and to the specified overspeed condition, with sufficient means for preventing the leakage of lubricant or entrance of foreign matter along the shaft. When furnished as guide bearings for high thrust units, they shall be oil lubricated. Hollow shaft motors shall have a steady bushing to support the head shaft at the lower end of the motor.
f. Grease lubricated bearings: furnished with provisions for in-service positive lubrication and a drain to guard against over lubrication.
g. Oil lubricated bearings: contained in an oil reservoir with sight level gauge, fill and drain openings with plugs, designed to prevent leakage and excessive aeration of the oil.
h. Anti-backspin device: when specified or requested by the pump manufacturer, provide a shaft mounted, mechanical non-reverse ratchet rated at 100 percent of motor full load torque for immediate protection against reversing due to phase reversals or from backspin at shutdown.

D. Enclosures

1. Motor frames: cast iron or welded heavy plate steel construction, stiff enough to withstand the rotating forces and torques generated and shall be designed to limit or avoid any undesirable harmonic resonances. Provide a threaded, forged steel, shouldered eyebolt blind tapped into the motor frame for lifting.

2. Condensate drain openings: locate drain holes at the low points in the end brackets to allow removal of accumulated moisture from enclosures. Provide corrosion resistant, breather drain plugs for severe duty motors.

3. Enclosure type: as specified in the mechanical equipment section, designed in accordance with NEMA MG1. Totally enclosed designs shall be suitable for outdoor use.

4. Hardware: hex head, SAE Grade 5 or better, plated for corrosion protection.

5. Main terminal box: fabricated steel or cast iron, sized per the NEC for number and size of conduit connections as indicated on the drawings, arranged to accommodate conduit entry from any quadrant, with a grounding terminal and gaskets between the box and motor frame and between the box and its cover.

6. Bearing housings: provide machined surfaces for attaching a magnet mounted accelerometer in order to monitor the motor vibration in the vertical, horizontal, and axial directions at each bearing housing.

7. Space heaters: provide silicone rubber strip type enclosure heaters for outdoor motors, or where otherwise specified. Heaters shall be rated 120 Volt, single phase, designed to prevent condensation inside the enclosure when the motor is idle, with leads brought out to the motor terminal box. The heater wattage and voltage shall be embossed on the motor nameplate.

8. Frame grounding: provide motor frame grounding pad or threaded stud where supplemental grounding to frame is indicated on the Drawings.

E. Accessories: provide where specified under the detailed mechanical specifications for individual equipment:

1. Winding temperature switch: three, snap action, bi-metallic, temperature actuated switches embedded in the connection end-turns of the motor winding with normally closed contacts and leads terminating in the main conduit box.

2. Winding temperature relay: complete winding thermal protection system consisting of three PTC thermistors and a separately mounted, separately excited, 115 VAC, 1 phase, solid state control module with dual Form C contacts, mounted in a NEMA 4X enclosure.

3. Bearing temperature detectors: replaceable, three wire RTDs, one per bearing with spring loaded tip, mounted as closely as possible to the outer surface of each bearing with conduit connection head and terminal block.

4. Bearing temperature relays: indicating type bearing temperature relays, furnished with iron or copper constantan thermocouples, one per bearing.

2.04 SURFACE PREPARATION AND SHOP COATINGS

A. Cast and Fabricated Components

1. Motor cast iron and fabricated metal components shall be cleaned; free of grease, oil, dirt, or other contaminants; then oxide primed and painted with manufacturer’s standard finish coating.

2. Severe duty motors: surpass the 250-hour salt spray test per ASTM B117.

B. Internal Surfaces

1. Internal surfaces: shaft, rotor, end bells and parts shall be covered with a corrosion-resistant coating of epoxy paint or equal material of 2 mils minimum dry film thickness for increased life against adverse environmental conditions. The stator bore and end turns shall be coated with clear epoxy varnish in addition to the insulating varnish treatment.

2. Shaft extension: protected with a rust preventive strippable coating capable of being peeled off or unwrapped.

3. Machined joints and threaded parts: coated with rust-inhibiting compound.

2.05 FACTORY TESTING

A. Each motor shall be given an unwitnessed routine short commercial test per NEMA MG1 and IEEE 112.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install the motors per manufacturer's installation instructions.

1. Prepare rigid foundation or mounting surface to minimize vibration and maintain alignment between motor and load shaft.

2. Align the motor shaft with driven equipment according to manufacturer's written instructions. Adjust axial position of motor frame with respect to load shaft.

3. Accurately adjust flexible couplings for direct drive according to machine manufacturer's guidelines. Check alignment to minimize vibrations. Coupling spacing shall be according to coupling manufacturer guidelines.

4. Anchor motor base to load bearing surface with grade 5 steel bolts or better.

B. Electrical Connections

1. Install motor branch circuit conduits and conductors in accordance with NEC and local code requirements.

2. Terminate the motor leads per the manufacturer's connection diagrams.

3. Install equipment grounding conductors per NEC and local code requirements.

4. Tighten electrical connections and terminals according to manufacturer's published torque values.

5. Install conduit and wiring between motor auxiliary devices and associated indicators, controllers and protective devices in accordance with shop drawings.

6. Connect electro-magnetic field sensitive devices such as RTDs, thermistors, thermal protector switches, and vibration sensors with twisted and shielded instrumentation wiring.

C. Pre-Commissioning Inspection

1. Inspect for physical damage. Verify all shipping materials and braces are removed.

2. Compare equipment nameplate information with site conditions and report any discrepancies.

3. Inspect for proper mounting, grounding, and wiring connections. Check all hardware for looseness and re-tighten as necessary.

4. Verify that the motor and the coupled load are properly aligned. Inspect bearings for proper lubrication and rotate motor shaft by hand to check for binding. Oil lubricated bearing housings that have been filled with preservative oil shall be drained and re-filled with the proper grade of bearing oil before putting the machine into service.

5. Clean motor externally, on completion of installation. Vacuum dirt and debris; do not use blown compressed air to assist in cleaning.

D. Field Commissioning

1. Perform insulation resistance tests in accordance with manufacturer's instructions. If the test fails consult the manufacturer and dry out the machine.

2. Perform a phase rotation test to ensure proper shaft direction with load uncoupled.

3. Check all connections with wiring diagrams prior to energizing.

4. Inspect for unusual mechanical or electrical noise or signs of overheating during initial test run.

5. Measure running current and evaluate relative to load conditions and nameplate full load amperes.

END OF SECTION 01171

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SECTION 01200
PROJECT MEETINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Schedule, attend and administer as specified pre-construction conference, periodic progress meetings, and specially called meetings throughout progress of work.

B. Representatives of Contractors, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.

C. Meetings, in addition to those specified in this Section, may be held when requested by the Owner, Engineer or Contractor.

1.02 RELATED REQUIREMENTS

A. Instructions to Bidders are included in Section 00100.

B. Shop Drawings, Working Drawings and Samples are included in Section 01300.

C. Project Record Documents are included in Section 01720.

D. Operating and Maintenance Data is included in Section 01730.

1.03 PRE-CONSTRUCTION CONFERENCE

A. Hold a pre-construction conference after award of Contract and before the start of construction activities.

B. Attendance:

1. Contractor’s project manager.

2. Contractor’s superintendent.

3. Any subcontractor of supplier representative whom the Contractor may desire, or the Owner or Engineer may request.

4. Owner's Representatives.

5. Engineer’s representatives.

6. Representatives of the City of Geneva.

7. Others as appropriate.

C. Preliminary Agenda:

1. Major subcontractors and suppliers. (Contractor shall provide listing at the meeting.)

2. Construction schedule, including critical work sequencing. (Contractor shall provide schedule at meeting.)

3. Liquidated Damages.

4. Major equipment deliveries and priorities.

5. Project Coordination:
   a. Designation of responsible personnel.

6. Procedures and processing of:
   a. Field decisions.
   b. Requests for Information (RFIs).
   c. Proposal requests.
   d. Submittals.
   e. Change Orders.
   f. Applications for Payment.

7. Adequacy of distribution of Contract Documents.

8. Procedures for maintaining Record Documents.

9. Use of premises:
   a. Office, work and storage areas.
   b. Owner's requirements.

10. Construction facilities, controls and construction aids.

11. Temporary utilities.

12. Contractor’s safety plan and first-aid procedures.

13. Security procedures.

14. Housekeeping procedures.

15. Submittal schedule.

16. Quality Control.

17. Planned outages.

18. Factory testing.

19. Field testing.

1.04 PROGRESS MEETINGS

A. Schedule regular periodic meetings. Frequency to be determined at Pre-Construction Conference.

B. Hold called meetings as required by progress of the work.

C. Location of the meetings: Project site.

D. Preliminary Agenda:

1. Review, approval of minutes of previous meeting.
2. Review of work progress since previous meeting.
3. Field observations, problems and conflicts.
4. Problems which impede Construction Schedule.
5. Review of off-site fabrication, delivery schedules.
6. Corrective measures and procedures to regain projected schedule.
7. Revisions to Construction Schedule.
8. Progress, schedule, during succeeding work period.
9. Coordination of schedules.
10. Review submittal log (as maintained by the Contractor in accordance with Section 01300) and schedule for remaining submittals.
11. Maintenance of quality standards.
12. Pending changes and substitutions.
13. Review proposed changes for:
    a. Effect on Construction Schedule and on completion date.
    b. Effect on other contracts of the project.
14. Review Record Documents.
15. Construction schedule.
16. Critical/long lead items.
17. Other business.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01200

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SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes the requirements for compiling, processing and transmitting submittals required for execution of the project.

B. Submittals are categorized into two types: Action Submittals and Informational Submittals, as follows:

1. Action Submittal: Written and graphic information submitted by the Contractor that requires the Engineer's approval. The following are examples of action submittals:
   a. Shop drawings (including working drawings, valve schedule, and product data).
   b. Samples.
   c. Operation & maintenance manuals.
   d. Site Usage Plan (Contractor's staging – including trailer siting and material laydown area).
   e. Schedule of values.
   f. Payment application format.

2. Informational Submittal: Information submitted by the Contractor that does not require the Engineer's approval. The following are examples of informational submittals:
   a. Shop Drawing Schedule.
   b. Construction Schedule.
   c. Statements of Qualifications.
   d. Health and Safety Plans.
   e. Work Plans.
   f. Outage Requests.
   g. Proposed Testing Procedures.
   h. Test Records and Reports.
   i. Vendor Training Outlines/Plans.
   j. Test and Start-Up Reports.
   k. Certifications.
   l. Record Drawings.
   m. Record Shop Drawings.
   n. Submittals required by laws, regulations and governing agencies.
   o. Submittals required by funding agencies.
   p. Other requirements found within the technical specifications.
   q. Warranties and Bonds.
   r. As-Built Surveys.
   s. Contract Close-out Documents.

1.02 RELATED WORK

A. Additional requirements may be specified in the Conditions of the Contract.

B. Additional submittal requirements may be specified in the respective technical Specification Sections.

C. Operation and Maintenance manuals are included in Section 01730.

D. Contract closeout submittals are included in Section 01700.

E. Warranties and Bonds are included in Section 01740.

F. Project Record Documents are included in Section 01720.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. All submittals shall be clearly identified as follows:

1. Date of Submission.

2. Project Number.

3. Project Name.

4. Contractor Identification:
   a. Contractor.
   b. Supplier.
   c. Manufacturer.
   d. Manufacturer or supplier representative.

5. Identification of the Product.

6. Reference to Contract Drawing(s).

7. Reference to specification section number, page and paragraph(s).

8. Reference to applicable standards, such as ASTM or Federal Standards numbers.

9. Indication of Contractor's approval.

10. Contractor's Certification statement.

11. Identification of deviations from the Contract Documents, if any.

12. Reference to previous submittal (for resubmittals).

13. Made in America (when required by the Contract).

B. Submittals shall be clear and legible, and of sufficient size for legibility and clarity of the presented data.

C. Submittal Log. Maintain a log of all submittals. The submittal log shall be kept accurate and up to date. This log should include the following items (as applicable):

1. Description.

2. Submittal Number.

3. Date transmitted to the Engineer.

4. Date returned to Contractor (from Engineer).

5. Status of Submittal (Approved/Not Approved/etc.).

6. Date of Resubmittal to Engineer and Return from Engineer (if applicable and repeat as necessary).

7. Date material released for fabrication.

8. Projected (or actual) delivery date.

D. Numbering System. Utilize the following submittal identification numbering system:

1. The first character shall be a D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.

2. The next five digits shall be the applicable Section Number.

3. The next three digits shall be the sequential number of each separate item or drawing submitted under each Specification Section, in the chronological order submitted, starting at 001.

4. The last character shall be a letter, A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc. A typical submittal number would be as follows:

D-03300-008-B

D = Shop Drawing
03300 = Section for Concrete
008 = the eighth different submittal under this Section
B = the second submission (first resubmission) of that particular shop drawing

E. Variances:

1. Notify the Engineer in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.

2. Notify the Engineer in writing, at the time of re-submittal (resubmission), of all deviations from previous submissions of that particular shop drawing, except those deviations which are the specific result of prior comments from the Engineer.

F. Action Submittals:

1. Shop Drawings, Working Drawings, Product Data and Samples:
   a. Shop Drawings:
      1) Shop drawings as defined in the Conditions of the Contract, and as specified in individual Sections may include, but are not necessarily limited to, custom

prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, valve schedules, wiring diagrams, coordination drawings, equipment inspection and test reports, and performance curves and certifications, as applicable to the work.

2) Contractor shall verify all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and coordinate each item with other related shop drawings and the Contract requirements.
3) All details on shop drawings shall clearly show the relation of the various parts to the main members and lines of the structure and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted.
4) All shop drawings submitted by subcontractors and vendors shall be reviewed by the Contractor. Contractor shall confirm, materials, dimensions, catalog numbers, technical data and performance criteria; and shall coordinate with other related shop drawings and the Contract requirements. In addition, Contractor shall confirm existing field conditions and dimensions and assure that the submittal is coordinated and compatible with existing conditions. Submittals directly from subcontractors or vendors will not be accepted by the Engineer.
5) The Contractor shall be responsible the accuracy of the subcontractor's or vendor's submittal; and, for their submission in a timely manner to support the requirements of the Contractor's construction schedule. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractor or vendor to correct, before submission to the Engineer. All shop Drawings shall be approved by the Contractor.
6) Delays to construction due to the untimely submission of submittals will constitute inexcusable delays, for which Contactor shall not be eligible for additional cost nor additional contract time. Inexcusable delays consist of any delay within the Contactor's control.
7) Submittals for equipment specified under Divisions 13 and 15 shall include a listing of installations where identical or similar equipment manufactured by that manufacturer has been installed and in operation for a period of at least five years.

b. Working Drawings:
1) Detailed installation drawings (sewers, equipment, piping, electrical conduits and controls, HVAC work, and plumbing, etc.) shall be prepared and submitted for review and approval by the Engineer prior to installing such work. Installation drawings shall be to-scale and shall be fully dimensioned.
2) Piping working drawings shall show the laying dimensions of all pipes, fittings, valves, as well as the equipment to which it is being connected. In addition, all pipe supports shall be shown.
3) Equipment working drawings shall show all equipment dimensions, anchor bolts, support pads, piping connections and electrical connections. In addition, show clearances required around such equipment for maintenance of the equipment.
4) Electrical working drawings shall show conduits, junction boxes, disconnects, control devices, lighting fixtures, support details, control panels, lighting and power panels, and Motor Control Centers. Coordinate all locations with the Contract Documents and the Contractor's other working drawings.

c. Product Data:
1) Product data, as specified in individual Specification Sections, include, but are not limited to, the manufacturer's standard prepared data for manufactured

products (catalog data), such as the product specifications, installation instructions, availability of colors and patterns, rough-in diagrams and templates, product photographs (or diagrams), wiring diagrams, performance curves, quality control inspection and reports, certifications of compliance (as specified or otherwise required), mill reports, product operating and maintenance instructions, recommended spare parts and product warranties, as applicable.

d. Samples:
   1) Furnish, samples required by the Contract Documents for the Engineer's approval. Samples shall be delivered to the Engineer as specified or directed. Unless specified otherwise, provide at least two samples of each required item. Materials or equipment for which samples are required shall not be used in the work unless and until approved by the Engineer.
   2) Samples specified in individual Specification Sections, include, but are not limited to: physical examples of the work (such as sections of manufactured or fabricated work), small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols, and other specified units of work.
   3) Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify and Contract Requirements.
   4) Approved samples not destroyed in testing shall be sent to the Engineer or stored at the site of the work. Approved samples of the hardware in good condition will be marked for identification and may be used in the work. Materials and equipment incorporated in work shall match the approved samples. Samples which fail testing or are not approved will be returned to the Contractor at his expense, if so requested at time of submission.

e. Professional Engineer (P.E.) Certification Form:
   1) If specifically required in any of the technical Specification Sections, submit a Professional Engineer (P.E.) Certification for each item required, using the form appended to this Section, signed and sealed by the P.E. licensed or registered in the state of Illinois.

2. Contractor's Certification:
   a. Each shop drawing, working drawings, product data, and sample shall have affixed to it the following Certification Statement: “Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements."
   b. Shop drawings, working drawings, and product data sheets 11-in x 17-in and smaller shall be bound together in an orderly fashion and bear the above Certification Statement on the cover sheet. The transmittal cover sheet for each identified shop drawing shall fully describe the packaged data and include a listing of all items within the package. Shop drawings that are not stamped will not be reviewed.

3. The review and approval of shop drawings, working drawings, product data, or samples by the Engineer shall not relieve the Contractor from the responsibility for the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Engineer will have no responsibility therefor.

4. Project work, materials, fabrication, and installation shall conform to approved shop drawings (including working drawings and product data) and applicable samples.

5. No portion of the work requiring a shop drawing (including working drawings and product data) or sample shall be started, nor shall any materials be fabricated or installed before approval of such item. Procurement, fabrication, delivery or installation or products or materials that do not conform to approved shop drawings shall be at the Contractor's risk. Furthermore, such products or materials delivered or installed without approved shop drawings, or in non-conformance with the approved shop drawings will not be eligible for progress payment until such time as the product or material is approved or brought into compliance with approved shop drawings. Neither the Owner nor Engineer will be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

6. Operation and Maintenance Data:
   a. Operation and maintenance data shall be submitted in assembled manuals as specified. Such manuals shall include detailed instructions for Owner personnel on safe operation procedures, controls, start-up, shut-down, emergency procedures, storage, protection, lubrication, testing, troubleshooting, adjustments, repair procedures, and other maintenance requirements.

7. Schedule of Values:
   a. On projects consisting of lump sums (in whole or in part) submit a proposed schedule of values providing a breakdown of lump sum items into reasonably small components – generally disaggregated by building, area, and/or discipline. The purpose of the schedule of values is for processing partial payment applications. If requested by the Engineer, provide sufficient substantiation for all or some items as necessary to determine the proposed schedule of values is a reasonable representation of the true cost breakdown of the Work. The schedule of values shall not be unbalanced to achieve early payment or over-payment in excess of the value of work or any other misdistribution of the costs. If, in the opinion of the Engineer, the schedule of values is unbalanced, Contractor shall reallocate components to achieve a balanced schedule acceptable to Engineer.

8. Payment Application Format:
   a. If an application form is included in the Contract Documents, use that form unless otherwise approved by the Engineer and Owner. If an application form is not included in the Contract Documents, Contractor may propose a form for approval.

9. Site Usage:
   a. Submit a proposed site staging plan, including but not limited to the location of office trailers, storage trailers and material laydown. Such plan shall be a graphic presentation (drawing) of the proposed locations; and, shall include on-site traffic modifications, and temporary utilities, as may be applicable.

G. Informational Submittals:

1. Shop Drawing Schedule:
   a. Prepare and submit a schedule indicating when shop drawings are required to be submitted to support the as-planned construction schedule. The submittal schedule shall allow sufficient time for preparation and submittal, review and approval, and fabrication and delivery to support the construction schedule.

2. Construction Schedule:
   a. Prepare and submit construction schedules and monthly status reports as specified.

3. Statements of Qualifications:
   a. Provide evidence of qualification, certification, or registration, as required in the Contract Documents, to verify qualifications of licensed land surveyor, professional engineer, materials testing laboratory, specialty subcontractor, technical specialist, consultant, specialty installer, and other professionals.

4. Health and Safety Plans:
   a. When specified, prepare and submit a general company Health and Safety Plan (HSP), modified or supplemented to include job-specific considerations.

5. Work Plans:
   a. Prepare and submit copies of all work plans needed to demonstrate to the Owner that Contractor has adequately thought-out the means and methods of construction and their interface with existing facilities.

6. Outage Requests:
   a. Provide sufficient notification of any outages required (electrical, flow processes, etc.) as may be required to tie-in new work into existing facilities. Unless specified otherwise elsewhere, a minimum of seven calendar days' notice shall be provided.

7. Proposed Testing Procedures:
   a. Prepare and submit testing procedures it proposes to use to perform testing required by the various technical specifications.

8. Test Records and Reports:
   a. Provide copies of all test records and reports as specified in the various technical specifications.

9. Vendor Training Outlines/Plans:
   a. At least two weeks before scheduled training of Owner's personnel, provide lesson plans for vendor training in accordance with the specification for O&M manuals.

10. Test and Start-up Reports:
    a. Manufacture shall perform all pre-start-up installation inspection, calibrations, alignments, and performance testing as specified in the respective Specification Section. Provide copies of all such test and start-up reports.

11. Certifications:
    a. Provide various certifications as required by the technical specifications. Such certifications shall be signed by an officer (of the firm) or other individual authorized to sign documents on behalf of that entity.
    b. Certifications may include, but are not limited to:
       1) Welding certifications and welders' qualifications.
       2) Certifications of Installation, Testing and Training for all equipment.
       3) Material Testing reports furnished by an independent testing firm.
       4) Certifications from manufacturer(s) for specified factory testing.
       5) Certifications required to indicate compliance with any sustainability or LEEDS accreditation requirements indicated in the Contract Documents.

12. Record Drawings:
    a. No later than Substantial Completion, submit a record of all changes during construction not already incorporated into drawings – in accordance with specification on Project Record Documents.

13. Record Shop Drawings:
    a. Before final payment is made, furnish one set of record shop drawings to the Engineer. These record shop drawings shall be in conformance with the approved documents and should show any field conditions which may affect their accuracy.

14. Submittals required by laws, regulations and governing agencies:
    a. Prepare and submit all documentation required by state or local law, regulation or government agency directly to the applicable agency. This includes, but is not limited to, notifications, reports, certifications, certified payroll (for projects subject to wage requirements) and other documentation required to satisfy all requirements. Provide to Engineer one copy of each submittal made in accordance with this paragraph.

15. Submittals required by funding agencies:
    a. Prepare and submit all documentation required by funding agencies. This includes, but is not limited to, segregated pay applications and change orders when required to properly allocate funds to different funding sources; and certified payrolls for projects subject to wage requirements. Provide one copy of each submittal made in accordance with this paragraph to the Engineer.

16. Other requirements of the technical Specification Sections:
    a. Comply with all other requirements of the technical specifications.

17. Warranties and Bonds:
    a. Assemble a booklet or binder of all warranties and bonds as specified in the various technical specifications and in accordance with the specification on Warranties and Bonds; and provide two originals to the Engineer.

18. As-Built Surveys:
    a. Engage the services of a licensed land surveyor in accordance with the Project Controls (Surveying) specification. Prior to Final Completion, provide an as-built survey of the constructed facility, as specified.

19. Contract Close-Out Documents:
    a. Submit Contract documentation as indicated in the specification for Contract Close-out.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

A. Provide an initial submittal schedule at the pre-construction meeting for review by Owner and Engineer. Incorporate comments from Owner or Engineer into a revised submittal schedule.

B. Maintain the submittal schedule and provide sufficient copies for review by Owner and Engineer. An up-to-date submittal schedule shall be provided at each project progress meeting.

3.02 TRANSMITTALS

A. Prepare separate transmittal sheets for each submittal. Each transmittal sheet shall include at least the following: Contractor's name and address, Owner's name, project name, project number, submittal number, description of submittal and number of copies submitted.

B. Submittals shall be transmitted or delivered directly to the office of the Engineer, as indicated in the Contact Documents or as otherwise directed by the Engineer.

C. Provide copies of transmittals forms or cover letters (without attachments) directly to the Resident Project Representative.

3.03 PROCEDURES

A. Action Submittals:

1. Contractor's Responsibilities:
   a. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work of other related Sections, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required). Coordinate with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. Extensions to the Contract Time will not be approved for the Contractor's failure to transmit submittals sufficiently in advance of the Work.
   b. The submittals of all shop drawings (including working drawings and product data) shall be sufficiently in advance of construction requirements to allow for possible need of re-submittals, including the specified review time for the Engineer.
   c. No more than 30 calendar days will be required for Engineer's review time for shop drawings and O&M manuals involving only one engineering discipline. No less than 45 calendar days will be required for Engineer's review time for shop drawings and O&M manuals that require review by more than one engineering discipline. Resubmittals will be subject to the same review time.
   d. Submittals of operation and maintenance data shall be provided within 30 days of approval of the related shop drawing(s).
   e. Before submission to the Engineer, review shop drawings as follows:
      1) Make corrections and add field measurements, as required.
      2) Use any color for its notations except red (reserved for the Engineer's notations) and black (to be able to distinguish notations on black and white documents).
      3) Identify and describe each and every deviation or variation from Contract documents or from previous submissions, except those specifically resulting from a comment from the Engineer on a previous submission.
      4) Include the required Contractor's Certification statement.
      5) Provide field measurements (as needed).
      6) Coordinate with other submittals.
      7) Indicate relationships to other features of the Work.
      8) Highlight information applicable to the Work and/or delete information not applicable to the Work.
   f. Submit the following number of copies

1) Shop drawings (including working drawings and product data) – Submit one hard copy to the engineer
2) Samples – three copies.
3) Site Usage Plan – three copies.
4) Schedule of values – one hard copy.
5) Payment application format – one hard copy

g. If Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, provide written notice thereof to the Engineer immediately; and do not release for manufacture before such notice has been received by the Engineer.
h. When the shop drawings have been completed to the satisfaction of the Engineer, carry out the construction in accordance therewith; and make no further changes therein except upon written instructions from the Engineer.

2. Engineer's Responsibilities:
   a. Engineer will not review shop drawings (including working drawings and product data) that do not include the Contractor's approval stamp and required certification statement. Such submittals will be returned to the Contractor, without action, for correction.
   b. Partial shop drawings (including working drawings and product data) will not be reviewed. If, in the opinion of the Engineer, a submittal is incomplete, that submittal will be returned to the Contractor for completion. Such submittals may be returned with comments from Engineer indicating the deficiencies requiring correction.
   c. If shop drawings (including working drawings and product data) meet the submittal requirements, Engineer will forward copies to appropriate reviewer(s). Otherwise, noncompliant submittals will be returned to the Contractor without action – with the Engineer retaining one copy.
   d. Submittals which are transmitted in accordance with the specified requirements will be reviewed by the Engineer within the time specified herein. The time for review will commence upon receipt of submittal by Engineer.

3. Review of Shop Drawings (Including Working Drawings and Product Data) and Samples:
   a. The review of shop drawings, working drawings, data and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:
      1) as permitting any departure from the Contract requirements.
      2) as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials.
      3) as approving departures from details furnished by the Engineer, except as otherwise provided herein.
   b. The Contractor remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.
   c. If the shop drawings (including working drawings and product data) or samples as submitted describe variations and indicate a deviation from the Contract requirements that, in the opinion of the Engineer are in the interest of the Owner and are so minor as not to involve a change in Contract Price or Contract Time, the Engineer may return the reviewed drawings without noting an exception.
   d. Only the Engineer will utilize the color "RED" in marking submittals.
   e. Shop drawings will be returned to the Contractor with one of the following codes:

Code 1 - “APPROVED” – This code is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.
Code 2 - "APPROVED AS NOTED" – This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.
Code 3 - "APPROVED AS NOTED/CONFIRM" – This combination of codes is assigned when a confirmation of the notations and comments is required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 15 days of the date of the Engineer's transmittal requiring the confirmation.
Code 4 - "APPROVED AS NOTED/RESUBMIT" – This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the entire package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the Engineer within 30 days of the date of the Engineer's transmittal requiring the resubmittal.
Code 5 - “NOT APPROVED” – This code is assigned when the submittal does not meet the intent of the contract documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the contract documents.
Code 6 - “COMMENTS ATTACHED” – This code is assigned where there are comments attached to the returned submittal, which provide additional data to aid the Contractor.
Code 7 - “RECEIPT ACKNOWLEDGED (Not subject to Engineer’s Review or Approval)” – This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer’s review and approval and is being filed for informational purposes only. This code is generally used in acknowledging receipt of means and methods of construction work plans, field conformance test reports, and health and safety plans.

Codes 1 through 5 designate the status of the reviewed submittal with Code 6 indicates that some or all of the Engineer’s comments are included in an attachment.

f. Repetitive Reviews: Shop drawings, O&M manuals and other submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be performed at the Contractor's expense. Reimburse the Owner for all costs invoiced by Engineer for the third and subsequent reviews.

4. Electronic Transmission:
   a. Action Submittals may be transmitted by electronic means provided the following conditions are met:
      1) The above-specified transmittal form is included.
      2) All other requirements specified above have been met including, but not limited to, coordination by the Contractor, review and approval by the Contactor, and the Contractor's Certification.
      3) The submittal contains no pages or sheets large than 11 x 17 inches.

4) With the exception of the transmittal sheet, the entire submittal is included in a single file.
5) The electronic files are PDF format (with printing enabled).
6) In addition, transmit one hard-copy (paper) originals to the Engineer.
7) The Engineer's review time will commence upon receipt of the hard copies of the submittal.
8) For Submittals that require certification, corporate seal, or professional embossment (i.e., P.E.s, Surveyors, etc.) transmit at least two hard-copy originals to the Engineer. In addition, provide additional photocopied or scanned copies, as specified above, showing the required certification, corporate seal, or professional seal.

B. Informational Submittals:

1. Contractor's Responsibilities:
   a. Number of copies: Submit three copies, unless otherwise indicated in individual Specification sections.
   b. Refer to individual technical Specification Sections for specific submittal requirements.

2. Engineer’s Responsibilities:
   a. The Engineer will review each informational submittal within 15 days. If the informational submittal complies with the Contract requirements, Engineer will file for the project record and transmit a copy to the Owner. Engineer may elect not to respond to Contractor regarding informational submittals meeting the Contract requirements.
   b. If an informational submittal does not comply with the Contract requirements, Engineer will respond accordingly to the Contractor within 15 days. Thereafter, the Contractor shall perform the required corrective action, including retesting, if needed, until the submittal, in the opinion of the Engineer, is in conformance with the Contract Documents.

3. Electronic Transmission:
   a. Informational submittals may be transmitted by electronic means providing all of the following conditions are met:
      1) The above-specified transmittal form is included.
      2) The submittal contains no pages or sheets large than 11 x 17 inches.
      3) With the exception of the transmittal sheet, the entire submittal is included in a single file.
      4) The electronic files are PDF format (with printing enabled).
      5) For Submittals that require certification, corporate seal, or professional embossment (i.e., P.E.s, Surveyors, etc.) transmit two hard-copy originals to the Engineer.

END OF SECTION 01300

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P.E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a professional engineer registered in the [State] [Commonwealth] of _____ and that he/she has been employed by

_____ to design
(Company Name)

_____
(Insert P.E. Responsibilities)

In accordance with Specification Section _____ for the

_____.
(Name of Project)

The undersigned further certifies that he/she has performed the said design in conformance with all applicable local, state and federal codes, rules and regulations; and, that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the

_____
(Insert Name of Owner)

or Owner's representative within seven days following written request therefor by the Owner.

_____	_____
P.E. Name	Company Name
_____	_____
Signature	Signature
_____	_____
P.E. Registration Number	Title

_____
Address

_____
Address

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SECTION 01370
SCHEDULE OF VALUES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Develop a Schedule of Values to be used for the Project. It is the Owner's intent that the Schedule of Values can also be used as a fair and expedient method of deleting items from the Work, should the Owner so desire. Therefore, it is the Contractor's responsibility, as well as to his advantage, to make the schedule as detailed and the items and their corresponding values as equitably determined and presented as possible.

B. The approved Schedule of Values may, at the discretion of the Engineer, be used as a guide in determining the value of Work involved in change orders.

C. The accepted Schedule of Values shall be used only as the basis for the Contractor's Applications for Payment.

D. Upon request of the Engineer, support the values with data which will substantiate their correctness.

1.02 RELATED REQUIREMENTS

A. General Conditions of the Contract.

B. Submittals is included in Section 01300.

1.03 SUBMITTALS

A. Submit in accordance with the submittal procedures included in Section 01300.

B. Submit a Schedule of Values allocated to the various portions of the work, within 21 days after the effective date of the Agreement:

1. Upon request of the Engineer, Contractor shall support the values with data which will substantiate their correctness.

2. The accepted Schedule of Values shall be used only as the basis for the Contractor's Applications for Payment.

C. Submit a Forecasts of Payments Schedule: Within 21 days after the effective date of the Agreement, the Contractor shall submit to the Engineer a Forecast of Payments Schedule forecasting the monthly partial payment amounts that are anticipated for the Project. During progress of the job, mark this schedule (which can be in chart format) to show actual payments to date, revise the Forecast of Payments Schedule as necessary, and submit the revised schedule to the Engineer with each payment request.

1.04 FORM AND CONTENT OF SCHEDULE OF VALUES

A. Type schedule on 8-1/2-in by 11-in or 8-1/2-in by 14-in paper. Contractor's standard forms and automated printout will be considered for approval by the Engineer upon Contractor's request. Identify schedule with:

1. Title of Project and location.

2. Engineer and Project number.

3. Name and Address of Contractor.

4. Contract designation.

5. Date of submission.

B. Schedule shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction.

C. Identify each line item with the number and title of the respective Section.

D. For each major line item list sub-values of major products or operations under the item.

E. In so far as possible, total quantities and unit prices shall be shown for all items of Work, separating for each item the materials and labor and such other sub-items as the Contractor may desire. “Lump sum,” “miscellaneous,” and other such general entries in the schedule shall be avoided whenever possible.

F. Items such as Bond premiums, insurance, temporary facilities, and equipment storage may be listed separately in the Schedule of Values, provided the costs can be substantiated. Overhead and profit shall not be listed as separate items.

G. For the various portions of the work:

1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.

2. For items on which progress payments will be requested for stored materials, break down the value into:
   a. The cost of the materials delivered and unloaded, with taxes paid. Paid invoices are required for materials upon request by the Engineer.
   b. The total installed value.
   c. Each item shall include the percent of the total Contract Price.

H. The sum of all values listed in the schedule shall equal the total Contract Sum. No additional payment will be allowed if the quantities shown in the Schedule of Values are less than those actually required to accomplish the Work, unless the quantities are altered by a change order.

I. The value of mobilization shall not exceed 2 percent of the Contract Price.

1.05 SUBSCHEDULE OF UNIT MATERIAL VALUES

A. Submit a sub-schedule of unit costs and quantities for:

1. Products on which progress payments will be requested for stored products.

B. The form of submittal shall parallel that of the Schedule of Values, with each item identified the same as the line item in the Schedule of Values.

C. The unit quantity for bulk materials shall include an allowance for normal waste.

D. The unit values for the materials shall be broken down into:

1. Cost of the material delivered and unloaded at the site, with taxes paid.

2. Copies of invoices for component material shall be included with the payment request in which the material first appears.

3. Paid invoices shall be provided with the second payment request in which the material appears, or no payment shall be allowed and/or may be deleted from the request.

E. The installed unit value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01370

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SECTION 01465
EQUIPMENT TESTING AND STARTUP

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide a competent field services technician of the manufacturers of all equipment furnished under other Sections to supervise installation, adjustment, initial operation and testing, performance testing, final acceptance testing and startup of the equipment.

B. Perform specified equipment field performance tests, final acceptance tests and startup services.

1.02 RELATED WORK

A. Operation and Maintenance Data is included in Section 01730.

B. Performance and acceptance testing and startup requirements are included in the applicable Sections.

1.03 SUBMITTALS

A. Submit name, address and resume of proposed field services technicians at least 30 days in advance of the need for such services.

B. Submit, in accordance with Section 01300, detailed testing procedures for shop tests, field performance tests and final acceptance tests as specified in the various equipment sections. Submittals shall include the following:

1. Test procedures shall be submitted at least 30 days in advance of the proposed test dates and shall include at least the following information:
    a. Name, classification, model and serial number of equipment to be tested, including reference to specifications section number and title.
    b. Testing schedule of proposed dates and times for testing.
    c. Summary of power, lighting, chemical, water, sludge, gas, etc., needs and identification of who will provide them.
    d. Outline specific assignment of the responsibilities of the Contractor and manufacturers' factory representatives or field service personnel.
    e. Detailed description of step-by-step testing requirements, with reference to appropriate standardized testing procedures and laboratory analyses by established technical organizations (e.g., ASTM, WPCF Standard Methods, etc.).
    f. Samples of forms to be used to collect and record test data and to present tabulated test results.

2. Copies of test reports upon completion of specified shop, performance and acceptance tests. Test reports shall incorporate the information provided in the test procedures submittals and modified to reflect actual conduct of the tests and the following additional information:
    a. Copy of all test data sheets and results of lab analyses.
    b. Summary comparison of specified test and performance requirements vs actual test results.

c. Should actual test results fail to meet specified test and performance requirements, describe action to be taken prior to re-testing the equipment.

3. Copies of the manufacturer's field service technician's report summarizing the results of his/her initial inspection, operation, adjustment and pre-tests. The report shall include detailed descriptions and tabulations of the points inspected, tests and adjustments made, quantitative results obtained, suggestions for precautions to be taken to ensure proper maintenance, and the equipment supplier's Certificate of Installation in the format specified herein.

1.04 QUALITY ASSURANCE

A. Field service technicians shall be competent and experienced in the proper installation, adjustment, operation, testing and startup of the equipment and systems being installed.

B. Manufacturers' sales and marketing personnel will not be accepted as field service technicians unless they can prove their qualifications.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PRELIMINARY REQUIREMENTS

A. After installation of the equipment has been completed and the equipment is presumably ready for operation, before it is operated by others, the manufacturer's field service technician shall inspect, operate, test and adjust the equipment. The inspection shall include at least the following points where applicable:

1. Soundness (without crack or otherwise damaged parts).

2. Completeness in all details, as specified and required.

3. Correctness of setting, alignment and relative arrangement of various parts.

4. Adequacy and correctness of packing, sealing and lubricants.

B. The operation, testing and adjustment shall be as required to prove that the equipment has been left in proper condition for satisfactory operation under the conditions specified.

C. Upon completion of this work, the manufacturer's field service technician shall submit a signed report of the results of his/her inspection, operation, adjustments and tests.

3.02 WITNESS REQUIREMENTS

A. Shop tests or factory tests may be witnessed by the Owner and/or Owner's representatives, as required by the various equipment specifications.

B. Field performance and acceptance tests shall be performed in the presence of the Owner, the Owner's designed personnel and/or Owner's representatives.

3.03 STARTUP AND ACCEPTANCE OF THE TREATMENT PLANT AND RELATED SYSTEMS

A. General Requirements

1. Successfully execute the step-by-step procedure of startup, normal operation, shutdown, and performance demonstration specified herein.

2. The startup and performance demonstration shall be successfully executed prior to Substantial Completion and acceptance by the Owner of the facility and its related systems.

3. All performance tests and inspections shall be scheduled at least 10 working days in advance or as otherwise specified with the Owner and the Engineer. All performance tests and inspections shall be conducted during the work week of Monday through Friday, unless otherwise specified.

B. Preparation for Startup

1. All mechanical and electrical equipment shall be checked to ensure that it is in good working order and properly connected.

2. All instruments and controls shall be calibrated through their full range. All other adjustments required for proper operation of all instrumentation and control equipment shall be made.

3. Perform all other tasks needed for preparing and conditioning the facility for proper operation.

4. No testing or equipment operation shall take place until it has been verified by the Engineer that all specified safety equipment has been installed and is in good working order.

5. No testing or equipment operation shall take place until it has been verified by the Engineer that all lubricants, tools, maintenance equipment, spare parts and approved equipment operation and maintenance manuals have been furnished as specified.

C. Equipment Startup

1. Demonstrate a seven consecutive 24-hour day period of successful operation as a prerequisite of Substantial Completion and Acceptance.

2. In the event of failure to demonstrate satisfactory performance on the first or any subsequent attempt, all necessary alterations, adjustments, repairs and replacements shall be made.

3. The Owner will provide all necessary chemicals and electricity. However, the Contractor shall provide all necessary personnel of the various construction trades, i.e., electricians, plumbers, etc., and field service personnel of the major equipment suppliers as required.

4. Do not, at any time, allow equipment to be operated in a manner which subjects equipment to conditions that are more severe than the maximum allowable operating conditions for which the equipment was designed.

END OF SECTION 01465

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EQUIPMENT SUPPLIER'S CERTIFICATE OF INSTALLATION

Owner _____

Project _____

Contract No._____

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

_____
(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial no.)

_____

installed for the subject project has (have) been installed in a satisfactory manner, has (have) been tested and adjusted, and is (are) ready for final acceptance testing and operation on:

Date_____

Time_____

CERTIFIED BY: _____
(Signature of Manufacturer's Representative)

Date:_____

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SECTION 01600
DELIVERY, STORAGE AND HANDLING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies the general requirements for the delivery, handling, storage and protection for all items required in the construction of the work. Specific requirements, if any, are specified with the related item.

1.02 TRANSPORTATION AND DELIVERY

A. Transport and handle items in accordance with manufacturer's instructions.

B. Schedule delivery to reduce long term on-site storage prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the Engineer.

C. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.

D. Deliver products to the site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting and installing.

E. All items delivered to the site shall be unloaded and placed in a manner which will not hamper the Contractor's normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic.

F. Provide necessary equipment and personnel to unload all items delivered to the site.

G. Promptly inspect shipment to assure that products comply with requirements, quantities are correct, and items are undamaged. For items furnished by others (i.e., Owner, other Contractors), perform inspection in the presence of the Engineer. Notify Engineer verbally, and in writing, of any problems.

H. If any item has been damaged, such damage shall be repaired at no additional cost to the Owner.

1.03 STORAGE AND PROTECTION

A. Store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor and reviewed with the Engineer by him/her. Instruction shall be carefully followed and a written record of this kept by the Contractor. Arrange storage to permit access for inspection.

B. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

C. Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural, miscellaneous and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs

vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in a manner to reduce breakage, cracking and spalling to a minimum.

D. All mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) shall be stored in a weathertight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Engineer. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer:

1. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.

2. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding." Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

3. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.

4. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

E. All paint and other coating products shall be stored in areas protected from the weather. Follow all storage requirements set forth by the paint and coating manufacturers.

END OF SECTION 01600

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SECTION01700
CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies administrative, verification and procedural requirements for project closeout, including but not limited to:

1. Project Record Documents Section 01720.

2. Spare parts and maintenance materials (spare paint, lubricants, special tools).

3. Record Shop Drawings Section 01300.

4. Warranties, guarantees, and bonds Section 01740 and applicable Sections in Technical Divisions.

5. Reconciliation of final accounting, final change order, final payment application (General Conditions) and Contractor's releases.

6. Permit close-outs including Certificate of Completion.

1.02 RELATED WORK

A. Operation and Maintenance (O&M) data and manuals Section 01730 and applicable Sections in Technical Divisions.

1.03 CLOSEOUT PROCEDURES

A. Provide all deliverables as specified, prior to submitting the final payment application.

B. Provide submittals to Engineer that are required by governing or other authorities having applicable jurisdiction including but not limited to permit close out information, certificates of occupancy, etc.

C. Submit Application for Final Payment identifying total adjusted Contract Sum, previous payments and sum remaining due, following submittal and approval of Record Documents and Record Drawings.

D. Submit Contractor's Final Release and Release of Liens with final payment application.

1.04 FINAL CLEANING

A. Contractor to complete final cleaning prior to submittal of the final application for payment.

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PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01700

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SECTION 01720
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall keep and maintain, at the job site, a copy of contract documents, marked up to indicate all changes made during the course of a project, as specified herein.

1.02 RELATED REQUIREMENTS

A. Record shop drawings as included in Section 01300.

B. Contract close-out submittals as included in Section 01700.

C. Operation and maintenance data as included in Section 01730.

D. Warranties and bonds as included in Section 01740.

1.03 REQUIREMENTS INCLUDED

A. Contractor shall maintain a record copy of the following documents, marked up to indicate all changes made during the course of a project:

1. Contract Drawings.

2. Specifications.

B. Contractor shall assemble copies of the following record documents for turnover to the Engineer at the end of the project, as specified:

1. Field Orders, Change Orders, and Design Modifications.

2. RFIs.

3. Field Test records.

4. Permits and permit close-outs (final approvals).

5. Certificate of Completion.

6. Laboratory test reports (e.g., bacteriological water quality).

7. Certificates of Compliance for materials and equipment.

8. Record Shop Drawings.

9. Samples.

10. Field survey of components using GPS as required in Section 01050.

C. Record Drawings:

1. The Contractor shall annotate (mark-up) the Contract Drawings to indicate all project conditions, locations, configurations, and any other changes or deviations that vary from the original Contract Drawings. This requirement includes, but is not limited to, buried or concealed construction, and utility features that are revealed during the course of construction. Special attention shall be given to recording the locations (horizontal and vertical) and material of all buried utilities that are encountered during construction – whether or not they were indicated on the Contract Drawings. The record information added to the drawings may be supplemented by detailed sketches, if necessary, clearly indicating, the Work, as constructed.

2. These annotated Contract Drawings constitute The Contractor's Record Drawings and are actual representations of as-built conditions, including all revisions made necessary by change orders, design modifications, requests for information and field orders.

3. Record drawings shall be accessible to the Owner and Engineer at all times during the construction period.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS AND SAMPLES

A. Maintain documents in a clean, dry, legible, condition and in good order. Do not use record documents for construction purposes.

B. Make documents and sample available for inspection by the Engineer or Owner at all times.

3.02 MARKING METHOD

A. Use the color *Red* (indelible ink) to record information on the Drawings and Specifications.

B. Label each document "PROJECT RECORD" in neat large printed letters.

C. Unless otherwise specified elsewhere, notations shall be affixed to hardcopies of documents.

D. Record information contemporaneously with construction progress.

E. Legibly mark drawings with as-built information:

1. Elevations and dimensions of structures and structural elements.

2. All underground utilities (piping and electrical), structures, and appurtenances:
   a. Changes to existing structure, piping and appurtenance locations.
   b. Record horizontal and vertical locations of underground structures, piping, utilities and appurtenances, referenced to permanent surface improvements.
   c. Record actual installed pipe material, class, size, joint type, etc.

3.03 RECORD INFORMATION COMPILATION

A. Do not conceal any work until the required information is acquired.

B. Items to be recorded include, but are not limited to:

1. Location of internal utilities and appurtenances concealed in the construction – referenced to visible and accessible features.

2. Field changes of dimensions and/or details:
   a. Piping relocations.
   b. Appurtenance relocations.

C. Changes made by Field Order, Change Order, design modification, and RFI.

D. Details not indicated on the original Contract Drawings.

E. Specifications – legibly mark each Section to record:

1. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually installed.

2. Changes made by Field Order, Change Order, RFI, and approved shop drawing.

3.04 SUBMITTAL

A. Monthly applications for payment will be contingent upon up-to-date Record Drawings. If requested by the Engineer or Owner, Contractor shall provide a copy of the Record Drawings, or present them for review prior to processing monthly applications for payment.

B. Upon substantial completion of the Work and prior to final acceptance, the Contractor shall finalize and deliver a complete set of Record Drawings to the Engineer conforming to the construction records of the Contractor. The set of drawings shall consist of corrected and annotated drawings showing the recorded location(s) of the Work. Unless specified otherwise elsewhere, Record Drawings shall be in the form of a set of prints with annotations carefully and neatly superimposed on the drawings in red.

C. Upon substantial completion of the Work and prior to final acceptance, the Contractor shall finalize and deliver a complete set of Record Documents to the Engineer conforming to the construction records of the Contractor. The set of documents shall consist of corrected and annotated documents showing the as-installed equipment and all other as-built conditions not indicated on the Record Drawings.

D. The information submitted by the Contractor into the Record Drawings and Record Documents will be assumed to be correct, and the Contractor shall be responsible for the accuracy of such information and shall bear the costs resulting from the correction of incorrect data.

E. Delivery of Record Drawings and Record Documents to the Engineer will be a prerequisite to Final payment.

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F. The Contractor shall maintain a copy of all books, records, and documents pertinent to the performance under this Agreement for a period of five years following completion of the contract.

END OF SECTION 01720

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SECTION 01730
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes procedural requirements for compiling and submitting operation and maintenance data required to complete the project.

1.02 RELATED WORK

A. Submittals are included in Section 01300.

B. Contract closeout is included in Section 01700.

C. Warranties and Bonds are included in Section 01740.

1.03 OPERATING MANUALS

A. Provide specific operation and maintenance instructions for all electrical, mechanical, and instrumentation & controls equipment furnished under various technical specifications Sections.

B. Separate manuals shall be provided for each type of equipment, or each Section number. Each manual shall contain the following:

1. Format and Materials:
    a. Binders:
        1) Commercial quality three ring binders with durable and cleanable plastic covers.
        2) Maximum ring width capacity: 3 inches.
        3) When multiple binders are used, correlate the data into related consistent groupings/volumes.
    b. Identification: Identify each volume on the cover and spine with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". Include the following:
        1) Title of Project.
        2) Identify the general subject matter covered in the manual.
        3) Identify structure(s) and/or location(s), of the equipment provided.
        4) Specification Section number.
    c. 20 lb loose leaf paper, with hole reinforcement.
    d. Page size: 8-1/2 inch by 11 inch.
    e. Provide heavy-duty fly leafs (section separators), matching the table of contents, for each separate product, each piece of operating equipment, and organizational sections of the manual.
    f. Provide reinforced punched binder tab; bind in with text.
    g. Reduce larger drawings and fold to the size of text pages - but not larger than 11 inches x 17 inches - or provide a suitable clear plastic pocket (with drawing identification) for such folded drawings/diagrams.

2. Contents:
    a. A Table of Contents/Index divided into section reflective of the major components provided.

b. Specific description of each system and components.
c. Name, address, telephone number(s) and e-mail address(es) of vendor(s) and local service representative(s).
d. Specific on-site operating instructions (including starting and stopping procedures).
e. Safety considerations.
f. Project specific operational procedures and recommended log sheet(s).
g. Project specific maintenance procedures.
h. Manufacturer's operating and maintenance instructions – specific to the project.
i. Copy of each wiring diagram.
j. Copy of approved shop drawing(s) and Contractor's coordination/layout drawing(s).
k. List of spare parts and recommended quantities.
l. Product Data: Mark each sheet to clearly identify specific products and component parts and data applicable to installation. Delete inapplicable information.
m. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
n. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.
o. Warranties and Bonds, as specified in the General Conditions.

3. Transmittals:
   a. Prepare separate transmittal sheets for each manual. Each transmittal sheet shall include at least the following: Contractor's name and address, Owner's name, project name, project number, submittal number, description of submittal and number of copies submitted.
   b. Submittals shall be transmitted or delivered directly to the office of the Engineer, as indicated in the Contact Documents or as otherwise directed by the Engineer.
   c. Provide copies of transmittals (only, i.e., without copies of the respective submittal) directly to the Resident Project Representative.

C. Manuals for Equipment and Systems – In addition to the requirements listed above, for each System, provide the following:

1. Overview of system and description of unit or system and component parts. Identify function, normal operating characteristics and limiting conditions. Include legible performance curves, with engineering data and tests and complete nomenclature and commercial number of replaceable parts.

2. Panelboard circuit directories including electrical service characteristics, controls and communications and color-coded wiring diagrams as installed.

3. Operating procedures: include start-up, break-in and routine normal operating instructions and sequences; regulation, control, stopping, shut-down and emergency instructions; and summer, winter and any special operating instructions.

4. Maintenance Requirements:
   a. Procedures and guides for troubleshooting; disassembly, repair, and reassembly instructions.
   b. Alignment, adjusting, balancing and checking instructions.
   c. Servicing and lubrication schedule and list of recommended lubricants.
   d. Manufacturer's printed operation and maintenance instructions.
   e. Sequence of operation by instrumentation and controls manufacturer.

f. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.

5. Control diagrams by controls manufacturer as installed (as-built).

6. Contractor's coordination drawings, with color coded piping diagrams, as installed (as-built).

7. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams. Include equipment and instrument tag numbers on diagrams.

8. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.

9. Test and balancing reports, as required.

10. Additional Requirements as specified in individual product specification.

11. Design data for systems engineered by the Contractor or its Suppliers.

D. Electronic Transmission of O&M Manuals:

1. Unless otherwise approved by the Engineer, O&M manuals may not be transmitted by electronic means other than by CD-R, DVD-R or DVD+R single use recordable discs. Electronic O&M manuals shall meet the following conditions:
   a. The above-specified transmittal form is included.
   b. All other requirements specified above have been met, including, but not limited to, coordination by the Contractor, review and approval by the Contactor.
   c. The submittal contains no pages or sheets large than 11 x 17 inches.
   d. With the exception of the transmittal sheet, the entire submittal is included in a single file.
   e. Files are Portable Document Format (PDF) – with the printing function enabled.
   f. All scanned manufacturer's O&M manuals must be quality checked after scanning to ensure the page are not crooked and all information is legible.

2. When electronic copies are provided, transmit two hard copy (paper) originals to the Engineer with an electronic copy on CD-R, DVD-R or DVD+R.

3. The electronic copy of the O&M manual shall be identical in organization, format and content to the hard copies of the manual.

4. The electronic O&M Manual shall be bookmarked identically to the paper manual table of contents to allow quick access to information. Electronic submittals that require extensive scrolling will not be accepted. The document shall be indexed and searchable.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

A. Operation and maintenance manuals shall be delivered directly to the office of the Engineer, as follows:

1. Provide preliminary copies of each manual to the office of the Engineer, no later than 30 days following approval of the respective shop drawings.

2. Provide final copies of each completed manual prior to testing.

3. Provide a letter that grants the Engineer and Owner to the limited right to use and reproduce each manual (in it its entirety or any portion thereof) from the respective equipment manufacturer(s). Such limited right shall allow the Engineer and Owner to use each manual or and portion thereof for:
   a. The potential assembly of a comprehensive facility operation and maintenance manual for the sole benefit of the Owner; and
   b. Supplemental training of the Owner's personnel and operators, over and above the required vendor's training, regarding operation of the facility as a system.

B. The Engineer will review Operation and Maintenance manuals submittals for operating equipment for conformance with the requirements of the applicable specification Section. The review will generally be based on the O&M Manual Review Checklist appended to this Section.

C. If during test and start-up of equipment, any changes were made to the equipment, provide two hard copies of as-built drawings or any other amendments for insertion, by the contractor, in the previously transmitted final manuals. In addition, provide one revised electronic version including the as-built drawings and any other amendments. The manuals shall be completed, including updates, if any, within 30 days of start-up and testing of the facility.

3.02 VENDOR TRAINING/INSTRUCTIONS (TO OWNER'S PERSONNEL)

A. Before final initiation of operation, Contractor's vendors shall train/instruct Owner's designated personnel in the operation, adjustment, and maintenance of products, equipment and systems at times convenient to the Owner.

B. Unless specified otherwise under the respective equipment specification section, vendor training/instruction shall consist of eight hours of training for each type of equipment. Such training/instruction shall be scheduled and held at times to accommodate the work schedules of Owner's personnel, including splitting the required training/instruction time into separate sessions and/or presented at reasonable times other than the Contractor's "normal working hours" or the Owner's normal day shift.

C. Use operation and maintenance manuals as basis for instruction. Train/instruct the Owner's personnel, in detail, based on the contents of manual explaining all aspects of operation and maintenance of the equipment. If the respective equipment is inter-related to the operation of other equipment, all interlock, constraints, and permissives shall be explained.

D. At least two weeks prior to the schedule for vendor training, a detailed lesson plan, representative of the material to be covered during instruction, shall be submitted to the

Engineer for approval. Lesson plans shall consist of in-depth outlines of the training material, including a table of contents, resume of the instructor, materials to be covered, start-up procedures, maintenance requirements, safety considerations, and shut-down procedures.

E. Prepare and insert additional data in each Operation and Maintenance Manual when the need for such data becomes apparent during training/instruction.

F. Vendor's training/instruction will be considered acceptable based on the completed Owner's Acknowledgement of Manufacturer's Instruction as indicated on the Equipment Manufacturer's Certification of Installation, Testing, and Instruction appended to this Section.

END OF SECTION 01730

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O&M Manual Review Checklist

Submittal No.: _____

Project No.: _____

Manufacturer: _____

Equipment Submitted: _____

Specification Section: _____

Date of Submittal:

	General Data	
1.	Are the area representative's name, address, e-mail address and telephone number included?	
2.	Is the nameplate data for each component included?	
3.	Are all associated components related to the specific equipment included?	
4.	Is non-pertinent data crossed out or deleted?	
5.	Are drawings neatly folded and/or inserted into packets?	
6.	Are all pages properly aligned and scanned legibly?	
7.	Is the .PDF document bookmarked according to the table of contents?	
	Operations and Maintenance Data	
8.	Is an overview description of the equipment and/or process included?	
9.	Does the description include the practical theory of operation?	
10.	Does each equipment component include specific details (design characteristics, operating parameters, control descriptions, and selector switch positions and functions)?	
11.	Are alarm and shutdown conditions specific to the equipment provided on this project clearly identified? Does it describe possible causes and recommended remedies?	
12.	Are step procedures for starting, stopping, and troubleshooting specific to the equipment provided included?	
13.	Is a list of operational parameters to monitor and record specific to the equipment provided included?	
14.	Is a proposed operating log sheet specific to the equipment provided included?	
15.	Is a spare parts inventory list included for each component?	
16.	Is a lubrication schedule for each component specific to the equipment provided included - or does it clearly state “No Lubrication Required"?	
17.	Is a maintenance schedule for each component specific to the equipment provided included?	
18..	Is a copy of the warranty information included?	

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Review Comments

Is the submittal fully approved (yes/no)? _____

If not, the following points of rejection must be addressed and require resubmittal by the Contractor:

Item No.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14, _____
15. _____

Reviewed By: _____ Date: _____

Legend

1 = Acceptable

2 = Not Adequate

3 = Not Included

Note: This submittal has been reviewed for compliance with the Contract Documents.

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SECTION 01740
WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1.02 RELATED WORK

A. Refer to Conditions of Contract for the general requirements relating to warranties and bonds.

B. General closeout requirements are included in Section 01700 – Project Closeout.

C. Specific requirements for warranties for the work and products and installations that are specified to be warranted are included in the individual Sections.

1.03 SUBMITTALS

A. Submit in accordance with the submittal procedures included in Section 01300.

B. Submit written warranties to the Owner prior to the date fixed by the Engineer for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the work, or a designated portion of the work, submit written warranties upon request of the Owner.

C. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner for approval prior to final execution.

D. Refer to individual Sections for specific content requirements, and particular requirements for submittal of special warranties.

E. At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1.04 WARRANTY REQUIREMENT

A. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

B. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefited from use of the work through a portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the contract Documents.

F. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers and subcontractors required to countersign special warranties with the Contractor.

1.05 DEFINITIONS

A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01740

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SECTION 11248
LIQUID POLYMER SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and install, place in operation, and field test the polymer system equipment as specified herein.

B. Furnish one (1) new polymer blending unit with progressive cavity pump, motors and controls, including all integral piping, valves, fitting, pipe supports, special equipment and appurtenances in accordance with these specifications, including all incidental work necessary to make it complete satisfactory and ready for operation.

C. The metering pump shall provide a 20:1 range and the dilution water control system shall provide a 10:1 range. If necessary, after start-up and polymer testing performed by others, the polymer system manufacturer shall make the necessary adjustments to the polymer metering pump and the water control system to meet the application requirements within the operating ranges above.

D. This Section is intended to give a general description of what is required but does not cover all details which may vary in accordance with the exact requirements of the equipment as offered. It is, however, intended to cover the furnishing, delivery, installation and field testing of all materials, equipment and apparatus as required. Furnish and install all additional auxiliary equipment necessary for the proper operation of the proposed installation not mentioned in this Section or shown on the Drawings.

1.02 RELATED WORK

A. Instrumentation and control work, except as specified herein, is included in Division 13. Instrumentation and controls provided in this section shall adhere to Instrumentation and Control Specifications Sections in Division 13.

B. Electrical work, except as specified herein is included in Division 16.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, copies of all materials required to establish compliance with this Section. Submittals shall include the following for each equipment item:

1. Complete description, including power requirements, materials, sizes, capacities, performance, and operating ranges.

2. Certified shop and erection drawings, including piping and flow schematics, showing all details of construction, dimensions, anchor bolt locations, and pipe and electrical connections.

3. Descriptive literature, bulletins and/or catalogs of the equipment.

4. Calculations for sizing the polymer preparation system.

5. The empty and operating weight of each item of equipment.

6. A total bill of materials for all equipment.

7. Description of factory finishes.

8. Expanded drawings showing numbered parts.

9. Data demonstrating compatibility of all wetted components with solution and emulsion polymers.

10. Complete master piping and wiring diagrams, elementary or control schematics and suitable control panel outline drawings and instrumentation systems.

11. Manufacturer's certificate of guarantee for the polymer make-up system, mixers, pumps and tanks.

12. Complete detailed operation and maintenance data, including drawings, storage requirements, startup requirements, repair procedures, diagnostics, and routine adjustments and maintenance.

13. Recommended lubricants and application intervals and procedures.

14. A list of manufacturer’s recommended spare parts to be supplied in addition to those specified herein.

B. Certificates

1. Provide certificate of compliance with Quality Assurance requirements of Paragraph 1.05.A. and B. if an unnamed manufacturer is provided.

C. Operation and Maintenance Data

1. Operating and maintenance instructions shall be furnished to the Engineer. The instructions shall be prepared specifically for this installation and shall include all required diagrams, cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such systems, including adjustments, trouble-shooting, diagnostics, testing, lubrication, preventative maintenance, and overhaul.

D. In the event that it is impossible to conform with certain details of this Section, describe completely all non-conforming aspects and explain why conformance is not appropriate.

1.04 QUALITY ASSURANCE

A. All of the equipment furnished under this Section shall be the product of manufacturers who are fully experienced, reputable and qualified in the manufacture of the system components to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods.

B. All equipment and controls specified in this Section shall be furnished by a single supplier who shall assume full responsibility for the proper operation of the complete systems.

C. Provide the services of a factory representative, who has a complete knowledge of the proper operation and maintenance, for three days to instruct representatives of the Owner and the Engineer on proper operation and maintenance of the equipment. This work may be conducted in conjunction with the inspection of installation and test run as specified in PART 3. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, provide additional service at no additional cost to the Owner.

D. Provide services, as required in Specification 01730, of manufacturer's technician(s) who are specifically trained on the type of equipment to be furnished under this Section. Submit qualifications of the technician(s) for approval. Man-day requirements listed below are minimums, are exclusive of travel time and do not relieve the Contractor of his obligation to provide sufficient services to supervise the erection, field testing, startup and operation of the equipment furnished under this Section.

1. Installation: Assist in locating equipment, setting, leveling, aligning, etc., for installation, in coordinating new and existing connections, and in supervising the installation.
   a. 1 visit of 1 man-day per visit

2. Field testing and startup: Provide written certification that the installation is complete and operable in all respects, and that no conditions exist which may affect the warranty. Provide a written report summarizing test procedures and tested and measured variables.
   a. 1 visit of 1 man-day per visit

3. Operation and maintenance (O&M). Provide field and classroom instruction on operation and maintenance of the equipment, including startup, shut-down, operation, troubleshooting, lubrication, maintenance and safety.
   a. 1 visit of 1 man-day per visit
      1) This service is exclusive of the assistance to the Contractor in checking installation, adjusting, and testing the systems.
   b. The instruction period shall be scheduled at least 10 days in advance with the Owner and shall take place prior to acceptance by the Owner. The final copies of operation and maintenance manuals specified in Section 01730 must have been delivered to the Owner prior to scheduling the instruction period with the Owner.
   c. Provide, in accordance with the provisions of Section 01730, one copy of a DVD produced during the O&M instruction sessions specified above, covering all aspects of operation and maintenance of the equipment, including startup, shutdown, operation, troubleshooting, lubrication, maintenance and safety.

1.05 SYSTEM DESCRIPTION

A. Liquid polymer blending unit: The unit shall draw concentrated liquid polymer from a tote using a variable-speed feed pump in the unit; control an adjustable flow of dilution water into the unit; mix the polymer and dilution water initially in a high-energy mixing zone and transfer the diluted polymer under pressure into a solids feed pipe. Polymer blend units will be used as follows:

1. Dewatering Centrifuge solids feed conditioning: The polymer blend system will dilute concentrated polymer from a tote and feed directly into a polymer injection point located directly upstream of the centrifuge feed tube.

B. The polymer dilution and feed system shall be capable of effectively activating and fully blending with water a homogenous polymer solution ranging from 0.1 to 1 percent concentration of emulsion polymers with active contents up to 75 percent.

C. Concentrated Polymer

Polymer Type:	Emulsion
Viscosity	up to 75,000 cps
Polymer Activity (percent active):	30 to 75
Solution Concentration Range (percent):	0.1 to 2
Neat Polymer Flow Range:	0.75 to 15 gph

D. Dilution Water

Inlet rate:	240 to 2400 gph
Inlet pressure:	0-160 psi
Source:	Ambient Temp. Potable Water

1.06 DELIVERY, STORAGE AND HANDLING

A. All pumps, mixers, control panels, and appurtenances shall be maintained in weatherproof, heated storage from delivery to the site until final acceptance. The Contractor shall provide such storage separately from any plant building prior to equipment installation. All equipment and parts shall be properly protected against any damage during a prolonged period at the site.

B. All equipment shall be properly crated to protect any and all components from damage during shipment.

C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

D. Finished surfaces of all exposed flanges shall be protected by wooden blank flanges, strongly built and securely bolted thereto.

E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

F. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

G. No shipment shall be made until approved by the Engineer in writing.

H. Inspection: Accept materials on Site in manufacturer’s original packaging and inspect for damage.

1.07 MAINTENANCE

A. Furnish one set of special tools for normal maintenance.

B. Furnish all spare parts required to ensure normal operation and preventive maintenance for a period of 12 months. As a minimum, the following shall be provided for the polymer feeder unit:

1. One set of all gaskets.

2. One polymer feed pump – complete.

3. One mixing chamber.

4. One mixing motor and impeller (if required).

C. Provide to the Owner a list of all spare and replacement parts with individual prices and locations where they are available. Prices shall remain in effect for at least 1 year after final Contract acceptance.

1.08 WARRANTY

A. The equipment shall be warranted for a period of two years from date of substantial completion as defined under the General Conditions, Division 0, to be free from defects in workmanship, design or material. If the equipment should fail during the warranty period due to a defective part(s), it shall be replaced in the machine and the unit(s) restored to service at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 GENERAL

A. Manufacturers; Models

1. Velodyne: VeloBlend Series VM-15P-2400-Rp-1-A-2.

2. UGSI ChemFeed: dynaBLEND® L6S-2400-15PCN-I5-3-TFS-420OUT.

3. ProMinent: ProMix M SG 1200X2-10.0PA System.

4. Or Approved Equal, which shall meet these specifications in full.

2.02 POLYMER MAKE-UP SYSTEMS

A. The following material requirements shall be strictly adhered to:

1. System skid shall be 304 stainless steel.

2. Hardware shall be Type 18-8 stainless steel.

3. Piping and fittings shall be Schedule 80 PVC.

4. Tubing and tube fittings shall be polyethylene, polypropylene, stainless steel and Viton.

5. Water solenoid valve shall be brass.

6. Pressure gauges shall be stainless steel, liquid filled.

7. Pressure switches shall have a brass connection.

8. Neat Polymer Flow sensor shall be acrylic, stainless steel, PVC and/or polypropylene.

9. Water control valve shall be PVC or stainless steel.

10. Mixing chamber body shall be PVC, 304 stainless steel, or acrylic.

11. Impeller shall by 304 stainless steel, or brass, if used.

12. Impeller shaft seal shall be Viton, stainless steel, ceramic, carbon, if used.

13. Mixing chamber pressure relief valve shall be brass, stainless steel or PVC.

14. Metering pump wetted parts shall be stainless steel and Viton.

15. Seals shall be Viton, ceramic, Teflon and/or carbon.

16. Control enclosure shall be 304 stainless steel or FRP.

2.03 EQUIPMENT

A. Polymer Activation and Blending Chamber (Velodyne Design)

1. A high-velocity hydro-mechanical polymer activation and blending device shall be provided with multi-stage and multi-zone technology.

2. The device shall be provided with both a non-mechanical and mechanical mixing stage:
   a. Non-Mechanical Stage: The device shall be capable of activating and blending polymer based on plant water pressure alone (pressure as indicated herein for Dilution Water). Polymer shall be injected directly into a high velocity, high energy water jet by means of an injection quill positioned such that the non-mechanical mixing energy is no way diminished prior to polymer and water contact. The non-mechanical zone shall be designed such that the velocity of the mixing energy-producing water jet is maintained or increases as flow decreases.
   b. Hydro-Mechanical Mixing Stage: In addition, the device shall be capable of producing its mixing energy independent of plant water pressure through a variable intensity, controllable stainless steel mechanical mixer. The mixing impeller shall be fully controllable and capable of inducing ultra-high, non-damaging mixing energy at all flow rates. This shall be accomplished by controlling mixing intensity and preventing over exposure to, or damaging recirculation through the impeller. The polymer mixing impeller shall be designed to produce both axial and radial flow to optimize mixing effectiveness and to effectively inducing high, non-damaging mixing energy over the systems full flow range with pressure as indicated herein for Dilution Water.
   c. Mixers that rely solely on plant water pressure and or flow for mixing energy will not be acceptable. Mixers where performance is affected by flow rate and therefore retention time resulting in under or over exposure to mixing energy, or which rely on

constant speed impellers or that rely on close tolerances for blending shall not be acceptable.

3. In order to prevent polymer build-up, the mixing chamber shall maintain high velocity in the entire chamber – at no time shall there be low velocity within any portion of the mixing chamber.

4. The mixing impeller shall be controlled by an SCR motor controller and driven by a wash-down duty motor. The motor shall be mounted horizontally or above the mixing chamber. Motors mounted under the mixing chamber where seal failure or leaks can damage the motor shall not be acceptable.

5. The mixer drive shaft shall be sealed by a mechanical seal which shall have an integrally mounted and factory plumbed seal flush. A drain port behind the seal shall be provided in the mixing chamber to drain the polymer solution in case of a seal failure. The seal shall be easily accessible for replacement. Systems without a seal flushing system shall not be considered. All bearings shall be external from the mixing chamber. Internal bearings shall not be acceptable.

6. Both mechanical and non-mechanical mixing zones shall be clear polycarbonate to view the mixing action and blending effectiveness. Acrylic chambers prone to becoming brittle over time and cracking, or opaque pipe shall not be acceptable to meet this requirement.

7. The mixing chamber shall have a maximum rated pressure of 100 psi. Provide a pressure relief on the mixing chamber factory set at 75 psi.

8. Provide a neat polymer check valve specifically designed to isolate neat polymer from dilution water. The valve shall be designed with an open, unobstructed path to the valve seat. The minimum open area of the valve seat shall be 3/16” without exception. The valve body shall be constructed of Teflon or PVC with Viton seals. The valve poppet and spring shall be stainless steel. The spring shall be outside of the polymer flow path to prevent build-up and plugging. The locking pin used to hold the valve in place shall be attached to the mixing chamber with a lanyard. The valve shall be readily accessible for cleaning and shall not require tools for removal, cleaning or replacement. Conventional check valves, valves that rely on ball seals, and or check valves that are installed inside the mixing chamber, or which require mixing chamber disassembly for servicing will not be accepted.

B. Polymer Activation and Blending Chamber (USGI)

1. A non-mechanical hydrodynamic blending device specifically designed to dilute and activate emulsion, dispersion and solution type polymer with viscosities up to 75,000 cps. and active contents up to 75%, shall be provided.

2. The liquid polymer activation chamber's mixing energy shall be staged such that it provides for high, non-damaging mixing energy over the full operating range of the system which then dissipates through concentric chambers. The integral water control device, which shall also produce mixing energy by creating a pressure drop across its orifice, shall be constructed of stainless steel and brass and shall be designed to allow orifice replacement without disassembly of any other part of the system. The system shall be designed for use with either potable or non-potable dilution water.

3. A mixing chamber drain valve with ½-inch fitting shall be provided and plumbed to the nearest floor drain. The mixing chamber shall have a maximum rated pressure of 150 psi.

4. Provide a bronze, adjustable-range pressure relief valve on mixing chamber with a range of 50 to 175 psi.

5. At no time shall polymer be exposed to excessive shear. System's which are "retention time dependent," a system which is prone to induce insufficient or excessive mixing energy depending on flow rate and the subsequent retention time in the mixing chamber, or which utilize conventional static mixers, mixing blocks, eductors, or flash mixers, shall not be considered. All components that require periodic maintenance shall be readily accessible.

6. Provide a neat polymer check valve specifically designed to isolate neat polymer from dilution water. The valve shall be designed with an open, unobstructed path to the valve seat. The valve body shall be constructed of Teflon and the ball shall be stainless steel. The valve shall be readily accessible for cleaning and shall be easily disassembled. Conventional check valves, and or check valves that are installed inside the mixing chamber, or which require mixing chamber disassembly for servicing will not be accepted.

C. Polymer Activation and Blending Chamber (ProMinent Design)

1. Polymer and water shall be mixed in a chamber designed to create sufficient mixing energy.
   a. The chamber shall contain a minimum of three distinct chambers. Dual or single mixing chamber designs shall be unacceptable.
   b. The design shall include a motor-driven impeller that will create high fluid sheer at point of polymer and water introduction. Systems that solely use a hydraulic means to activate polymer shall not be accepted.
   c. Polymer solution shall undergo a tapered mixing intensity slope as it exits the initial sheer zone and passes through a second, and third mixing zones isolated by baffles.
   d. Each chamber shall contain Polymer activation efficiency consistent over the entire dilution water range.

2. Mixing chamber shall be opaque to prevent solution degradation from ultraviolet light and to inhibit the growth of algae in the chamber. Clear or translucent mixing chambers shall be unacceptable.

D. Neat Polymer Metering Pump

1. Each unit shall have one (1) neat polymer progressive cavity pump integrally mounted on the systems skid. The metering pump(s) shall have a range as specified herein. The pump shall be a positive displacement, progressive cavity type constructed of stainless steel and Viton. The pump seal shall be packing type. Mechanical seals shall not be used. A 90 VDC wash-down duty motor shall drive the pump. A gear reducer shall be provided to produce a maximum pump shaft speed of not more than 545 RPM. The motor shall be controlled by an SCR motor controller located in the NEMA 4X system control panel.

2. Provide a calibration column with two full port PVC ball valves having Viton o-rings. The column shall be calibrated for a one-minute draw-down and read in GPH and milliliters. Provide clear PVC as material, with slip-on cap, and NPT vent connection of ½ inch.

3. Provide an optical or thermal dispersion type loss of polymer flow sensor.

4. The pump shall be mounted to the frame with a stainless steel bracket which positions the pump suction off the base to maintain ideal pump suction conditions.

5. All controls and equipment necessary to provide a complete and operating system apart from what is mentioned here shall be provided by the manufacturer, this also includes the controls from the machine control panel.

E. Dilution Water System

1. The dilution water flow rate shall be monitored by a paddle type flow meter having the range as specified herein. Unions or flanges shall be provided on the flow meter to allow easy removal for cleaning. The flowmeter shall be mounted in the vertical configuration.

2. The unit shall have an electric solenoid valve for on/off control of total dilution water flow.

3. The unit shall have a linear actuated variable rate control valve to automatically proportion water flow to polymer flow for polymer / water ratio control.

4. A differential pressure type low water differential pressure alarm shall be provided. The switch shall be adjustable between 25 and 100 psig. Proof pressure shall be 500 psi minimum. The pressure switch shall be as manufactured by Ashcroft.

5. Provide a 2-1/2-inch stainless steel liquid filled pressure gauge to monitor dilution water inlet pressure.

F. Solution Discharge Assembly

1. Provide a 2-1/2-inch stainless steel liquid filled pressure gauge to monitor system discharge pressure

2. Provide a swing type check valve to prevent back flow (loose item). The check valve shall be sized for the total solution flow of the system, constructed of PVC and Viton. Contractor may elect to install the swing check valve just downstream of the polymer system solution discharge.

G. Controls

1. Provide a NEMA 4X Control Panel including a control power transformer and rotary style disconnect.

2. The control panel shall utilize an Allen Bradley Micrologix 1400 Series PLC.

3. Provide the following control panel integral to the system’s frame.

4. The enclosure shall be rated NEMA 4X and constructed of 304 stainless steel or FRP. The control panel shall consist of all digital displays, potentiometers, switches, lights, relays, and other control devices required for a complete operable system. The control panel and all components shall be industrial duty. All skid mounted electrical components interconnected to the control panel shall terminate at numbered and labeled terminal blocks. The terminal blocks shall be sized for 14 ga. wire. Wires shall be neatly run

through wire raceway and numbered with shrink tubing type labels. Adhesive labels shall not be used. The control panel shall be positioned such that there are no obstructions in front of the control panel per related NFPA requirements. Control.

5. Power: 120 / 1 / 60 Hz.

6. A circuit breaker or fuses on the main control circuit and on each motor shall be provided as manufactured by Allen Bradley or equal. Fuses shall not be used for circuit protection.

7. A controller shall be provided including a 5.7" TFT touch screen.

8. Operator Interface features:
    a. LOCAL / REMOTE start/stop mode select:
        1) LOCAL start/stop mode: System shall run based on operator input from touch panel start/stop push-button.
        2) REMOTE start/stop mode: System shall start and stop according to the state of remote dry contacts (closed = run, open = stopped).
        3) MANUAL / WATER MASTER / PACED POLY RATIO operational mode select.
    a. MANUAL mode: The desired water flow is set manually using increase/decrease pushbuttons on touch panel. The desired polymer flow is set manually using increase/decrease pushbuttons on touch panel. Solution concentration defined by water and polymer settings.
        1) MANUAL mode run screen features:
            a) Water control increase/decrease pushbuttons.
            b) Water flow rate (GPH) display.
            c) Polymer control increase/decrease pushbuttons
            d) Polymer flow rate (GPH) display.
            e) Solution concentration (% poly) display.
            f) Total solution flow rate (GPH)
            g) WATER MASTER mode:
                - Desired water flow is set manually using increase/decrease pushbuttons on the touch panel.
                - Polymer flow adjusts automatically to maintain operator desired solution concentration. Desired solution concentration is adjusted manually using increase/decrease pushbuttons on touch panel.
        2) WATER MASTER mode run screen features:
            a) Water control increase/decrease pushbuttons.
            b) Water flow rate (GPH) display.
            c) Polymer flow rate (GPH) display.
            d) Solution concentration control increase/decrease pushbuttons.
            e) Solution concentration (% poly) display.
            f) PACED POLY RATIO mode:
                - Water flow adjusts automatically to maintain operator desired solution concentration.
                - Polymer flow paced by remote 4-20mA (supplied by others).
                - Desired solution concentration adjusted manually using increase/decrease pushbuttons on touch panel.
        3) PACED POLY RATIO mode run screen features:
            a) Water flow rate (GPH) display.
            b) Remote pacing signal level (mA)

c) Polymer flow rate (GPH) display.
d) Solution conc. Control increase/decrease pushbuttons.
e) Desired solution concentration (% poly) display.
f) Solution concentration (% poly) display.

4) Inputs (signals by others):
   a) Remote Start / Stop (discrete dry contact)
   b) Pacing Signal Based on Process Flow (4-20mA)
5) Outputs:
   a) System Running (discrete dry contact)
   b) Remote Mode (discrete dry contact)
   c) Common Alarm (discrete dry contact)
   d) Polymer Pump Rate (4-20mA)

H. System Skid

1. The system's frame shall be of rugged 304 stainless steel construction. No mild steel shall be used. All piping shall be rigidly supported.

2. Under no circumstance shall the pump suction exceed 5” from the bottom of the skid.

3. The overall system dimensions shall not exceed 36”W x 24”D X 68”H.

I. Skid Appurtenances

1. Pressure switch (NEMA 4X) on water inlet pipe for low pressure alarm and unit shut down.

2. Calibration column for concentrated polymer.

3. Rotameter for dilution water flow rate, which should be mounted in the vertical orientation.

4. Loss of polymer flow sensor interlocked to shut system down on low/loss of polymer flow.

5. Discharge solution high pressure switch and gauge which will shut down the system on a high-pressure discharge.

6. Other appurtenances as recommended by the manufacturer

J. Performance

1. Units shall completely dilute and activate the concentrated polymer at the specified rates without significant degradation of the activated polymer molecules. The standard of performance shall be equal to that of a motor-driven, high-shear primary mixer and low-shear static secondary mixer.

PART 3 EXECUTION

3.01 SURFACE PREPARATION AND SHOP PRIME PAINTING

A. Surface preparation and shop painting shall be performed as part of the work of this Section and shall be as recommended by the Manufacturer.

B. Each pump and associated equipment shall be shop-primed and finished-coated in accordance with Manufacturer's standard practice prior to shipment. Color shall be selected by the Engineer and an adequate supply of touch-up paint shall be supplied by the Manufacturer.

C. All interior and exterior wetted surfaces of pumps and exterior of motor enclosure shall be thoroughly cleaned, dry and free of all rust, mill scale, grease, dirt, other foreign matter and supplied with Manufacturer's standard coatings meeting the requirements.

D. Machine surfaces that are not painted shall be protected by coating with a corrosive protective compound.

E. All nameplates shall be properly protected during painting.

3.02 INSTALLATION

A. Install each polymer make-up feed system in accordance with manufacturer's instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the recommendations of the manufacturer. Set anchor bolts in accordance with the shop drawing.

3.03 FIELD TESTING

A. The following shall be done by a qualified serviceman of the manufacturer of the equipment and accessories supplied.

1. Supervision: Checking the installation of all components before power is applied.

2. Check out: Placing the equipment into operation and making necessary adjustments.

3. Instruction: The manufacturer shall include one day to instruct Owner's personnel in the use, operation and maintenance of all the equipment.

B. Working under the direction of the manufacturer's representative, conduct in the presence of the Engineer, such tests as are necessary to indicate that each item of equipment conforms to this Section. Supply all electric power, water and polymer to complete the field tests.

C. If the performance of any item of equipment does not meet the specified requirements, take corrective measures or remove and replace the unit with one which satisfies the conditions specified. A two-hour operating period of each item of equipment will be required before acceptance. During this two-hour operating period, supply all power and water necessary.

END OF SECTION 11248

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SECTION 11306
SUBMERSIBLE SOLIDS HANDLING PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install, and place in operation the submersible wastewater pumps shown on the Drawings and specified herein. The equipment to be furnished and installed shall be as shown on the Drawings and shall include pumps, motors, and appurtenances, all tested and ready for operation.

B. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment as offered. It is, however, intended to cover the furnishing, factory testing, delivery and complete installation of all materials, equipment and appurtenances for the complete pumping units as herein specified, whether specifically mentioned in these Specifications or not.

C. Pump motors, cables and appurtenances shall be rated for operation in a Class I Division 1, Group D hazardous environment.

1.02 RELATED WORK

A. Submittals are included in Section 01300.

B. Operation and maintenance is included in Section 01730.

C. Warranties are included in Section 01740.

D. Electrical work is included in Division 16.

1.03 SYSTEM DESCRIPTION

A. Pumps will pump return activated sludge (RAS). The equipment to be furnished under this Section shall include three submersible wastewater pumps to be installed in the RAS/WAS Pumping Station wet well, motor, and accessories, all as specified herein and as shown on the Drawings.

1.04 QUALIFICATIONS

A. To assure unity of responsibility, the pumps and motors and other auxiliary equipment, and materials specified in this Section shall be furnished and coordinated by the pump manufacturer who shall assume responsibility for the satisfactory operation of the entire pumping system including pumps, motors, and accessories.

B. The pumps and other equipment covered by this Specification shall be standard production units of the manufacturers, currently available and listed in the respective manufacturer's catalog. The pumps furnished shall be in accordance with the Hydraulic Institute Standards and shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

C. All equipment furnished under this Specification shall be new and unused, shall be the standard product of manufacturers having a successful record of manufacturing and servicing similar equipment and systems to that specified herein for a minimum of five years.

D. The pumping equipment shall be furnished complete with accessories required and shall meet the detailed requirements of the Specifications.

1.05 SUBMITTALS

A. Copies of all materials required to establish compliance with the Specifications shall be submitted in accordance with the provisions of the General Conditions and Section 01300. Submittals shall include at least the following:

1. Shop and erection drawings showing all important details of construction, dimensions and anchor bolt installation requirements.

2. Descriptive literature, bulletins, and/or catalogs of the equipment. Sufficient data shall be submitted to document previous production of each pump model proposed for use on this Contract.

3. Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves to ANSI/HI 11.6 acceptance grade 1U, based on actual factory tests of similar units, which show that they meet the specified requirements for head, flow rate, efficiency, NPSH3, submergence and horsepower. Curves shall be submitted on 8-1/2-inch by 11-inch sheets, at as large a scale as is practical. Curves shall be plotted from zero flow at shut off head to pump flow rate at minimum specified total head (TH). The POR and AOR (refer to ANSI/HI 9.6.3) shall be clearly shown on the curves. Catalog sheets showing a family of curves will not be acceptable.

4. The total weight of the equipment including the weight of the single largest item.

5. Complete wiring diagrams and schematics of all power and control systems showing wiring requirements between all system components, motors, sensors, and related systems.

6. A complete total bill of materials of all equipment.

7. A list of the manufacturer's recommended spare parts to be supplied, with the manufacturer's current price for each item. Include gaskets, seals, etc. on the list. List bearings by the bearing manufacturer's numbers only.

8. All submittal data required by the General Conditions.

9. Complete motor data, including, but not limited to:
   a. Type of enclosure design.
   b. Rated horsepower.
   c. Rated voltage.
   d. FLA.
   e. Starting current.
   f. LRA.
   g. LR KVA.
   h. NEMA starting code letter and insulation code letter.

i. RPM.
j. Input power in kW at nameplate rating.
k. Starting calculations.
l. Cable size.
m. Efficiency at 50%, 75% & 100% load, and power factor at 50%, 75% & 100% load.
n. Power and control cable size and materials of construction, details of cable sealing method, description and type of motor thermal protection, description of insulation system and service factor.

10. Certified agreement to the conditions of the warranty.

11. Submit description of factory test plan including test procedures and equipment.

12. Submit for approval results of factory testing.

B. In the event that the equipment offered does not conform with all of the detailed requirements of the Specifications, describe completely all nonconforming aspects. Failure to describe any and all deviations from the specifications will be cause for rejection.

1.06 OPERATING INSTRUCTIONS

A. Operating and Maintenance Manuals shall be furnished. The manuals shall be prepared specifically for equipment furnished and installed on this Contract and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment. The number and special requirements shall be as specified in the Section 01730.

B. The Contractor shall include in his bid price the services of a pump factory representative for two four hour sessions. The first period shall be to inspect for proper installation. The second period shall be to instruct the Owner’s personnel for proper operation and maintenance of the pumps.

C. The Manufacturer shall provide detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.

1.07 TOOLS AND SPARE PARTS

A. The Manufacturer shall furnish a complete list of recommended spare parts, gaskets, lubricants and sealants necessary for the first five years operation of each pumping system.

1.08 PRODUCT HANDLING

A. All equipment and parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of fabrication, including storage in accordance with Manufacturer’s requirements until final delivery to the job site.

B. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

C. Finished surfaces of all exposed pump openings shall be protected by wooden blanks, strongly built and securely bolted thereto or by other approved means.

D. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

E. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

F. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.09 WARRANTY

A. All equipment supplied under this section shall be warranted for a period of one year by the Contractor and the Manufacturer. Warranty period shall commence on the date of Owner acceptance, as outlined in Division 1 and in Division 0.

B. In addition, Manufacturer shall warrant the pump/motor for a period of five years, prorated after the initial 1.5 years. This Manufacturer warranty duration includes the warranty period identified above and as outlined in Divisions 1 and 0.

C. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the Owner.

D. The Manufacturer 's warranty period shall run concurrently with the Contractor 's warranty period. No exception to this provision shall be allowed.

E. Refer to Section 01740 for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hidrostal: Model F-10K-MD

B. No Or equal allowed.

2.02 GENERAL

A. The pumping units required under this Section shall be complete including pumps and motors with proper alignment and balancing of the individual units. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the work to be done. Ample room shall be provided for inspection, repairs, and adjustments.

B. Stainless steel nameplates giving the name of the manufacturer, the rated flow rate, head, speed, and all other pertinent data shall be permanently attached to each pump and motor. Additional stainless steel nameplates shall be provided to be installed by the Contractor at an acceptable above grade location as instructed by the Engineer such that the pumps do not need to be removed to gather the information.

C. The pumps shall be totally submersible, solids handling, rotodynamic pumps with immersible close coupled motors designed to pump raw wastewater. The design shall be such that the pumping units shall be automatically connected to the discharge piping when lowered into place on the discharge connection, providing a water tight seal. The pumps shall be designed to be easily removed from their discharge connections and the wet well for inspection or service. Lifting the pumps from their discharge connections or the wet well shall require neither the removal of any bolts, nuts or other fastenings nor the need for personnel to enter the pump well.

2.03 CONDITIONS OF OPERATION

A. Each pump shall be designed for the conditions of service tabulated as follows and shall operate within the system head curve envelope as appended. All pumps with specific speed less than 4,500 (US units) shall have a continuously rising head performance curve for stable pump operation from the minimum head operating point to the shut-off head. For pumps where specific speed is greater than or equal to 4,500, the intersection of the pump head and system head curves shall be used to demonstrate stable operation.

B. The pumps shall operate throughout the entire operating range with the maximum vibration velocity in inches per second RMS unfiltered, measured in the field, shall be less than the requirements of ANSI/HI 11.6-latest edition.

C. Each pump shall be designed for the conditions of operation tabulated as follows.

Item Description	Design Conditions
Number of Pumps	3
NominalMotor Full Load Speed (FLS) (rpm)	1140
Maximum Allowable Motor (HP)	19.2
Motor Design Voltage/Phase/Frequency	460/3/60
Maximum Anticipated Pumped Fluid Temperature (degrees F.)	70
Minimum Pump Discharge Size (inches)	10
Minimum Pump Shut-Off Head at Motor FLS (feet)	48.7
Maximum Primary TH (feet)	18.7
Minimum Flow Rate at Primary TH (gpm)	1900
Minimum Hydraulic Efficiency at Primary Flow Rate (%)	77
Minimum Size Solids Passing (inches)	4.5
Maximum NPSHA at Primary TH (feet)	8.5

D. Each pumping unit and its driving equipment shall be designed and constructed to withstand the maximum turbine run-away speed of the unit due to back flow through the pump.

2.04 PUMP CONSTRUCTION

A. The basic design shall be a single-passage, clog-free pump, utilizing a screw-centrifugal impeller. The overall pump design shall combine high efficiency, low required NPSH, a large solid passage, and the ability to handle rags or other fibrous material without plugging.

B. The hydraulic design of the impeller shall combine the action of a positive displacement screw with the action of a single-vane centrifugal impeller to provide a single, non-bifurcated flowstream with only gradual changes in flow direction.

C. The pump volute, backplate, suction cover, and impeller flange shall be of closed-grained cast iron, ASTM A45-CL30. The impeller shall be of High Chrome: ASTM A532-CL.III Type A. The impeller liner shall be of High Chrome Iron: ASTM A532-CL.III Type A, minimum 450 Brinell hardness. All external bolts and nuts shall be type 316 stainless steel.

D. The leading edge of the impeller vane shall blend into the impeller body in such a way that any rag or other fibrous material caught on the leading edge and folded over both sides of the vane will be unfolded and released as the textile follows the flowstream through the pump.

E. The impeller flange or impeller shall contain a spiral groove on the rear face so that any solids in the pumped media are discharged from the space between the backplate and the rear of the impeller.

F. In order to maintain optimum running clearances along the entire length of the impeller to maintain design hydraulic efficiencies, the geometry of the impeller and suction liner shall be conical, so any axial adjustment of the suction liner will cause the clearance between the impeller and suction liner to change uniformly along the entire length of the impeller. Designs incorporating curved, or combination curved/conical impeller and suction liner are not acceptable because in such designs clearances cannot be adjusted uniformly over the full length of the impeller.

G. Each pump shall be provided with a balanced tandem mechanical shaft seal system. The upper (inner) of the tandem set of seals shall operate in an seal lubricant chamber located just below the stator housing. At a minimum, this set shall contain one stationary silicon carbide and one positively driven rotating carbon ring and shall function as an independent secondary barrier between the pumped liquid and the stator housing. The lower (outer) of the tandem set of seals shall function as the primary barrier between the pumped liquid and the stator housing. This set shall consist of a stationary ring and a positively driven rotating ring, both of which shall be either tungsten carbide or silicon carbide. Each interface shall be held in contact by its own Hastelloy-C® or Elgiloy® spring system. The seal body shall be Type 316 stainless steel. The o-rings shall be FKM (Viton)®.The seals shall require neither maintenance or adjustment, but shall be easily inspected and replaceable. Seal design shall provide pressure applied to the outside diameter of the face. Shaft seals with conventional double mechanical seals containing either a common single or double spring acting between the upper and lower units are not acceptable nor equal to the dual independent seal specified.

H. The minimum pump discharge size, shall be the minimum allowable nominal diameter of the discharge piping, as shown on the Drawings, except as allowed otherwise by this specification. Unless otherwise noted, the diameter of the opening at the connection between the pump and the discharge should normally be the same as the minimum specified discharge size.

I. Each pump shall be fitted with a Type 316 stainless steel lifting cable and a short piece of suitably sized Type 316 stainless steel chain between the bail and cable. The lifting cable and chain shall be rated for five times the pump weight (minimum). The lifting cable and chain combined length shall be equal to the wet well depth (top slab finished grade to wet well bottom) plus six feet to permit raising the pump for inspection and removal.

2.05 SUBMERSIBLE MOTORS

A. Pump motors shall be housed in an air filled, water-tight casing, and shall have Class F or better non-hygroscopic insulated windings which shall be moisture resistant. Oil filled motor housing

is not acceptable for motors greater than 15 HP. The motors shall be suitable for use withVFDs. The motor stator shall be dipped and baked three times in a VPI process and heat shrunk fitted into the stator housing. As an alternative, trickle impregnation method may be used for motor stator windings. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. Motors shall be NEMA Design B, equipped with a 1.15 service factor, as defined in the NEMA MG1 standard, based upon the nameplate horsepower rating for across-the-line service. A service factor of 1.0 will be acceptable when driven by a VFD (non-sinusoidal power supply). The motor insulation system shall be rated at 155ºC or better. Motor shall be capable to operate in an ambient temperature of 40ºC continuously with Class B temperature rise. The motor shall be NEMA Starting Code G or H, or better. Motors shall be non-overloading and capable of sustaining a minimum of ten starts per hour. Motors shall be provided with a minimum power factor of 0.80 at full load. Pump and motor shall be of the same manufacturer.

B. Thermistors shall be provided on pump motors that run continuously in a partially or non-submerged condition. Three thermistor type thermal sensors embedded in the stator windings, wired in parallel, will send a signal to an external relay, which will open a protective circuit if winding temperature exceeds rated operating temperature of 140ºC. Upon tripping, the external relay must manually reset and the cause of the overheating investigated before the motor can be returned to operation. When the motor is operated on VFD, thermistor type thermal protection must be used.

C. The pump motor shall incorporate a closed-loop cooling circuit with an integrated cooling pump rated for continuous duty in a completely dry mode; as well as; in a fully submerged condition without damage. The cooling jacket shall be cast iron ASTM A48 class 30 or steel. The coolant pump impeller shall be mounted directly on the motor shaft between the tandem mechanical seals to circulate coolant fluid into the top inter-space between the cooling jacket and motor housing, over the surface of the motor, through ducts in the bearing housing and into a casing heat exchanger. Heat losses from the motor shall be transferred to the fluid pumped in the casing heat exchanger, which forms a structural unit together with the discharge cover of the pump. After passing through the volute-casing heat exchanger, the coolant shall return to the suction side of the internal coolant pump (impeller). Coolant shall be an environmentally safe glycol based antifreeze or an environmentally safe food grade oil rated for use down to temperatures of minus 20ºC (minus four degrees Farinheight). Fans, blowers or auxiliary cooling systems that are mounted external from the pump motor enclosure are not acceptable.

D. When applied in wet pit application, the pump motors shall be designed so that the pump will be capable of running continuously in a totally dry condition under full load without damage for a cleaning cycle (15 minutes maximum). Pump motor shall be non-overloading within the range of operation between shutoff and the low head run-out conditions shown on the pump conditions of operation data table above. For pumps where specific speed is greater than or equal to 4,500, the range from the pump head and system head curves intersection point and low-head run out conditions shall be used to demonstrate non-overloading over the range of operating conditions.

E. The pump/motor shaft shall be constructed of type 416, 420 or type 431 stainless steel. When operating at the pump design point, the shaft shall have a maximum deflection of 0.2 mm at the lower seal face and a maximum deflection of 0.45 mm at the wear ring area. The shaft shall rotate on permanently lubricated ball bearings properly sized to withstand the axial and radial forces. The ABMA Minimum L-10 bearing life shall be at least 30,000 hours rated at the pump BEP.

F. The pump motor with its appurtenances and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet. All mated surfaces shall be machined, fitted with O-rings for watertight sealing.

G. The pumps shall be provided with a cable entry design that shall preclude specific torque requirements to insure a water tight and submersible seal. The cable entry shall be certified by UL or FM to have passed pull-testing requirements. The cable entry junction chamber and motor shall be separated by a stator lead, sealing gland or terminal board, which shall isolate the motor interior from foreign material gaining access to the pump motor top. The cable entry system shall be field serviceable. The power and control cable entry into the lead connection chamber may also be epoxy encapsulated for positive moisture sealing. A BUNA-N cable grommet shall be provided in addition to the epoxy sealed leads.

H. Cables, Conduits and Accessories

1. The pumps shall be supplied with power and sensor conductors. Pump motor cables shall be sized to meet applicable NEC requirements. The cable shall consist of a type SPC or SEOW insulated cable with a double jacketed protection system. The cable shall have a neoprene or chlorinated polyethylene outside and synthetic rubber inside, and shall exceed industry standards for oil, gas and sewage resistance. Individual conductors shall be of type RUW. Pump cables shall be provided of sufficient length, 50 ft. minimum, so that the cables may be continuous between the pump and the disconnect with no splices if feasible.

2. If more than one cable is being provided per pump, the Contractor shall furnish and provide for the installation of the additional conduits, etc. as required for each additional cable. Only one cable per conduit will be allowed at the pump station. Conduit sized per manufacturers recommendations but not smaller than 3/4-inch.

3. Contractor shall furnish all required stainless steel conduit hardware and fittings.

4. Conduit seals shall be equal to Crouse-Hinds Type "EYS."

5. Coordinate the installation of the above materials with the Manufacturer.

I. Seal Failure Monitor

1. Seal failure indication shall be provided for each pump on the operator display. Voltage or current sensing relays as required by the pump manufacturer shall be provided to sense seal failure.
   a. The use of general purpose relays or neon lights for seal monitoring is specifically prohibited.
   b. Seal Fail relays shall be Warrick 17A1GO
   c. Intrinsically Safe

J. Motor Overtemperature

1. Motor Over-temperature indication shall be provided for each pump on the operator display. The alarm light shall remain on and the pump shall not be allowed to restart until the motor has cooled and the reset button has been pressed.

2.06 SHOP PAINTING

A. Each pump and associated equipment shall be shop-primed and finished-coated in accordance with the Manufacturer's standard practice prior to shipment. Color shall be selected by the Engineer and an adequate supply of touch-up paint shall be supplied by the Manufacturer.

B. All interior and exterior wetted surfaces of pumps and exterior of motor enclosure shall be thoroughly cleaned, dry and free of all rust, mill scale, grease, dirt, other foreign matter and supplied with Manufacturer’s standard coatings.

C. All nameplates shall be properly protected during painting.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the Manufacturer’s instructions and recommendations in the locations shown on the Drawings. The Contractor shall furnish all required oil and grease for initial operation, if required, in accordance with the Manufacturer 's recommendations. Anchor bolts shall be set in accordance with the Manufacturer 's recommendations.

B. Upon completion of each pump application, the Manufacturer shall inspect the installation and submit a certificate stating that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.02 INSPECTION AND TESTING

A. General

1. The Engineer shall be notified in writing prior to initial shipment and/or testing, in ample time so that arrangements can be made for inspection by the Engineer.

B. Factory Pump Test

1. All pumps shall receive a non-witness factory test.

2. The Manufacturer shall factory test all pumps prior to shipment in accordance with the Hydraulic Institute standards, latest version. Flow rate, total head and Input KW shall be tested and recorded for at least five points on the pump performance curve. Test shall be performed to demonstrate that the pumps meet ANSI/HI 11.6 acceptance grade 1U for all specified points. The five points shall include all of the points specified herein.

3. The Manufacturer shall perform hydrostatic test on the pressure-containing parts in accordance with ANSI/HI 11.6. Test shall be conducted on each pump prior to shipment.

4. The Manufacturer shall perform the following test on each pump prior to shipment from factory:
   a. Megger motor and pump for insulation breaks or moisture.
   b. Prior to submergence, the pump shall be run dry and checked for correct rotation.

c. Pump shall be run for a minimum of 30 minutes in a submerged condition.
d. The pump shall be removed from test tank, meggered immediately for moisture and upper and lower seal unit shall be checked for water intrusion.
e. A written certification test report regarding the above tests shall be submitted for approval prior to shipment.

C. Field Pump Test

1. The Manufacturer shall furnish the services of a representative with complete knowledge of proper operation and maintenance to inspect the final installation and supervise the test run of the equipment.

2. Written test procedures shall be submitted to the Engineer for approval 30 days prior to testing.

3. The Contractor shall furnish all water, power, facilities, labor, materials, supplies and test instruments required to conduct the field testing.

4. The Final Acceptance Test shall demonstrate that all items of these Specifications have been met by the equipment as installed and shall include, but not be limited to, the following tests:
   a. That the quick release lift out feature functions properly and allows the pump to be raised and lowered without draining the pit.
   b. That all units have been properly installed and are in correct alignment.
   c. The Contractor shall check for correct lubrication in accordance with manufacturer's instructions. The Contractor shall check direction of rotation of all motors and reverse connections, if necessary.
   d. That the units operate without overheating or overloading any parts and without objectionable vibration.
   e. That there are no mechanical defects in any of the parts.
   f. That the pumps can deliver the specified total head and flow rate to demonstrate that the pumps generally meet the requirements specified (factory performance test is the basis of pump acceptance).
   g. That the pump sensors and controls perform satisfactorily as to sequence control, correct start and stop elevations, and proper level alarm functions.

5. If the pump performance does not meet the specifications, corrective measures shall be taken or pumps shall be removed and replaced with pumps which satisfy the conditions specified.

6. A five-day continuous operating period of the pumps will be required before acceptance. If pumping system fails during the test period, the test shall be restarted (including reset of time to zero) after repair (or replacement) has been completed.

END OF SECTION 11306

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SECTION 11314
SCREW IMPELLER CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and install, complete and ready for operation screw impeller centrifugal pumps as shown on the Drawings and specified herein.

B. Electric motors shall be furnished as part of the work of this section and shall conform to all applicable portions of Section 01171.

1.02 RELATED WORK

A. Mechanical piping, valves, pipe hangers and supports are included in the respective sections of Division 15.

B. Instrumentation is included in Division 13.

C. Electrical work is included in Division 16.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, copies of all materials required to establish compliance with the specifications. Submittals shall include the following:

1. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.
2. Descriptive literature, bulletins, and catalogs of the equipment.
3. Data on the characteristics and performance of the pump. Data shall include guaranteed performance curves, based on actual shop tests of duplicate units, which show that they meet the specified requirements for head, capacity, efficiency, allowable NPSH, allowable suction lift, and horsepower. Curves shall be submitted on 8 1/2-in by 11-in sheets.
4. The total weight of the equipment including the weight of the single largest item.
5. A complete total bill of materials for all equipment.
6. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, packing, etc. on the list. List all bearings by the bearing manufacturer's numbers only.
7. All information required by Division 1.
8. A statement indicating bearing life.
9. Complete data on motors in accordance with Section 01171.
10. Complete description of surface preparation and shop prime painting.
11. Factory performance test data as specified in Part 2.

B. In the event that it is impossible to conform with certain details of the specifications because of different manufacturing techniques, describe completely all nonconforming aspects.

C. Submit manufacturer's certification of installation as specified in Part 3.

1.04 QUALITY ASSURANCE

A. All pumps shall be manufactured in accordance with all applicable standards of the Hydraulic Institute.

B. The Drawings and Specifications have been based upon the pumping equipment of Hidrostal LLC Aurora, IL.

1.05 DESCRIPTION OF SYSTEMS

A. All the equipment specified herein is intended to be standard equipment for pumping thickened solids as described below:

1. Recirculating sludge to and from digesters.
2. Solids concentration in the pumped liquid shall be between 1 percent and 6 percent for all applications.

B. The pump shall be as follows:

1. Digester Recirculation Pump #2
   a. Model E5K-LM4R+E2M1 by Hidrostal LLC Aurora, IL.
   b. No Or Equal Allowed.

C. The pump shall be designed for the conditions of service as shown in Table 11314-1.

1.06 OPERATING INSTRUCTIONS

A. Copies of an operating and maintenance manual shall be furnished to the Engineer as provided for in Section 01730. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, description, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include trouble shooting data and full preventative maintenance schedule.

B. A factory representative who has complete knowledge of proper operation and maintenance shall be provided for two days to instruct representatives of the Owner and the Engineer on proper operation and maintenance. This work may be conducted in conjunction with the inspection of the installation and test run as provided under Part 3. If there are difficulties in operation of the equipment because of the manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. The listed service requirements are exclusive of travel time and shall not limit or relieve the Contractor of the obligation to provide sufficient service necessary to place the equipment in satisfactory and functioning condition.

1. Start-Up: Complete review of installation. Provide written certification that the installation is complete and operable in all respects, and that no conditions exist which may affect the warranty. Provide written report, summarizing test procedures, tested and measured variables (flows, pressures, shaft-speed, vibration measurements, alignment check, etc.):
   a. One, eight-hour day
2. Field and classroom instruction on operation and maintenance of the equipment, including start-up, shut-down troubleshooting, lubrication, maintenance and safety.
   a. One, eight-hour day.

b. The Contractor alone shall be responsible for requesting these services and shall coordinate these requests with all other relevant trades, to assure the effectiveness of the manufacturers' service. In the event that the lack of coordination by the Contractor results in the need to recall the service representative, the lost time shall not be counted against the above days.

1.07 TOOLS AND SPARE PARTS

A. One set of all special tools required for normal operation and maintenance shall be provided.

B. The following spare parts shall be provided:

1. One double mechanical seal for each pump.
2. One complete sets of gaskets, "O"-rings, etc. for each pump.
3. Two shaft sleeves.
4. In addition, furnish a list of all spare and replacement parts available for the equipment, with a curved price list. The list of prices shall hold firm for the Owner for one year.
5. One impeller and lock nut.

1.08 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage, and handling of equipment shall be in accordance with Section 01600 and as specified herein.

B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the unit and equipment are ready for operation.

C. All equipment and parts shall be properly protected against any damage during shipment. The Contractor shall store equipment in accordance with the manufacturer's instructions.

D. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

E. The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank flanges, strongly built and securely bolted thereto.

F. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

G. No shipment shall be made until approved by the Engineer in writing.

H. For protection of bearings during shipment and installation, the bearing shall be properly processed. Anti-friction bearings, if pre-lubricated, shall be protected in accordance with the bearing manufacturer's recommendations against formation of rust during a long period of storage while awaiting completion of installation and start-up of the machine in which they are used. Anti-friction bearings which are not pre-lubricated shall be properly treated in accordance with the bearing manufacturer's recommendation against formation of rust during a long period of storage while waiting completion of installation and start-up by the application of Exxon Rust-Ban No. 392, or equal treatment.

1.09 WARRANTY

A. Section 01740 – Warranties and Bonds: Product warranty requirements.

B. Provide manufacturer's warranty for pumping system.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General

1. The equipment covered by this section is intended to be standard pumping equipment of proven ability as manufactured by reputable concerns having long experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods, and shall operate satisfactorily when installed as shown on the Drawings.
2. All parts shall be so designed and proportioned as to have liberal strength, stability and stiffness and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs, and adjustment.
3. Pump bases shall be rigidly and accurately anchored into position and all necessary foundation bolts, plates, nuts, and washers shall be installed by the Contractor in accordance with the installation requirements of the equipment manufacturer. Anchor bolts, nuts, and washers shall be of Type 304 stainless steel.
4. Stainless steel nameplates giving the name of the manufacturer, the rated capacity, head, speed, and any other pertinent data shall be attached to each pump.
5. The nameplate ratings for the motors shall not be exceeded, nor shall the design service factor be reduced when its pump is operating at any point on its characteristic curve.
6. The manufacturer shall supply all motors and factory mount them on a common base plate with the pumps.
7. Pumps and pump bases shall have suitable provisions to collect leakage and permit it to be drained away.

B. Screw Impeller Centrifugal Pumps

1. The pumps shall be of the vertical, heavy duty, clog free, single suction, helical screw centrifugal, dry pit type.
2. The pumps shall incorporate an impeller which combines the action of a positive displacement screw and a single vane centrifugal impeller. The design shall permit low liquid velocities and gradual acceleration and change of flow direction of the pumped media. The impeller/casing design shall result in a single helical passage free of surfaces to which solid or fibrous material can adhere. The overall pump design shall combine high efficiency, low required NPSH, large passageways, and the ability to efficiently handle high concentrations of fibrous soft solids.
3. The pump casing shall be of close grain grey iron, ASTM A48, Class 30. The casing shall be end type suction and vertical up discharge. Suction and discharge shall have ANSI 125 lb. standard flanges. The casing shall be equipped with all necessary vents and drain connections. The casing and bearing frame shall be of the back-pull-out design to allow

disassembly of the pump without disturbing the piping. The suction casings shall incorporate a replaceable high chrome iron suction liner of minimum 450 Brinell Hi-Chrome iron, ASTM A532. The clearance between the impeller and liner or casing/ cone shall be externally adjustable. The geometry of the impeller and housing or liner shall be conical, so that axial adjustment will adjust the clearance uniformly along the entire length of the impeller.

4. The impeller shall be of 450 Brinell, high chrome iron ASTM A532, and statically and dynamically balanced. The impeller shall be mounted on an impeller flange by means of a pinned and registered fit at the periphery. The impeller shall be secured by an impeller bolt. The impeller flange shall be secured to the shaft by a nut and woodruff key. The impeller flange shall have a machined eccentric spiral groove on the rear face such that any solids in the pumped media are discharged from the space between the bearing housing and the rear of the impeller.

5. The pump shaft shall be AISI C1045 or better, or rolled forged steel, amply proportioned for all thrusts and moments which may occur during operation at all speeds. The shaft shall be protected throughout the stuffing box by a removable 11 to 13 percent chrome hardened stainless steel or 316 stainless steel shaft sleeve. An O-ring or other approved means shall be used to prevent leakage between the shaft and sleeve. The shaft sleeve shall be easily removable, snug fitting, and positively secured to the shaft so as to prevent relative rotation.

6. The bearing housing shall be of cast grey iron, ASTM A48. The pump shaft shall be supported on radial and thrust bearings, designed for an ABMA B-10 life of 40,000 hours. Bearings shall be grease lubricated, and suitable provisions shall be made for re-greasing, unless bearings are permanently sealed. Bearings shall be enclosed in a dust and moisture proof housing. Refer to Section 01600 concerning protection of bearings during shipment and storage, and prior to start-up.

7. The seal housing shall be cast integrally with the back head, readily accessible and its construction shall permit the use of mechanical seal. Seals shall be factory installed.
    a. Mechanical seals shall be double mechanical type equipped with ceramic stationery and carbon rotating seal faces.
    b. Tandem Mechanical Seal Arrangement requiring no external flush. Shaft sealing shall be by independently mounted, tandem mechanical seals contained in an oil chamber that is formed as an intrinsic part of the bearing frame and allows the seals to be completely submerged in and lubricated by the oil bath. Externally mounted oil reservoirs are not acceptable.
        1) The mechanical seal nearest the bearing shall utilize carbon/ceramic faces and shall isolate the seal cooling oil from the bearing frame. When mounted in a vertical configuration, this shall allow the pump to operate continuously submerged within 4" of the upper bearing cap.
        2) The mechanical seal nearest the impeller shall be a stainless steel or rubber bellows-type construction firmly attached to the rotating face and clamped to the shaft to prevent contaminants from contacting the stainless-steel spring which loads the seal face. The seal faces shall be a solid tungsten-carbide rotating face running against a solid silicon-carbide stationary face. Seals with both faces of similar materials, or seals with bonded, soldered, or converted face surfaces are not equal or acceptable.
        3) The mechanical seal nearest the impeller shall be contained in a seal chamber formed by the impeller flange and a recess cast into the motor frame. To prevent debris from entering the chamber and to prolong the mechanical seal life, a flush

port shall be provided so that an optional external water flush can be supplied directly into the seal chamber.

4) The mechanical seal nearest the impeller shall be isolated from contaminants in the pumped media by a labyrinth-fit between the backside of the impeller and the backplate, as well as by pump-out grooves cast into the impeller back shroud and into the backplate, to minimize debris reaching the shaft seal.
5) “Back to back" mounted double mechanical seals are not acceptable unless the contractor provides an approved seal pressurization system that guarantees the oil between the seals is always pressurized to at least 1-1/2 times the maximum shut-off head of the pump.
6) Seals requiring a water flush may be furnished in lieu of the non-flushed seal, provided the contractor furnishes, at no extra charge, all of the external auxiliary equipment necessary for the flushing system, including, but not limited to, stainless steel tubing, pressure gauge, flowmeter, shutoff and water supply isolation system, pressure regulator, and throttling valve.

C. Pump Drive Units

1. The pump and motor base shall be fabricated from steel, designed to provide rigid support of the pump and motor. Each base shall be furnished with suitable bolt and grout holes to facilitate mounting at site. Units shall be provided with V-Belts and sheaves to provide the required pump speed to meet performance conditions. Suitable OSHA guards are required.
2. Drive motors shall be totally enclosed fan cooled (TEFC) NEMA Design B, severe duty rated and as specified in Part 1 and Section 01171. The rated horsepower shall be such that the motors will not be overloaded, nor the service factor reduced when the pumps are operated at any point on the maximum speed performance curve.
3. Each pump shall be connected by V-Belt to its driver by means of a Falk, or equal all metal flexible coupling, suitably sized to transmit the required driving torque and to accommodate unavoidable shaft misalignment. All couplings shall be provided with removable coupling guards in conformance with OSHA.

2.02 SHOP PAINTING

A. Surface preparation and shop painting shall be performed as part of the work of this Section and shall be as recommended by the Manufacturer.

B. Each pump and associated equipment shall be shop-primed and finished-coated in accordance with Manufacturer’s standard practice prior to shipment. Color shall be selected by the Engineer and an adequate supply of touch-up paint shall be supplied by the Manufacturer.

C. All interior and exterior wetted surfaces of pumps and exterior of motor enclosure shall be thoroughly cleaned, dry and free of all rust, mill scale, grease, dirt, other foreign matter and supplied with Manufacturer’s standard coatings meeting the requirements.

D. Machine surfaces that are not painted shall be protected by coating with a corrosive protective compound.

E. All nameplates shall be properly protected during painting.

2.03 FACTORY INSPECTION AND TESTS

A. Factory performance testing shall be conducted in the manufacturer's shop, to show satisfactory mechanical operation of screw impeller pumps. Each pump shall be tested to show operation of the unit and hydraulic performance in strict accordance with the specifications. Tests shall be performed in accordance with the latest edition of the Hydraulic Institute Standards.

1. The Manufacturer shall factory test all pumps prior to shipment in accordance with the Hydraulic Institute standards, latest version. Flow rate, total head and Input KW shall be tested and recorded for at least five points on the pump performance curve. Test shall be performed to demonstrate that the pumps meet ANSI/HI 14.6, American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests, acceptance grade 1U for all specified points. The five points shall include the points specified herein. Pumps shall be run at shut-off. During each test, the pump shall be run at each head condition for sufficient time to accurately determine discharge, head, power input, and efficiency. The pump under test shall be modified until the foregoing conditions are met, and data approved by the Engineer.
2. Each pump assembly shall also be subjected in the shop to a hydrostatic test. The test pressure shall be not less than 50 percent above maximum speed shut-off head. Under this test pressure, no parts shall show undue deflection, leakage, or other defects. Any defects disclosed by this test shall be corrected only by methods accepted by the Engineer.
3. All test procedures shall be in accordance with factory test procedures specified above, and four copies of certified results of tests shall be submitted to the Engineer.
4. A failure of the pump meeting the operating requirements specified for any reason shall be considered an incomplete test. Upon correction of the problem causing failure, the pump shall be retested.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. Anchor bolts shall be supplied and set by the Contractor in accordance with the manufacturer's recommendations.

B. The pump bases shall be installed on concrete pads and shall be securely attached thereto. During installation, the pump bases shall be supported on shims and non-shrink grout shall be placed under the equipment base. After cure of the grout, the shims shall be removed and the voids cured with non-shrink grout, and the nuts on the anchor bolts shall be tightened securely. Nuts placed on the anchor bolts below the pump base plate shall not be allowed.

C. Submit a certificate from the manufacturer stating that the installation has been found to be in complete accordance with the manufacturer's requirements, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication, and care of the equipment. Field test shall not be conducted until such time that the entire installation is complete, the installation certificate is submitted and approved, and the units are ready for testing.

3.02 FIELD INSPECTION AND TESTING

A. Furnish the services of a factory representative for a minimum number of days as specified herein, who has complete knowledge or proper operation and maintenance to inspect the final installation and supervise a test run of the equipment.

B. After the pumps have been completely installed, the Contractor (working under the direction of the manufacturer) shall conduct in the presence of the Engineer, such tests as are necessary to indicate that pump efficiency and discharge conform to these Specifications.

C. Operate each pump for a minimum of four hours, during which time the head, flow, and power draw shall be recorded. Operate suction and discharge valves to simulate various head conditions. In-place flow meters and calibrated pressure gauges to be furnished by the Contractor shall be utilized to determine the pump operating characteristics. Assist the Engineer as required in taking all data. Pump performance, as determined by the field data, shall conform to the characteristics specified herein. Each pump shall operate without excessive noise, vibration, or overheating.

D. If any unit fails to fulfill the performance required by these specifications, corrective measures shall be taken by the Contractor and the units retested to assure full compliance with these Specifications. A revised written report shall be submitted to the Engineer.

E. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.

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TABLE 11311-1
DIGESTER SLUDGE RECIRCULATION PUMP NO. 2

PUMPING UNIT DESIGN REQUIREMENTS

Item Description	Design Conditions
Pumping Medium	Digested Sludge Recirculating in the Primary Digester and Secondary Digester
Constant Speed or VFD	Constant Speed
Number of Pumps	1
Maximum Motor Full Load Speed (rpm)	1,200
Maximum Allowed Motor (HP)	5
Motor Design Voltage/Phase to be Supplied	460/3
Maximum Anticipated Pumping Temperature (degrees F.)	100
Minimum Pump Discharge Size (inches)	5
Minimum Base Elbow Discharge Size (inches)	5
Minimum Pump Shut-Off Head at Design Speed (feet)	20
Secondary TH (feet)	29
Minimum Capacity at Secondary TH (gpm)	300
Minimum Overall Efficiency at Secondary TH (%)	65
Intermediate (Design) Capacity (gpm)	500
Minimum TDH at Intermediate (Design) Capacity (feet)	20
Minimum Overall Efficiency at Intermediate (Design) Capacity (%)	75.6
Maximum Primary TH (feet) – Runout Condition	16
Minimum Capacity at Primary TH (gpm)	600
Minimum Overall Efficiency at Primary Capacity (%)	75
Maximum NPSHR at Primary TH (feet)	8.7

Note that minimum overall efficiencies listed are pump efficiencies

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SECTION 11315
PROGRESSIVE CAVITY PUMP

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install a progressive cavity pump as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Training Requirements are included in Section 01730.

B. Operating and Maintenance Data is included in Section 01730.

C. Motors are included in Section 01171.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, the following:

1. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.

2. Descriptive literature, bulletins and/or catalogs of the equipment.

3. Data on the characteristics and performance of the pump. The data shall include guaranteed performance curves, based on actual shop tests of like pumping units, which show that they meet the specified requirements for head, capacity and horsepower. Curves shall be submitted on 8-1/2-in by 11-in sheets.

4. Complete data on motors and power factor correction capacitors in accordance with Section 01171.

5. Complete master wiring diagrams, elementary or control schematics, including coordination with other electrical control devices.

6. The total weight of the equipment, including the weights of the larger components.

7. A complete total bill of materials for all equipment.

8. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, etc. on the list. List bearings by the bearing manufacturer's numbers only.

9. Complete description of surface preparation and shop prime painting.

B. Operating and Maintenance Data

1. Operating and maintenance instructions shall be furnished to the Engineer as provided for in Section 01730. The instructions shall be prepared specifically for this installation and

shall include all cuts, drawings, equipment lists, descriptions, etc., that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

2. A factory representative who has complete knowledge of proper operation and maintenance of the pump shall be provided to instruct representatives of the Owner on proper operation and maintenance. See Section 01730. Provide training agenda and training materials per Section 01730.

1.04 QUALITY ASSURANCE

A. Should equipment that differs from the specified requirements be offered and determined to be equal to that specified, such equipment shall be acceptable only on the basis that any revisions in the layout and construction of the structures, piping, electrical, and appurtenant equipment, required to accommodate such a substitution shall be made at no additional cost to the Owner.

B. Pump, drive unit and motor shall be furnished by the pump manufacturer and be factory-mounted on a common base plate of cast iron or fabricated steel.

1.05 SYSTEM DESCRIPTION

A. All of the equipment specified herein is intended to be standard equipment designed for use in pumping thickened waste activated sludge (TWAS) from the thickened WAS tanks to the digesters for sludge transfer. The maximum expected solids concentration is seven percent. Each pump shall be designed for intermittent service.

B. Pump shall have a design capacity of 50 gpm at a maximum pressure of 35 psi.

C. The pump drive shall consist of a variable speed motor and gear box which shall be directly connected to the pump shaft through low speed coupling.

D. The pump shall be controlled locally and remotely for start-stop.

E. The pump motor shall be 5 Hp.

1.06 MAINTENANCE

A. Tools and Spare Parts

1. One set of all special tools required for normal operation and maintenance shall be provided.

2. The following spare parts shall be provided:
   a. One set of mechanical seals for each pump size.
   b. One complete set of gaskets for a pump.
   c. One rotor and one stator.
   d. One set (2 total) of shaft universal joints with seal kits.

1.07 WARRANTY

A. Section 01740 – Warranties and Bonds: Product warranty requirements.

B. Provide manufacturer’s warranty for pumping system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Moyno Industrial Products: 2000 Series Model 2E022G1.

B. No Or Equal Allowed.

2.02 MATERIALS AND EQUIPMENT

A. General

1. The equipment specified herein is intended to be pumping equipment of proven ability as manufactured by a reputable firm having experience in the production of such equipment. The equipment furnished shall be designed, constructed and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings.

2. All parts shall be so designed and proportioned as to have liberal strength and stiffness and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs and adjustment.

3. All necessary foundation bolts, plates, nuts and washers shall be furnished by the equipment manufacturer and shall be of Type 316 stainless steel. Minimum foundation bolt diameter shall be 3/4-in.

4. Stainless steel nameplates giving the name of the manufacturer, the rated capacity, head, speed and any other pertinent data shall be attached to the pump.

5. The manufacturer shall supply motor, factory-mounted to a common base plate with the pump.

6. The nameplate rating of the motor shall not be exceeded, nor shall the motor design service factor be reduced when its pump is operating at any point on its characteristic curve.

7. Pump and pump base shall have suitable provisions to collect leakage and permit it to be drained away.

B. Pump

1. Pump shall be heavy duty, positive displacement, two stage, progressive cavity type. The pump body shall be of thick-walled cast iron and shall incorporate two inspection ports 180 degrees apart. The pump shall be cradle mounted to permit the suction port to be rotated to any angle perpendicular to the centerline of the pump. Suction and discharge connections shall be six-inch, 125 lb ANSI cast iron flanged.

2. The pump rotor shall be machined of high carbon tool steel, hardened to a Rockwell "C" value of 50 to 56 and covered with a heavy layer of hard chrome plate at least 0.01-in thick for abrasion resistance.

3. The rotor shall rotate relative to a one-piece, Nitrile 100 rubber stator of approximate 70 Durometer hardness (Shore A) chemically bonded to its steel tube housing. The stator shall be arranged to prevent the pumped material from contacting the bonding or the tube.

4. The rotor shall be joined to the drive shaft by a carbon steel connecting rod and crowned-gear type, grease-lubricated, sealed universal joints of chrome alloy tool steel of adequate design to transmit the required thrust and torque while allowing the rotor to move through is eccentric path. The gear joint seals shall be clamped at both outside and inside diameters and recessed within heavy walled steel tubing to prevent damage by rags or other objects.

5. To maximize universal joint and seal life, the connecting rod operating angle shall not exceed 1-1/4 degrees off center. To minimize the moment of the transmitted radial force on the bearings and to minimize overall pump length, the connecting rod shall telescope within a hollow drive shaft and shall be attached to the drive shaft in close proximity to the bearings. This point of attachment shall not be more distant from the nearest bearing than the spacing between the two bearings. This method of drive shall minimize the shaft deflection in the stuffing box area.

6. The drive shaft shall be mounted in two ball or tapered roller bearings. The ABMA minimum B-10 life expectancy of the bearings shall be in excess of 100,000 hours at the maximum operating conditions specified herein. Fittings shall be provided for grease lubrication of the bearings.

7. The stuffing box shall be equipped with a double mechanical seal with tungsten carbide rotating faces and carbon stationary faces. Provide fluoroelastomer elastomers and 316 stainless steel gland. Seal flush water accessories shall be as shown on the Drawings by the installing contractor.

C. Motor

1. Motor shall be horizontal, totally enclosed, fan cooled, foot mounted, severe duty rated, NEMA Design B, of horsepower and speed as specified above and shall conform to Section 01171.

2. Provide a factory-installed winding temperature detector with leads terminating in the main conduit box. The winding temperature detector shall be normally open, bimetallic contacts, one per phase winding.

3. Provide a C-Faced Gear Reducer capable of handling the pump and motor loading with sufficient reduction to meet the pump required speed with the motor running at full speed. Reducer shall be sized to handle the full pump torque requirements with a 1.25 service factor.

4. The drive shall use a low speed direct coupling and shall come complete with guard in conformance with OSHA.

D. Base

1. The motor, drive and pump shall be mounted on a common base of welded steel or cast iron.

2.03 SURFACE PREPARATION AND SHOP PRIME PAINTING

A. Surface preparation and shop painting shall be performed as part of the work of this Section and shall be as recommended by the Manufacturer.

B. Each pump and associated equipment shall be shop-primed and finished-coated in accordance with Manufacturer's standard practice prior to shipment. Color shall be selected by the Engineer and an adequate supply of touch-up paint shall be supplied by the Manufacturer.

C. All interior and exterior wetted surfaces of pumps and exterior of motor enclosure shall be thoroughly cleaned, dry and free of all rust, mill scale, grease, dirt, other foreign matter and supplied with Manufacturer's standard coatings meeting the requirements.

D. Machine surfaces that are not painted shall be protected by coating with a corrosive protective compound.

E. All nameplates shall be properly protected during painting.

2.04 HIGH PRESSURE DISCHARGE SENSOR

A. Replace existing high pressure discharge sensors with new devices. Devices shall conform to Section 13340.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. The pump assembly shall be installed under supervision of a representative of the manufacturer supplying the equipment. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. Anchor bolts shall be set in accordance with the manufacturer's recommendations.

3.02 INSPECTION AND TESTING

A. Furnish the services of a factory representative for a minimum of two days who has complete knowledge of proper operation and maintenance to inspect the final installation and supervise a test run of the equipment.

B. After the pump has been completely installed, the Contractor, under the direction of the manufacturer's factory representative, shall conduct in the presence of the Engineer, such tests as are necessary to ensure that pump operation and performance conforms to the requirements specified. Pump shall be operated for at least 24 hours prior to test completion.

C. If the pump performance does not meet the specified requirements, corrective measures shall be taken, or pump shall be removed and replaced with pump which satisfies the conditions specified at no additional cost to the Owner.

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SECTION 13300
INSTRUMENTATION AND CONTROLS – GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall procure the services of Process Control System Supplier (PCSS) to furnish and install all materials, equipment, labor and services, required to achieve a fully integrated and operational system as specified herein, in the Specification Sections listed below, and in related drawings, except for those services and materials specifically noted.

1.

Section No	Title
13302	Testing
13303	Training
13305	Control Descriptions
13306	Application Engineering Services
13340	Instruments

B. **Process Control System Supplier for the Project shall be Tri-R Systems Incorporated, Dekalb, Illinois.**

C. Auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, shall be included whether they are shown on the Drawings or not.

D. All equipment and installations shall satisfy applicable Federal, State and local codes.

E. Use the equipment, instrument, and loop numbering scheme shown on the Drawings and specifications in the development of the submittals. Do not deviate from or modify the numbering scheme without the Engineer's approval.

1.02 RELATED WORK

A. Instrumentation and Controls conduit systems are specified in Section 16110.

B. Instrumentation signal cable and alarm and status wiring are specified in Section 16120.

C. Relevant equipment Sections in Divisions 11, 13, 15, and 16 with specific requirements called out.

1.03 SUBMITTALS

A. General Requirements:

1. Refer to Section 01300 for general submittal requirements.

2. Shop drawings shall demonstrate that the equipment and services to be furnished comply with the provisions of these specifications and shall provide a complete record of the equipment as manufactured and delivered.

3. Submittals shall be complete; giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature shall not be acceptable.

4. Substitutions on functions or type of equipment specified shall not be acceptable unless specifically noted.

5. Separate submittals shall be made for each submittal listed below.

B. Project Plan, Deviation List, and Schedule Submittal:

1. Submit, within 30 calendar days after Notice to Proceed, a Project plan. The Project Plan shall be submitted and approved before further submittals shall be accepted. The Project Plan shall, at a minimum, contain the following:
   a. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. A discussion of startup, replacement of existing equipment with new, switchover (Maintaining Plant Operations during system transition), approach to testing and training, and other tasks as required by these specifications shall be included as applicable.
   b. Preliminary list of HMI software, PLC software, and PLC hardware, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to beginning development of system programming. Review and approval of software and hardware systems as part of this Project Plan stage shall not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of manufacturer or model of these systems after the submittal is approved is not allowed without Engineer approval.
   c. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.
   d. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, loop, and I/O wiring diagrams.
   e. List of all graphics intended to be created for this project.
   f. List of all PLC programs that will be created or modified for this project.

2. Exceptions to the Specifications or Drawings shall be clearly defined in a Deviation List. The Deviation List shall consist of a paragraph by paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that an evaluation may be made by the Engineer. If no exceptions are taken to the specifications or drawings the PCSS shall make a statement as such. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.

3. Project schedule shall be prepared in Gantt chart format clearly showing task linkages for all tasks and identifying critical path elements. PCSS schedule must be based on the

General Contractor schedule and must meet all field installation, testing, and start-up milestones in that schedule. The project schedule shall illustrate I&C related major project milestones including the following:

a. Schedule for all subsequent project submittals. Include the time required for Contractor submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
b. Proposed dates for all project coordination meetings.
c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
d. Software purchasing and configuration (following approval of related submittals).
e. Shipment of instrument and control system equipment.
f. Installation of instrument and control system equipment.
g. Testing: Schedule for all testing.
h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and HMI server/workstation provided under this Contract.
i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.
j. Incorporate time constraints for AESS activities as defined in Section 13306.

C. Input/Output (I/O) List Submittal:

1. Submit, within 60 days after Notice to Proceed, a complete system I/O address list for equipment connected to the control system under this Contract.

2. I/O list shall be based on the P&ID's, the Drawings, the design I/O list (if included), and requirements in the Specifications.

3. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.

4. The I/O list shall reflect all active and spare I/O points. Add points to accommodate spare I/O as required in the specifications.

5. The I/O list shall be arranged such that each control panel has a dedicated worksheet. At a minimum, I/O worksheet shall include the following information:
   a. TAG NUMBER(S): As indicated on the Drawings, the identifier assigned to a device that performs a function in the control system. As part of this information, the loop number of the tag shall be broken out to allow for sorting by loop.
   b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
   c. PHYSICAL LOCATION: The Control Panel designation of where the I/O point is wired to.
   d. LOGICAL POINT ADDRESS: I/O address of each point.
   e. Physical POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
   f. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.
   g. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points are "1."

h. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
i. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
j. P&ID: the P&ID or drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.

6. The I/O list shall be sorted in order by:
   a. Physical location.
   b. I/O Type.
   c. Loop Number.
   d. Device Tag.

7. Once the I/O list is approved, the PLC I/O addresses shall not be modified without approval by the Engineer.

D. Field Instruments Submittal:

1. Refer to the Instruments section for submittal requirements.

E. Testing Plan Submittals:

1. Refer to Section 13302 for specific testing submittal requirements.

F. Training Plan Submittals:

1. Refer to Section 13303 for specific training requirements.

G. Spares, Expendables, and Test Equipment Lists Submittal:

1. Submit a list of, and descriptive literature for, spares, expendables, and test equipment.

2. Submit a list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the manufacturer.

3. Submit unit and total costs for the additional spare items specified or recommended for each subsystem.

H. Operations and Maintenance (O&M) Manuals:

1. Submit in accordance with Section 01730.

2. Furnish O&M manuals as specified herein. If the PCSS is performing the AE work, provide AE Manuals as specified in Section 13306.

3. The operations and maintenance manuals shall, at a minimum, contain the following information:
   a. Table of Contents:
      1) A Table of Contents shall be provided for the entire manual with the specific contents of each volume clearly listed. The complete Table of Contents shall appear in each volume.
   b. Instrument and Equipment Lists:

1) The following lists shall be developed in Microsoft Excel format and provided not only as a hardcopy in O&M but also electronically on a CD.
2) An instrument list for all devices supplied including tag number, description, specification section and paragraph number, manufacturer, model number, serial number, range, span, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
3) An equipment list for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, serial number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

c. Equipment Operations and Maintenance Information:
1) ISA-TR20.00.01-2001(updated in 2004-2006) data sheets shall be provided for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001(updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
2) Vendor O&M documentation for each device, piece of equipment, or OEM software shall be either new documentation written specifically for this project or modified standard vendor documentation. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or crossed out. Groups of pages that do not apply at all to the specific model supplied shall be removed.
3) Provide the record documentation of the system audit as specified in Section 13302 – Testing.
4) Include the calibration forms developed as specified in Section 13302 – Testing.

d. As-Built Drawings:
1) Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. These drawings shall include all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS.
2) As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.

e. Original Licensed Software:
1) Submit original software diskettes or CD-ROMs of all software provided under this Contract. Submit original paper based and electronic documentation for all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers and related information. All software provided under this Contract shall be licensed to the Owner at the time of purchase. Provide media in software sleeves within O&M manual.

f. Electronic O&M Information:
1) In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of

configuration files, on CDROM or DVD. Electronic documents shall be supplied in Adobe Acrobat format.

2) Provide electronic files for all custom-developed manuals including training manuals. Text shall be supplied in both Microsoft Office format and Adobe Acrobat format.
3) Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
4) Each computer system hardware device shall be backed up onto CDROM or DVD after Substantial Completion and shall be turned over to the Owner.
5) If specified in the training section, provide digital copies of all training videos. Videos shall be in a format that is readable by standard DVD players and by standard PC DVD drives. Format shall be a minimum of 800 by 600 pixels and shall include sound.

4. The cover and edge of each volume shall contain the information as specified in Section 01730.

1.04 COORDINATION MEETINGS

A. Schedule the mandatory coordination meetings as described herein. The meetings shall be held at the Owner's designated location and shall include attendance by the Owner, the Engineer, the Contractor, the PCSS's Project Engineer, and the AESS Project Engineer, if applicable. Other Division 13 specifications may require additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. Meeting shall be scheduled a minimum of one week before the requested meeting date.

1. A project kickoff coordination meeting shall be held within two weeks after submitting the Project Plan. The purpose of the meeting shall be to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. The meeting will last up to one business day.

2. A submittal review coordination meeting shall be held after the Hardware, Panel Drawing, and Loop Drawing Submittal package has been reviewed by the Engineer and returned to the PCSS. The purpose of this meeting shall be to review comments made on the submittal package; to refine scheduled deadline dates; coordinate equipment installation activities; and provide a forum for any further required coordination between the PCSS and AESS. The meeting will last up to one business day.

3. Regular on-site meetings when the PCSS staff is at the plant site.

1.05 REFERENCE STANDARDS

A. Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.

B. International Society of Automation (ISA):

1. ISA S5.2, Binary Logic Diagrams for Process Operations.

2. ISA S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.

3. ISA S5.4, Instrument Loop Diagrams.

4. ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

5. ISA RP60.3, Human Engineering for Control Centers.

6. ISA RP60.6, Nameplates, Labels, and Tags for Control Centers.

7. ISA-99, Industrial Automation and Control Systems Security.

C. National Electrical Manufacturers Association (NEMA).

D. National Fire Protection Agency (NFPA):

1. NFPA 70, National Electrical Code (NEC).

2. NFPA 79, Industrial Control Equipment.

E. Underwriters Laboratories, Inc. (UL):

1. UL 508 - Industrial Control Equipment - for custom fabricated equipment.

2. A nationally recognized testing laboratory, as approved by the Authority having jurisdiction, may substitute for UL listing on commercial off the shelf products.

1.06 QUALITY ASSURANCE

A. The Process Control System Supplier (PCSS) shall be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems integrator" shall be interpreted to mean an organization that complies with all of the following criteria:

1. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel shall hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel shall include, as a minimum, the lead field technician.

2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be for projects where the PCSS's contract was of similar size to this project.

3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.

B. The PCSS shall maintain a permanent, fully staffed and equipped service facility within 200 miles of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 4 hours of notification starting at two months before scheduled startup to two months after startup completion.

C. PCSS shall hold a valid UL-508 certification for their panel fabrication facility.

D. Actual installation of the instrumentation system need not be performed by the PCSS's employees; however, the PCSS as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.

E. The selected PCSS shall be one of the following:

TRI-R Systems Incorporated
1804 E. Lincoln HWY
DeKalb, IL 60115
PHONE: 815-787-0830

PCSS above is currently performing other upgrades at the Plant, therefore, no equal allowed to maintain panels and programming consistency.

1.07 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage, and handling shall be in accordance with Section 01600.

B. Shipping Precautions:

1. After completion of shop assembly, factory test and approval of all equipment, cabinets, panels and consoles shall be packed in protective crates and enclosed in heavy duty (5 mil) polyethylene envelopes or secured sheeting to provide protection from damage, dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at the job site.

2. Manufacturer's special instructions for field handling, storage and installation required for protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other means of protection.

3. None of the HMI control and monitoring equipment shall be shipped to the site until the control room areas comply with specified ambient temperature and humidity. Have qualified personnel accept the equipment on delivery and supervise unloading within the control room areas.

4. If any apparatus has been damaged, such damage shall be repaired at no additional cost to the Owner.

1.08 NOMENCLATURE AND IDENTIFICATION

A. Field Instrument Tags:

1. See Section 13340.

1.09 WARRANTY

A. Provide warranty per Section 01740 – Warranties and Bonds, and as specified herein.

1.10 MAINTENANCE CONTRACT

A. A written proposal for a maintenance contract executed by the PCSS shall be provided to the Owner for onsite preventive maintenance services related to the Instrumentation and Control system. The cost of this maintenance contract shall not be included in the Contract Price.

B. This proposal shall be provided within 30 days after final acceptance for the purpose of entering a contract for annual maintenance subsequent to the first year of maintenance. Standard per diem rates for providing breakdown service shall be set forth in the contract. Such rates shall be fair and reasonable and reflect the lowest rates offered to most favored customers. The fee quoted shall be firm for a minimum of 90 days from date of issue.

C. This maintenance contract shall include all labor, parts, and emergency calls providing on-site response within 24 hours, to provide complete system maintenance for a period of one year after the date of Substantial Completion of the system for all equipment and software provided as part of the PCSS scope of work.

D. Provide software updates throughout the maintenance contract period. Provide latest official released version for all software provided under this Contract. Owner shall have the latest software releases at the end of the maintenance contract period.

E. The maintenance contract shall also include a minimum of 4 preventive maintenance visits by qualified service personnel of the Supplier who is familiar with the type of equipment provided for this project. Each preventive maintenance visit shall include routine adjustment, calibration, cleaning and lubrication of system equipment and verification of correct operation.

F. Visits to the sites to correct deficiencies under warranty shall not be included in this preventive maintenance service contract.

G. Emergency maintenance procedures or plant visits may coincide with a preventive maintenance visit; however, they shall not replace the work intended to be performed during a preventive maintenance visit. The Supplier shall have full responsibility for the system hardware preventive and corrective maintenance.

H. During the one-year maintenance period, observation of maintenance operations by plant personnel and the instruction of said personnel in the details of the maintenance work being performed, shall be provided.

1.11 PROJECT/SITE REQUIREMENTS

A. Environmental Requirements. Refer to Section 16000 and Electrical Drawings for specific environmental and hazardous area classifications.

B. Elevation: Equipment shall be designed to operate at the project ground elevation.

C. Temperature:

1. Outdoor areas' equipment shall operate between -30 to 50 C degrees ambient.

2. Equipment located in indoor locations shall operate between 5 to 35 C degrees ambient minimum.

3. Storage temperatures shall range from 0 to 50 C degrees ambient minimum.

4. Additional cooling or heating shall be furnished if required by the equipment as specified herein.

D. Relative Humidity. Air-conditioned area equipment shall operate between 20 to 95 percent relative, non-condensing humidity. All other equipment shall operate between 5 to 100 percent relative, condensing humidity.

PART 2 PRODUCTS

2.01 GENERAL

A. All instrumentation and electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture and fungus. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.

B. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks unless otherwise noted. Fasteners for securing control panels and enclosures to walls and floors shall be either hot-dipped galvanized after fabrication or stainless steel. Provide stainless steel fasteners only in corrosive areas rated NEMA 4X on the Drawings or as defined under Section 16000. Provide minimum size anchor of 3/8-inch.

C. All indicators shall be linear in process units, unless otherwise noted. All transmitters shall be provided with indicators in process units, accurate to two percent or better.

D. All equipment, cabinets and devices furnished shall be heavy-duty type, designed for continuous industrial service. The system shall contain similar products of a single manufacturer, and shall consist of equipment models, which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

E. All electronic/digital equipment shall be provided with radio frequency interference protection.

F. Electrical:

1. Equipment shall operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power

supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

2. With the exception for field device network connected devices, all electronic instrumentation shall utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).

3. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed.

4. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless noted otherwise.

5. Switches and/or signals indicating an alarm, failure or upset condition shall be wired in a fail-safe manner. A fail-safe condition is an open circuit when in an alarm state.

6. Materials and equipment shall be UL approved whenever such approved equipment and materials are available.

7. All equipment furnished shall be designed and constructed so that in the event of power interruption, the systems specified herein shall go through an orderly shutdown with no loss of memory and shall resume normal operation without manual resetting when power is restored, unless otherwise noted.

2.02 ELECTRICAL SURGE PROTECTION

A. General – Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with normal operation but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an 8x20µs impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground in accordance with Section 16660.

B. Provide protection of all analog signal (4-20 mA) circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Protection devices located near the transmitter shall be mounted in a separate NEMA 4X stainless steel enclosure (plastic is not acceptable) or conduit mounted, and shall be Phoenix Contact PT Series, MTL Surge Technologies (Telematic) TP48, Citel TSP-10 series, or equal. Substitution of a single device to protect both 120 VAC and 4-20 mA wires to an instrument is acceptable. Protection devices in control panels shall be MTL Surge Technologies (Telematic) SD Series, Phoenix Contact PT Series, Citel DLA series, or equal.

C. Provide protection of all 120 VAC power feeds into control panels, instruments, and control room equipment. Surge arresters shall be Transtector ACP-100BW Series, Phoenix Contact "Mains-PlugTrab", MCG Surge Protection 400 Series, Citel DS40 series, or equal.

D. Non-Fiber Based Data Highway or Communications Circuits – Provide protection on all communication and data highway circuits that leave a building or are routed external to a building. Circuit protection shall be provided at both ends of the line. Surge protection devices shall be Phoenix Contact PlugTrab Series, Transtector FSP Series, MTL Surge Technologies (Telematic) NP Series, Citel DLA series or MJ8 series, or equal.

E. RF Coaxial Cable – Provide protection on communication cables between radios and antennas, mounted either inside the panel, or in the wall of the enclosure in accordance with NEMA and UL standards. Surge protection devices shall be Citel P8AX series, Polyphaser, or equal.

F. Inductive Loads – Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120 VA or less that drive solenoid, coil, or motor loads.

G. Telephone Circuits – At a minimum, provide Telephone Company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract.

2.03 SPARE PARTS

A. All spare parts shall be wrapped in bubble wrap, sealed in a polyethylene bag complete with dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's contact information (address and phone number), part name, part number, part ordering information, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the Owner or Engineer.

B. Furnish one of each type of installed Surge protection devices.

C. Other spare parts are specified in each section. An overview follows:

1. Instrument related Spare Parts – see the Instrument section(s).

2.04 TEST EQUIPMENT

A. Provide all test equipment, instruction manuals, carrying/storage cases, unit battery charger, special tools, calibration fixtures, cord extenders, patch cords, test leads, and miscellaneous items for checking field operation of all supplied equipment.

B. All test equipment shall be wrapped in bubble wrap, sealed in a polyethylene bag with a dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's part number, and equipment name shall be supplied. The test equipment shall be delivered and stored in a location directed by the Engineer.

C. As a minimum, furnish the following test equipment:

1. One complete electronic process calibrator sets with rechargeable batteries, cases, spare fuses, test leads, and PC based software. Provide model 830 as manufactured by Altek, or equal.

2. One portable digital multi-meter (DMM) with rechargeable battery and test leads, and carrying case, Fluke 289 Industrial Digital Multimeter, or equal. Combing the features of

the electronic process calibrator and the DMM such as the Fluke 787 Process meter is acceptable.

3. One calibration pump, Model A-396A as manufactured by Dwyer Instruments, Inc., or equal.

4. One hand-held HART communicator, with case and all necessary accessories, Model 375 by Rosemount, or equal.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

A. Instrumentation and accessory equipment shall be installed in accordance with manufacturer instructions. The indicated locations of equipment, transmitters, alarms and similar devices indicated are approximate only. Exact locations of all devices shall be as approved by the Engineer during construction. Obtain in the field, all information relevant to the placing of process control equipment and in case of interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner at no additional cost to the Owner.

B. Provide brackets and hangers required for mounting of equipment.

C. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at only one ground point for each shield.

D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, ship material in sections sized to permit passing through restricted areas in the building. Provide on-site service to oversee the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. Certify that field wiring associated with the equipment is installed in accordance with best industry practice. Coordinate work under this Section with that of the electrical work specified under applicable sections of Division 16.

E. Provide sunshades for equipment mounted outdoors in direct sunlight. Sunshades shall include standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North or as required to minimize the impact of glare and ultraviolet exposure on digital readouts.

3.02 TESTING

A. Refer to Section 13302.

3.03 TRAINING

A. Refer to Section 13303.

END OF SECTION 13300

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SECTION 13302
TESTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to complete the testing of all devices and systems furnished and installed as detailed on Drawings, and as specified herein.

B. Refer to Section 13300 for other general requirements.

1.02 RELATED WORK

A. Refer to Section 13300.

B. Division 1 "Equipment Testing and Start-up" Section 01465.

1.03 SUBMITTALS

A. Refer to Section 13300.

B. Testing Submittals – Submit, in one submittal, the following testing related documents:

1. Status signoff forms:
    a. Develop and submit project specific I/O Status and Automatic Control Strategy signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.
        1) Example forms are shown in the Appendices.
        2) Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
        3) Submit testing forms prior to start of testing.

2. Testing Procedures:
    a. Submit detailed procedures proposed to be followed for each of the tests specified herein. The test procedures shall serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified.
    b. Documents shall be structured in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.
    c. Test procedures shall indicate all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.
    d. Test procedures shall be structured in a cause and effect manner where the inputs are indicated, and the outputs are recorded.
    e. Test procedures shall include the demonstration and validation under normal operating conditions and under various failure scenarios as specified in Contract Documents.
    f. Testing may not start until all Testing Submittals have been approved.

C. Test Documentation:

1. Upon completion of each required test, document the test by submitting a copy of the signed off Testing Status forms. Testing shall not be considered complete until the signed-off forms have been submitted and approved. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.04 MAINTENANCE

A. Refer to Section 13300.

1.05 COST OF TRAVEL

A. Scheduled tests will only be attended once by Engineer /Owner. If test is not successful, all subsequent tests will be performed at Contractor's expense. Reimburse Owner for all costs, including labor and expenses, invoiced by Engineer and incurred by Owner for subsequent retests.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TESTING – GENERAL

A. Refer to Section 13300.

B. Testing services shall be conducted by both PCSS and Applications Engineering System Supplier (AESS) firm performing work for the PCSS

C. Results of all testing shall be tracked on a project specific status sign off form or similar document. PCSS shall be responsible for maintaining the sheet. Appendix of this Section has an example template for this sheet.

D. Tests the PCSS is required to perform are as follows:

1. Field Testing:
   a. Functional Demonstration Test (FDT).
   b. Site Acceptance Test (SAT).

E. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.

F. PCSS shall coordinate all required testing with Contractor, affected Subcontractors, Engineer, and Owner.

G. No equipment shall be shipped to jobsite until Engineer or Owner has received all Factory Testing results and approved the system as ready for shipment.

H. Engineer reserves the right to test or re-test any functions.

I. Correction of Deficiencies:

1. Deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet specification requirements at no additional cost to Owner.

2. Testing, as specified herein, shall be repeated after correction of deficiencies is made until specified requirements are met. This work shall be performed at no additional cost to Owner.

3.02 FIELD TESTING – FUNCTIONAL DEMONSTRATION TEST (FDT)

A. After facility is started-up and running treatment process in automatic control to extent possible, a Functional Demonstration Test shall be performed. Purpose of FDT is to allow Engineer or Owner representatives to witness actual functionality, performance, and stability of system while connected to process equipment.

B. Required Documents for Test:

1. Set of panel drawings and wiring diagrams from ORT with corrections noted.

2. Set of Contract Documents – all drawings and specifications.

3. All design change related documentation.

4. Signed-off master copy of the PCSS developed field testing signoff forms.

5. Testing procedures.

6. Copy of completed calibration forms.

7. One copy of all O&M Manuals for PCSS supplied equipment.

C. A witnessed FDT shall be performed on each process area. To extent possible, repeat testing performed during ORT.

D. Daily schedule specified to be followed during factory tests shall also be followed during FDT.

E. After coordinating with Operations, a "Black Start" of the plant shall be performed to confirm plant operation recovers as specified in Contract Documents. Black start means shutting off power to the plant and turning it back on. Separate tests shall be performed by recovering the plant while on generator (if a generator is specified) and while on utility power.

F. Punch list items and resolutions noted during test shall be documented on Punch list/Resolution form. In event of rejection of any part or function test procedure, PCSS shall perform repairs, replacement, and/or retest within 10 days.

G. Upon successful completion of the FDT, PCSS shall submit a record copy of test results as specified in "Part 1 – General."

3.03 FIELD TESTING – SITE ACCEPTANCE TEST (SAT)

A. After completion of FDT, and system is started-up and running treatment process in automatic control to extent possible, system shall undergo a test as defined in Division 1 "Equipment Testing and Start-up" Section 01465.

B. While this test is proceeding, Engineer and Owner shall have full use of system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. Plant operations shall remain responsibility of Owner and decision of plant operators regarding plant operations shall be final.

C. During this test, PCSS and AESS personnel shall be present as required to address any potential issues that would impact system operation. PCSS and AESS is expected to provide personnel for this test who have an intimate knowledge of hardware and software of system. When PCSS and AESS personnel are not on-site, PCSS and AESS shall provide cell phone/pager numbers that Owner personnel can use to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.

D. Any malfunction during test shall be analyzed and corrections made by PCSS. In event of rejection of any part or function, PCSS shall perform repairs or replacement within 5 days.

E. Throughout duration of SAT, no software or hardware modifications shall be made to system without prior approval from Owner or Engineer.

3.04 CERTIFICATE OF INSTALLATION

A. Following successful completion of SAT test, PCSS shall submit a Certification of Installation for system as required in Division 1 "Equipment Testing and Start-up" Section 01465.

END OF SECTION 13302

APPENDIX 13302-A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM

An example template for I/O Status signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

APPENDIX 13302-B: EXAMPLE AUTOMATIC CONTROL STRATEGIES SIGN OFF FORM

An example template for Automatic Control Strategies signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific Automatic Control Strategies signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

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[Project Name] Appendix A - Input/Output (I/O) Status Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Field Testing.
Instrument Alarm Setpoint - Setpoint for any alarms set by PCSS
Wiring Complete - Signal wired from field device to PLC
I/O Tested - Signal tested from field device to SCADA HMI

PLC	Signal Tag	Description	Range or Active State when closed	P&ID	Signal	Rack	Slot	Channel	Instrument Alarm Setpoint	Calibrate, config., and Wiring complete	Date	PCSS I/O testing	Date	I/O Testing to the HMI	Date	Notes
PLC-SC	LIT-4000-1	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1	0								
PLC-SC	LIT-4010-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1	1								
PLC-SC	SI-4100-1	RAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	2								
PLC-SC	SI-4100-4	RAS Pump No. 4 Speed Feedback	0-100%	15	AI	2	1	3								
PLC-SC	FIT-4102-1	RAS Flow Pumps 1-3	0-1900 GPM	14	AI	2	1	4								
PLC-SC	SI-4110-1	WAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	5								
PLC-SC	N/A	Spare Slot	N/A	N/A	Spare	2	5	N/A								
PLC-SC	SC-4100-1	RAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	0								
PLC-SC	SC-4100-2	RAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7	1								
PLC-SC	SC-4100-3	RAS Pump No. 3 Speed Setpoint	0-100%	14	AO	2	7	2								
PLC-SC	SC-4110-1	WAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	3								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	4								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	5								
PLC-SC	TSH-4000-1	Secondary Clarifier No. 1 High Temp	Normal	8	DI	3	1	0								
PLC-SC	XA-4000-1	Secondary Clarifier No. 1 Motor Overload	Normal	8	DI	3	1	1								
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	2								
PLC-SC	WAHH-4000-1	Secondary Clarifier No. 1 High High Torque	Normal	8	DI	3	1	3								
PLC-SC	YRI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1	4								
PLC-SC	YCI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1	5								
PLC-SC	YFI-4100-1	RAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	6								
PLC-SC	FAL-4100-1	RAS Pump No. 1 Low Flow	Normal	14	DI	3	1	7	50 GPM	RJM	12/18/2011	JAS	12/22/2011	MIC	12/29/2011	Example completed line
PLC-SC	Spare	Spare	Normal	14	DI	3	1	8								
PLC-SC	YRI-4100-1	RAS Pump No. 1 Running	Running	14	DI	3	1	9								
PLC-SC	YCI-4100-1	RAS Pump No. 1 In Remote	In Remote	14	DI	3	1	10								
PLC-SC	YFI-4110-1	WAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	11								
PLC-SC	FAL-4110-1	WAS Pump No. 1 Low Flow	Normal	14	DI	3	1	12								
PLC-SC	Spare	Spare	Normal	14	DI	3	1	13								
PLC-SC	YRI-4110-1	WAS Pump No. 1 Running	Running	14	DI	3	1	14								
PLC-SC	YCI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	15								
PLC-SC	HSS-4000-2	Secondary Clarifier No. 2 Start Command	Start	8	DO	4	6	0								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	1								
PLC-SC	HSS-4100-2	RAS Pump No. 2 Start Command	Start	14	DO	4	6	2								
PLC-SC	HSS-7000-2	Sludge Holding tank Tank Blanket No. 2 Start Command	Start	17	DO	4	6	3								
PLC-SC	HSS-4100-5	RAS Pump No. 5 Start Command	Start	15	DO	4	6	4								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	5								
PLC-SC	HSS-4105-1	Secondary Scum Pump No. 2 Start/Stop	Start	15	DO	4	6	6								
PLC-SC	HSS-4110-2	WAS Pump No. 2 Start/Stop Command	Start	15	DO	4	6	7								
PLC-SC	7160-FQI-1	Sludge Loadout LCP Pumping Indicator	Pumping	17	DO	4	6	8								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	9								
PLC-SC	HSS-7115-2	Sludge Holding Tank Mixer No. 2 Start	Start	17	DO	4	6	10								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	11								
PLC-SC	HSO-7117-2	Sludge Holding Tank Discharge Valve No. 2 Open CMD	Open	17	DO	4	6	12								
PLC-SC	HSC-7117-2	Sludge Holding Tank Discharge Valve No. 2 Close CMD	Close	17	DO	4	6	13								
PLC-SC	HSS-7120-2	TS Transfer Pump No. 2 Start Command	Start	17	DO	4	6	14								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	15								

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[Project Name] Appendix B - Automatic Control Strategies Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Testing

Auto. Control Strategies. - Loop operational in Automatic as defined in Control Stategies

Control Strategies Loop #	Control Strategy Description	P&ID	Auto. Control Strategy	Date	Notes
LOOP 281 - 284	LOW FLOW PUMPS	8			
LOOP 290	LOW EQ CHANNEL FLOW NO.4	8			
LOOP 300	MICROFILTRATION AIR SUPPLY LOW PRESSURE	10			
LOOP 351, 352	SITE LIFT STATION PUMP NO.1 AND NO. 2	12			
LOOP 355	SITE LIFT STATION HIGH AND LOW LEVEL CONTROL	12			
LOOP 371, 372	SLUDGE HOLDING TANK NO.1 AND NO. 2 LEVEL	14			
LOOP 381, 382	SLUDGE TRANSFER PUMPS	14			
LOOP 385	SLUDGE TRANSFER PUMPS REMOTE START/STOP COMMAND	14			
LOOP 700	EFFLUENT PUMPING STATION LEVEL	14			
LOOP 701, 702, 703	EFFLUENT PUMP NO.1	14			
LOOP 840	POST AERATION CHANNEL AIR FLOW CONTROL	15			
LOOP 900	SLUDGE TRANSFER PUMPS DISCHARGE FLOW	8			
LOOP 971	CENTRIFUGE SLUDGE FEED PUMP NO.1	8			
LOOP 1001	CENTRIFUGE NO.1 SLUDGE FEED FLOW CONTROL	8			
LOOP 1411, 1412	SODIUM HYPOCHLORITE STORAGE TANKS LEVEL	8			
LOOP 1421, 1422	SODIUM HYPOCHLORITE PUMPS	8			
LOOP 1430	SODIUM HYPOCHLORITE STORAGE TANKS CONTAINMENT AREA HIGH LEVEL DETECTION	14			
LOOP 2051, 2052, 2053	DIESEL ENGINE GENERATOR STATUS	14			
LOOP 2055	TRANSFER SWITCH STATUS	14			
LOOP 2060	GENERATOR KILOWATTS MONITORING	14			
APPENDIX ONE	EQUIPMENT RESTART DURING A POWER LOSS WITH THE GENERATOR RUNNING	14			
APPENDIX TWO	EQUIPMENT RESTART WITH POWER RESTORED AFTER A POWER LOSS	14			
N/A	SELF-HEALING CAPABILITIES OF NETWORK	N/A			
N/A	REDUNDANT SCADA SERVER FAILOVER AND RECOVERY	N/A			

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SECTION 13303
TRAINING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish training as specified herein.

B. This Section covers the training requirements for all devices and systems furnished and installed as detailed on the Drawings.

C. Refer to Section 13300.

1.02 RELATED WORK

A. Refer to Section 13300.

1.03 SUBMITTALS

A. Refer to Section 13300 for general submittal requirements.

B. Preliminary Training Plan Submittal

1. Prior to the preparation of the Final Training Plans, submit outlines of each training course including course objectives and target audience, resumes of instructors, prerequisite requirements for each class, and samples of handouts for review.

C. Final Training Plan Submittal

1. Upon receipt of the Engineer's comments on the preliminary training plan, submit the specific proposed training plan. The training plan shall include:
   a. Definitions, objectives, and target audience of each course.
   b. Schedule of training courses including proposed dates, duration and locations of each class.
   c. Complete copy of all proposed handouts and training materials. Training information shall be bound and logically arranged with all materials reduced to a maximum size of 11-inch by 17-inch, then folded to 8.5-inch by 11-inch for inclusion into the binder.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. The cost of the training programs shall be included in the Contract price. The training and instruction shall be directly related to the system being supplied. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the system.

B. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.

C. All onsite instructors must be intimately familiar with the operation and control of the Owner's facilities.

D. Provide detailed training manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project. The manuals shall be provided in hardcopy for each student. Provide electronic copy of each training manual in PDF format for Owner's future use.

E. The trainer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, all training materials shall be delivered to Owner.

F. The Owner reserves the right to videotape all custom training sessions. All training tapes shall become the sole property of the Owner.

G. Cost of Travel for off-site training

1. Cost of Travel for off-site training shall be paid directly by the entity employing the staff doing the traveling.

3.02 TRAINING SUMMARY

A. The following training courses listed in the summary table shall, as a minimum, be provided:

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Control System Overview Seminar	Covered in AESS scope of work			
Operator Control System Training	Covered in AESS scope of work			
System Reports and Historian Implementation	Covered in AESS scope of work			
Installed Control System	2	8	1	Maintenance, Administrator
Instrument manufacturer training	4	4	1	Maintenance
Instruments	8	4	1	Maintenance
Instruments - Operator familiarity	2	8	1	Operations

B. Definitions of audience roles

1. Administrator – personnel responsible for maintaining the HMI / SCADA system.

2. Maintenance – personnel responsible for maintaining the field controller hardware and instrumentation system.

3. Operations – personnel responsible for daily plant operations.

4. Management – non-daily operations personnel.

3.03 ONSITE TRAINING

A. Training personnel shall be intimately familiar with the control system equipment, its manipulation, and configuration. Training personnel shall command knowledge of system debugging, program modification, troubleshooting, maintenance procedure, system operation, and programming, and shall be capable of transferring this knowledge in an orderly fashion to technically oriented personnel.

B. Installed Control System Training

1. Provide training for the Owner's personnel in the functionality, maintenance, and troubleshooting, of the installed Control System. The training shall be held before the Functional Demonstrator Test (FDT), but not more than two months before.

2. Training and instruction shall be specific to the system that is being supplied.

3. Training shall consist of classroom instructions and hands-on instruction utilizing the Owner's system.

4. Detailed training shall be provided on the actual configuration and implementation for this Contract. Training shall cover all aspects of the system that will allow the Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. The training shall cover the following subjects, as a minimum:
   a. System overview.
   b. System hardware components and specific equipment arrangements.
   c. Periodic maintenance.
   d. Troubleshooting and diagnosis.
   e. Network configuration, communications, and operation.
   f. TCP/IP addressing procedures for all Ethernet devices.

C. Instrument Manufacturer Training

1. Manufacturer instrument training shall be provided for those instruments where specifically indicated in the Instruments section. This shall be on-site training provided by an authorized representative of the manufacturer. The manufacturer's representative shall be fully knowledgeable in the operation and maintenance of the equipment.

D. Instrument Training

1. Provide instruction on the maintenance of the field and panel instrumentation for the Owner's instrumentation technicians. This training shall be conducted before the FDT, but no more than 1 month before and at a time suitable to the Owner. This training shall take place at the Owner's facility. As a minimum the following shall be included:
   a. Training in standard hardware maintenance for the instruments provided.
   b. Specific training for the actual instrumentation configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up for this Contract.
   c. Test, adjustment, and calibration procedures.
   d. Troubleshooting and diagnosis.
   e. Periodic maintenance.

E. Instruments – Operator familiarity

1. Provide operator level instruction on the use of the field and panel instrumentation for the Owner's operations staff. This training shall be conducted before the 30-day site acceptance test, but no more than 1 month before and at a time suitable to the Owner. This training shall take place at the Owner's facility. Include hands on demonstration of the information each transmitter indicates, and the method used to retrieve any operator information from the transmitter, including use of pushbuttons and interpretation of international graphic symbols used on the instruments.

END OF SECTION 13303

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SECTION 13305
CONTROL DESCRIPTIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section is provided to clarify the control strategies to be used to program the system.

B. All SCADA PLC controller programming and SCADA Operator Interface Terminal (OIT) or Operator Workstation Station (OWS) graphics and programming shall be performed as defined in Section 13300.

1.02 RELATED WORK

A. Refer to Section 13300 “Instrumentation and Controls – General Provisions.”

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. The control descriptions are broken into areas. The following is a list of areas and the loop numbers associated with each area.

1.	Miscellaneous Sludge Pumping	(P&ID-2)	(Coordinate loop numbers with owner)
	RAS/WAS Pumping Station	(P&ID-3)	0501

B. The control descriptions are sorted by loop number for each area. The loop index has three columns associated with it; Loop Number, Loop Description, and Page. Each loop is associated with a specific SCADA I/O cabinet location to which it shall communicate.

C. The control descriptions are broken into a hierarchical layer concept. There may be one layer or multiple layers per loop, depending upon that loop. An example of multiple layered loop is as follows. The lowest layer of control, local control, is at that piece of equipment or that piece of equipment's panel or drive. The second layer of control is at an intermediate control panel between the equipment and the SCADA I/O or vendor's PLC I/O. The third layer would be at the vendor's PLC or microprocessor touchscreen station. The highest layer of control is by the SCADA PLC System with its associated operator workstations (OWS) in the main control room, remote office locations, and satellite locations operator interface terminals (OITs). The SCADA PLC/ OWS refers to both the SCADA PLC, which does the actual monitoring and control logic for the process equipment and the SCADA operator workstation (OWS), which are computers that have graphical software that interface to the PLC software for monitoring and implementing all operator-required tasks to control that process equipment. Any functions done in the operator workstations also take place at all the SCADA OITs.

3.02 CONTROL FUNCTION DEFINITIONS AND GENERAL CRITERIA

A. The hardware and/or software functions noted by this paragraph reference are to be implemented by the SCADA PLC/OWS control system specified herein.

B. The following list of ISA abbreviations is typical of those utilized. The description, following the abbreviation, summarizes the basic function to be implemented in the SCADA PLC/OWS software.

1. HS: Represent selector switches or pushbuttons, which shall be implemented by keyboard entry. Function shall be similar to their hardware counterparts. Examples are as follows:
   a. HSH-Open Command
   b. HSL-Close Command
   c. HSS-Start/Stop Command

2. YI: Represents equipment status (i.e., availability, running, in remote, etc.) implemented by a change of color on the OWS symbol for this equipment. For motor driven equipment such as pumps, blowers, compressors, etc., availability contact represents remote operation and no alarm conditions. Examples are as follows:
   a. YCI-Selector switch in computer, auto or remote position
   b. YRI-Motor running status
   c. YFI-Motor failure or overload status
   d. YMI-Selector switch in maintenance position

3. PAL, AAH, UA, etc.: Represent high or low alarms implemented on the OWS.

4. FIC, PIC, AIC, etc.: Represent PID process controllers implemented in a computer logic algorithm incorporating proportional, integral, and/or derivative modes. Local/remote and manual/auto capabilities shall be provided.

5. FIK, PIK, AIK, etc.: Represent control stations implemented in logic (via keyboard entry and CRT display) to allow downloading of a set point to a FIC, PIC, AIC, etc., and display of the process variable or controller output.

6. FI, PI, AI, etc.: Represent digital output display on the CRT of a process variable in engineering units and/or a dynamic representation of the variable by symbol or graphical means.

7. FIR, PIR, AIR, Represent values stored on the hard disk to provide the data for historical trend graphics of process variables against time (or other selected variables).

8. ZSH, ZSL etc.: Represent high or low, open or close limit positions implemented on the OWS

C. All interlocks that are represented, before the local operational descriptions, or are stated as hardwired interlocks, shall interlock all the controls locally and at the SCADA PLC/OWS or at the vendor PLCs. The SCADA PLC shall be programmed to shutdown that equipment if that hardwired interlock is also wired to the SCADA PLC.

D. All interlocks that are represented in a particular layer of the operational descriptions, shall interlock all the controls in that layer and the layer after it. However, the interlock shall not interlock the commands in the layer before it.

E. The SCADA system shall stop a motor or drive in its program if it does not receive the auto or remote status or one of its software interlocks trip. If the drive or motor is in hand or remote it will continue to run but the SCADA start/stop output will be open.

F. All motors that are requested to start by an operator or an automatic program shall alarm if the run confirm status for that motor does not activate within two seconds. If a motor stops by an interlock or stops without any operator or SCADA intervention, then that motor shall go into alarm. All motors that are stopped by a program or the operator shall not go into an alarm.

G. All valves that are requested to open by an operator or an automatic program shall alarm if the open feedback status for that valve does not activate within ten seconds. All valves that are requested to close by an operator or an automatic program shall alarm if the close feedback status for that valve does not activate within ten seconds.

H. All motors shall be programmed so if a motor stops for any reason, it shall not be re-started automatically once the problem with the motor has been resolved. The start command on the OWS shall not be a maintained contact but a momentary command to the PLC. The run confirms of all motors shall seal in the control output to the motor once the momentary start command drops out. The run confirms shall be on a five second timer delay in that if the run confirm is not present after five seconds, the contact output to the motor from the PLC shall drop out. Thus, the only way a motor can be restarted after five seconds by the SCADA system is if the operator reinitiates the start command for that motor on the OWS or when that motor control at the OWS is placed in complete automatic mode and the SCADA computer through logic/interlocks requests the motor to run.

I. Terminology associated with interlocks is as follows:

   1. When a contact or status is true, the SCADA computer will receive power to its input channel. The SCADA computer registers this as a binary bit of one.

   2. When a contact or status is false, the SCADA computer will receive no power (open circuit) to its input channel. The SCADA computer registers this as a binary bit of zero.

J. When an analog signal goes outside the 4-20 mA range due to a failure at the instrument or PLC card, the following SCADA programming shall take place:

   1. Alarm the signal at any local OITs and in the HMI system.

   2. If the analog signal is associated with a control loop or ratio control loop that loop shall go into manual.

   3. If the analog signal is used in a calculation, that calculation shall use the last good analog signal. The computer shall place the control loop in manual if using the calculation.

K. Disable all alarms on analog inputs unless specifically called for in the drawings or specifications.

L. All interlocks that shutdown (Stop a piece of equipment and prevent it from being restarted or moved) shall be shown on the faceplate pop-up graphic for that piece of equipment.

M. The run confirms or on status of all motors and lamps shall be accumulated to calculate a run time status of the equipment on the HMI graphic. Each run time accumulation shall come with a reset button on the HMI screen.

N. All flow indications shall be totalized. Do not totalize if the analog signal is outside the 4-20 mA range. Each flow totalization shall come with a reset button on the HMI screen. Do not totalize if the value of the flow input is less than 2% of the full range of the input.

O. Setpoints in the HMI shall have security. The setpoints shall be grouped by operational and maintenance setpoints. The PLC will use retentive memory to maintain updated setpoints.

3.03 INDIVIDUAL CONTROL DESCRIPTIONS AND CONTROL SEQUENCES

LOOP INDEX

LOOP No.	**LOOP DESCRIPTION**	**PAGE No.**
LOOP XXXX	PRIMARY SLUDGE FLOW TO DIGESTERS	5
LOOP XXXX	RAS SLUICE GATES TO BIOREACTORS	55
LOOP 0501A	WAS FLOW TO RECEIVING TANKS	7
LOOP XXXX	DIGESTED SLUDGE FLOW TO CENTRIFUGE	88
LOOP XXXX	POLYMER FEED SYSTEM	8
LOOP XXXX	THICKENED WAS FLOW TO DIGESTERS	10

LOOP XXXX PRIMARY SLUDGE FLOW TO DIGESTERS

General: Continuous flow measurement by means of a magnetic flow meter. Primary Sludge Flow shall be monitored and displayed on the SCADA system.

Control:

Local:

None

SCADA PLC/OWS:

None

Alarms / Monitoring:

Local:

Flow indication at the transmitter (FIT)

SCADA PLC/OWS:

Primary Sludge Flow
Primary Sludge Flow total w/ reset
Primary Sludge Flow total current day
Primary Sludge Flow total previous day
Primary Sludge Flow Transmitter Fault

Hardwired I/O:

Tag	Type	Description
FIT-XXX	AI	Primary Sludge Flow

LOOP XXXX RAS SLUICE GATES TO BIOREACTORS

General: RAS sluice gates shall be monitored and controlled by the SCADA system.

Control:

Valve Actuator:

When the Local/Remote hand switch at the gate actuator is in the 'Local' position, the operator shall be able to open and close the gate and enter a desired position setpoint (0-100%) from the gate actuator.

Hardwired Interlocks:

None.

PLC:

Software Interlocks:

None.

Open/Close Operation:

When the Local/Remote hand switch at the gate actuator is in the 'Remote' position, control is transferred to the SCADA system.

Manual: In manual, the operator shall be able to open and close the gate and enter a desired position setpoint (0-100%) from the OWS on the appropriate graphic display.

SCADA OWS:

The operator shall be able to open and close the gate at the OWS.

Alarms / Monitoring:

Local:

Open/Close status at the gate
Position Indication at the gate

PLC:

If the gate is requested to open by an operator or an automatic program but the open feedback status for that gate does not activate within thirty seconds, "Fail to Open" alarm shall be activated at the OWS.

If the gate is requested to close by an operator or an automatic program but the close feedback status for that gate does not activate within thirty seconds, "Fail to Close" alarm shall be activated at the OWS.

If the gate is requested to achieve a certain position set point by an operator or an automatic program but the position feedback deviates for +/-3% after time delay, "Gate Position Request Not Achieved" alarm shall be activated at the OWS.

SCADA OWS:

Gate Remote Status
Gate Opened Status
Gate Closed Status
Gate Position Indication (0-100%)
Gate Position Setpoint

Gate Open Command
Gate Close Command
Gate Fail to Open
Gate Fail to Close
Gate Position Request Not Achieved
Alarms shall be latched and will require acknowledgement at the OWS

Hardwired I/O:

Tag	Type	Description
HS-XXXX	DI	RAS Sluice Gate 1 In Remote
ZSL-XXXX	DI	RAS Sluice Gate 1 Opened
ZSL-XXXX	DI	RAS Sluice Gate 1 Closed
ZC-XXXX	AO	RAS Sluice Gate 1 Position Command
ZI-XXXX	AI	RAS Sluice Gate 1 Position Indication
HS-XXXX	DI	RAS Sluice Gate 2 In Remote
ZSL-XXXX	DI	RAS Sluice Gate 2 Opened
ZSL-XXXX	DI	RAS Sluice Gate 2 Closed
ZC-XXXX	AO	RAS Sluice Gate 2 Position Command
ZI-XXXX	AI	RAS Sluice Gate 2 Position Indication

LOOP 0501A WAS FLOW TO RECEIVING TANKS

General: Continuous flow measurement by means of a magnetic flow meter. WAS Flow shall be monitored and displayed on the SCADA system.

Control:

Local:

None

SCADA PLC/OWS:

None

Alarms / Monitoring:

Local:

Flow indication at the transmitter (FIT)

SCADA PLC/OWS:

WAS Flow
WAS Flow total w/ reset
WAS Flow total current day

WAS Flow total previous day
WAS Flow Transmitter Fault

Hardwired I/O:

Tag	Type	Description
FIT-0501A	AI	WAS Flow

LOOP XXXX DIGESTED SLUDGE FLOW TO CENTRIFUGE

General: Continuous flow measurement by means of a magnetic flow meter. Digested Sludge Flow shall be monitored and displayed on the SCADA system.

Control:

Local:

None

SCADA PLC/OWS:

None

Alarms / Monitoring:

Local:

Flow indication at the transmitter (FIT)

SCADA PLC/OWS:

Digested Sludge Flow
Digested Sludge Flow total w/ reset
Digested Sludge Flow total current day
Digested Sludge Flow total previous day
Digested Sludge Flow Transmitter Fault

Hardwired I/O:

Tag	Type	Description
FIT-XXX	AI	Digested Sludge Flow

LOOP XXXX POLYMER FEED SYSTEM

General: The Polymer Feed System shall be monitored and controlled at the SCADA system. The system is provided as a vendor package and is supplied with a local control panel connected via hardwired I/O to the SCADA RTU-5 control panel in

the centrifuge building. Refer to Section 11248 for specific control details about the Polymer Feed System.

Control:

Local:

Local control of the Polymer system is defined by Section 11248 and the Polymer system supplier.

PLC:

PLC control of the Polymer system is defined by Section 11248 and the Polymer system supplier.

SCADA OWS:

The operator shall be able to start and stop the system at the OWS.

Alarms / Monitoring:

Local:

Alarms and displays at the polymer system control panel are as provided by Section 11248 and the polymer system supplier.

SCADA OWS:

Polymer Feed System Running
Polymer Feed System Alarm
Polymer Feed System In Remote
Polymer Feed System Start Command
Polymer Feed System Stop Command
Polymer Feed System Pump Rate
Polymer Feed System Pacing Signal

Hardwired I/O:

Tag	Type	Description
YL-XXXX	DI	Polymer Feed System Running
YA-XXXX	DI	Polymer Feed System Alarm
HS-XXXX	DI	Polymer Feed System In Remote
HS-XXXX	DO	Polymer Feed System Start
HS-XXXX	DO	Polymer Feed System Stop
FC-XXXX	AO	Polymer Feed System Pacing Signal
FI-XXXX	AI	Polymer Feed System Pump Rate

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LOOP XXXX THICKENED WAS FLOW TO DIGESTERS

General: Continuous flow measurement by means of a magnetic flow meter. Thickened WAS Flow shall be monitored and displayed on the SCADA system.

Control:

Local:

None

SCADA PLC/OWS:

None

Alarms / Monitoring:

Local:

Flow indication at the transmitter (FIT)

SCADA PLC/OWS:

Thickened WAS Flow
Thickened WAS Flow total w/ reset
Thickened WAS Flow total current day
Thickened WAS Flow total previous day
Thickened WAS Flow Transmitter Fault

Hardwired I/O:

Tag	Type	Description
FIT-XXX	AI	Thickened WAS Flow

END OF SECTION 13305

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SECTION 13306
APPLICATIONS ENGINEERING SERVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. If referred to anywhere else in the project manual, Application Engineering (AE) or Applications Engineering System Supplier (AESS) services are those services specified in this Section.

B. Application Engineering services shall be provided by the PCSS or by an AESS firm performing work for the PCSS.

C. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system as specified herein. All equipment shall be controlled in full conformity with the Contract Drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment.

1. Provide configuration of the PLC provided for all equipment shown on the drawings, except for controls equipment shown being provided as part of a vendor package system.

2. Provide configuration of the HMI System Software, Operator Interface Terminals, and drivers provided for all equipment shown on the drawings, including equipment provided by vendor package systems.

3. Provide configuration of any alarm dialer(s) provided.

4. Provide configuration of system reports using the Reporting Software provided.

5. Provide for and test communications and functionality between all connected devices (such as PLCs) and the HMI software packages, including devices supplied by others, as depicted on the system architecture drawings in order to provide a comprehensive working system of data collection, storage and reporting.

D. All work shall be coordinated with plant operating personnel to minimize impacts on daily operation. Delays caused for any reason shall be noted and formally submitted to the Engineer and the Owner in the form of a letter.

1.02 RELATED WORK

A. Refer to Section 13300 “Instrumentation and Controls – General Provisions.”

1.03 SUBMITTALS

A. Provide all required submittals in accordance with Section 01300. The submittals listed below shall be provided as a minimum;

1. System Standards and Conventions.

2. Operator Interface.

3. Controller Program.

4. Reports.

5. Software Maintenance documentation.

6. Operations and Maintenance Manuals.

B. System Standards and Conventions Submittal

1. Following the standards and conventions workshop, submit the standards and conventions that will be used on this project. The submittal shall define, at a minimum:
   a. Graphic display standards, including color conventions, equipment symbols, display format, equipment control pop-up displays, trend displays, and display navigation. Include samples of each proposed type of graphic display (i.e., overview, detail, diagnostic, tabular, etc.)
   b. System naming conventions, such as graphic displays naming, database naming, tag names, and computer naming.
   c. System configuration, including network addressing and PLC/RTU addressing
   d. Alarm configuration standards, including priorities and logging
   e. Security configuration standards, including user groups and privileges
   f. PLC/RTU standard programming modules, including analog input scaling, flow totalization, equipment runtime, motor start/stop, valve open/close, and any other standard logic planned to be used.

2. To facilitate the Owner's future operation and maintenance, the submitted standards and conventions shall be used as the basis for programming and configuration of the system. System programming and configuration shall not begin prior to the System Standards and Conventions Submittal.

C. Operator Interface

1. Following the approval of the standards and conventions submittal, submit a draft of all proposed graphic displays, examples of each type of pop-up (faceplate) displays, and examples of trends. For those graphics which will be duplicated more than once for similar type of equipment, submit the graphics for the first equipment only.

2. Following the draft graphics review meeting and prior to the factory test, submit a ready-for testing version of all graphic displays. These graphics should be completely finished other than the incorporation of comments and changes resulting from testing.

3. Submitted graphic displays and trends shall be no less than 8.5 inches by 11 inches and in full color.

D. Controller Program Submittal

1. For each controller, submit the following using the controller manufacturer's built in printing functions. Electronic submission of Adobe Portable Document Format ("pdf") files in lieu of paper submittals is acceptable. Review will be for general program

organization, level of documentation, and overall programming standards (basic pump and valve control, for example). The review will not attempt to confirm the logic works correctly for every loop.

a. PLC programs showing ladder logic, function block, high level language or other controller language used. Include individual rung, network, and/or command descriptions with abundant comments to clearly identify function and intent of each code segment. Each logic segment shall be clearly presented, the function of each timer described, the purpose of each subroutine call labeled and defined, etc. Program documentation shall be sufficiently clear to allow determination of compliance with the process control requirements included in the control descriptions and with the Drawings. The submittal shall demonstrate that all logic provided under this project follows the same structure and format and reflects a common programming approach.
b. Submit a memory usage report for the controller. This report shall indicate total memory capacity and unused memory capacity.
c. Submit cross reference index of I/O allocation and controller memory address. Every physical I/O point as well calculated or virtual I/O required for the implementation of the process scheme shall be included.

2. Submit details of control system communication. Submit a "memory map" or other means showing which signals are exchanged between PLCs. Also submit a HMI tag database showing all signals exchanged between the PLCs and HMI. Any specific communication block memory addresses shall be defined.

E. Reports

1. Following the Historical Workshop, submit all aspects of the reports generation system and shall include as a minimum the following:
   a. A complete list of all reports to be developed.
   b. A complete listing of all signals to be reported, including calculated values.
   c. Description of reporting data storage design, including method data is polled and stored.
   d. Description of methodology for entering manual data and interfaced used.
   e. Procedures for recall, generation and printing of reports
   f. Printout of each report to be provided with details of each cell, where data comes from, and calculation of raw data.

F. O&M Manuals – Software Maintenance Manuals

1. Include these manuals as part of Section 13300 "Final System Documentation." This required information is in addition to all requirements of Section 13300.

2. Software Listings and Databases – Submit hard copies of the same information required in the "Controller Program Submittal" except include files updated to reflect the as built system. Include PDF versions of these files in the CD specified below.

3. PID Loop Tuning Parameters – Submit annotated chart recorder traces or computer system trend screen printouts showing tuned control loop response to plus and minus 40 percent of full span step changes of loop setpoint for each individual loop. For cascade loops, submit charts showing response of the secondary loop with secondary setpoint on manual and also response of the entire cascade control loop in automatic mode. Include a description of tuning methodology used.

4. If available as part of the software provided, supply hardcopies of configuration information for the HMI systems, reporting systems, and any other programs developed under this Contract.

5. Machine Readable Documentation – Provide two sets of as built software documentation on CD-ROMs in original electronic format for all PLC, HMI systems, reporting systems, and any other programs developed under this Contract. All changes made during or after testing, start-up, and commissioning shall be incorporated.

G. O&M Manuals – Operator Manuals

1. Provide Operator's Manuals prior to final acceptance of the system.

2. These manuals shall be separately bound and shall contain all information necessary for the operator to monitor and control the plant from the control system. The manuals shall be written in non-technical terms and shall be organized for quick access to each detailed description of the operator's procedure. Manuals shall contain, but not be limited to, the following information:
   a. A comprehensive table of contents of the manual.
   b. A simple overview of the entire system indicating the function and purpose of each piece of equipment.
   c. A detailed description of the operation of the HMI and OIT including all appropriate displays. Including a screenshot of each HMI and OIT display screen and annotating each function in text is an acceptable format for presenting this information.
   d. Step-by-step procedures for starting up or shutting down an individual component of the control system and also of the entire system.
   e. Login / logout procedures.
   f. Complete, step-by-step procedures for printing reports and entering manual data.
   g. Complete, step-by-step procedures for performing system or selected file backup and restoration including archiving historical data. Include recommended archiving schedule for historical data.
   h. Operational description for operating HMI computer equipment and peripherals including printers, CD-ROMs, removable bulk storage devices, UPS, etc. Description shall include procedures for typical maintenance and troubleshooting tasks.
   i. A complete glossary of terms and definition of acronyms.
   j. List of personnel to be contacted for warranty and emergency services, including name, address, telephone number, pager or cell phone number, fax number, and email address

3. Include these manuals as part of Section 13300 "Final System Documentation." This required information is in addition to all requirements of Section 13300.

1.04 MAINTENANCE

A. Refer to Section 13300.

1.05 WARRANTY:

A. Refer to Section 13300 and supplement that with the requirements below.

B. All application work shall be warranted in accordance with Section 01740.

C. Provide telephone technical support within 4 hours of warranty claim. If failure cannot be resolved by telephone, provide onsite technical support within 24 hours of warranty claim.

1.06 COORDINATION MEETINGS AND WORKSHOPS

A. Refer to Section 13300. The meetings below are in addition to the meetings specified in that section.

B. Schedule and conduct a standards and conventions workshop. The purpose of this workshop shall be to review the standards, conventions, and methodologies that will be used to program and develop the programs (i.e., HMI and PLC databases, HMI graphics, and PLC programming, etc.) and will solicit Engineer and Owner's input. Submit an agenda with examples for items to be discussed at a client workshop.

C. Schedule and conduct a draft graphics review meeting. The purpose of this meeting shall be to present draft graphics for the Owner's and Engineer's review and feedback prior to creating the full set of graphics for review. For repetitive graphics such as graphics for multiple process trains, include an example of the first graphic only for discussion. Include discussion of process and overview displays, examples of pop-ups, trends, and system navigation tools. Expect major comments and incorporate any changes resulting from those comments.

D. Schedule and conduct a second graphics review meeting. The purpose of this meeting is to finalize the process of building the required HMI system. This meeting will be held after return of the draft graphics submittal and incorporation of comments. At this meeting, present the actual software displays, databases, security system, reports, and the like. The Owner will make comments on the system for incorporation prior to the factory test. Bring a working system to allow for a live demonstration of the graphics.

E. Schedule and conduct a factory testing coordination meeting two weeks prior to factory testing. The purpose of this meeting is to discuss the specifics of the proposed tests and to provide a forum for coordinating the required factory testing.

F. Schedule and conduct a field-testing coordination meeting two weeks prior to field testing. The purpose of this meeting is to discuss the specifics of the proposed tests and to provide a forum for coordinating the required field-testing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. The system specified herein shall perform the following generalized functions:

1. The system shall allow the operator to control equipment such as pumps and valves as shown on the Drawings and as defined in Section 13305 – Control Descriptions.

2. Perform real-time process control, including proportional integral derivative control action, sequencing, process calculations, etc.

3. Collect, calculate, and store accurate, reliable operating information for present and future uses.

4. Assist remote site operating personnel by noting and communicating off normal operating conditions and equipment failures.

5. Accumulate and store equipment running times for use in preventative maintenance.

6. Provide color graphic displays and reports for use by the system operating and supervisory personnel.

7. Provide trending for all analog values.

8. Provide control system diagnostics.

9. All process control functions including PID, calculations, sequencing, timing, etc., shall be done in the process controller. The HMI software shall perform the real-time database, report generation, graphic screens, program development, set point modification, data archiving, etc.

10. The system shall allow the operator to manually control (by keyboard entry and mouse type pointing device) the status of pumps, valves, etc. (i.e., on off, open close, setpoint value, etc.) when viewing the appropriate graphic screen on the HMI.

3.02 CONTROLLER PROGRAMS

A. All applications programs shall be developed in a structured manner and shall follow an intuitive arrangement so that an instrumentation technician with basic programming knowledge will be able to understand. Programs shall utilize standard program templates or subroutines for repetitive logic such as equipment control, flow total calculations, equipment runtime calculations.

B. Make changes to the application programs and software configuration, based on comments during the submittals, the factory tests, the field tests, and during the commissioning process to meet the design intent, at no additional cost to the Owner.

3.03 GRAPHIC DISPLAYS – GENERAL

A. All displays shall contain and continuously update the displayed process variables, date and time of day. All process values shall be displayed in engineering units. All displays shall incorporate references to both instrumentation tag numbers and plant equipment numbers. All process variables shall be displayed on their associated display(s) with correct engineering units. Process variables shall display their associated data quality flags.

B. All operator commands related to controlling field devices or system attributes shall require multiple keystrokes or mouse actions to protect against inadvertent operations. The operator shall receive confirmation of the selected point to be controlled, at which time a cancellation of the control can be affected.

C. Process graphic displays shall be based on the P&ID's, site plan drawings, mechanical drawings and electrical drawings included in these Contract Documents. The graphic displays shall depict

process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.

D. All main graphical screens shall include a title bar, main graphic area, navigational buttons, and alarm summary bar. Title bar shall be displayed on the top of each screen and include display name, description and time/date. The main graphical area shall contain primary screen data in graphical format. Navigational buttons shall include a minimum of main menu, trends, main alarm summary, and security log in.

E. Animation shall be provided to mimic level changes in tanks or vessels, and to mimic rotation of rotating equipment when running. Valve colors shall change when opened and closed.

F. Unless specifically noted, all timers, setpoints, alarm actuation levels, etc., shall be adjustable from the operator interface.

G. The system shall show field conditions with text that can alternate (i.e., OPEN/CLOSE, START/STOP, HIGH/LOW) and change color correspondingly. Field devices that are tri-state must be represented in three conditions.

H. Conditions in the field designated as alarm conditions shall report to the operator workstation, actuate an audible alarm, and provide a visual blinking image on the associated graphic page. All alarms and events shall be displayed on the screen and archived.

I. All interlocks that affect equipment operation shall be identified both by alarm and by HMI indication.

J. All analog inputs shall be checked for out of range (via high and low limit checks) and alarmed.

K. All process flow streams shall be labeled and color coded using the project color schedule in Division 9. All structures and equipment shall be identified by name and appropriate equipment and loop tags.

L. Color coding for equipment status and alarms shall follow the existing HMI system and be consistent throughout the plant.

M. Automatically record all alarm and events should any of the following sequences or events occur:

1. Date/Time entry.

2. Limit changes.

3. Any commanded or uncommanded change of any point.

4. Alarm conditions.

5. PLC activation or deactivation.

6. Operator login or logout activity.

N. There may be additional general programming requirements listed in Part 1 of the Section 13305 – Control Descriptions that impact the HMI configuration.

3.04 SPECIFIC GRAPHIC SCREENS

A. At a minimum, provide the following types of graphic screen indicated below.

1. Main menu screen shall be developed to link to all screens and process areas. The screen shall be a complete and logical listing of the names and number of all screens

2. Overall plant process block flow diagram screen shall show all major processes in block form with flow arrows. Each block shall include a text description of key individual treatment processes. Navigational buttons to the individual treatment processes shall be performed by pressing on the text description.

3. Individual treatment process screens shall graphically screen key process variables and equipment. No operator entries shall be done from these screens. Individual process flow screens for each process shall include all process components, including tanks, pumps, blowers, mixers, drives, flow meters, valves, mechanical devices, as well as manual shutoff and isolation valves. These diagrams shall be generally depicted from the P&ID's and there shall be at least 1 screen per P&ID on average.

4. Individual unit process screens depicted from the P&ID's are used for control and screen of each major item of process equipment, process variables, and control devices, including pumps, blowers, valves, gates, mixers, drives etc. Navigational buttons shall consist of the P&ID's flow arrows to other individual unit processes. The unit process screens shall provide the ability for the operator to go to individual equipment popup screens. These diagrams shall be generally depicted from the P&ID's and there shall be at least 2 screens per P&ID on average.

5. Popup screens shall be provided for each piece of equipment to start/stop equipment, open / close valves, implement automatic control, adjust set points, establish and adjust tuning parameters, set alarm limits and initiate a sequence.

6. PLC system diagnostic screens, showing the operational status, and fault conditions of all PLC components, including processors, I/O modules, OIT's, power supplies and UPS units.

7. Communications diagnostic screens, showing the details of network status, communications status of all major components including Operator Work Stations, peripheral devices and network components.

8. Maintenance screens shall screen the raw value for each analog and digital I/O point in the system. They shall also allow the operators/maintenance personnel to enter an override value for an analog point that is then used by the system instead of the value read from the input card / communications link.

9. Trend screens with the capability to screen up to eight, operator assigned, analog and/or digital process variables. Each analog value will be shown on a trend screen.

10. Main alarm summary screen shall screen the following information on each alarm: Time, tag name, description, alarm type, current value and status. An acknowledge alarm button shall acknowledge all new unacknowledged alarms. The acknowledged and unacknowledged alarms shall be different colors. Acknowledged alarms shall clear automatically after the condition is corrected.

11. Analog variable screens showing a tabular summary of all plant process variables, in operator assigned groupings.

3.05 SECURITY

A. The system shall be configured and implemented with security to prevent unauthorized access. The system shall allow authorized changes to system operation through defined user accounts and password verification.

B. Coordinate with Owner user account information, including login name and password for each account.

C. Security levels of "display only", "operator mode", "supervisor mode", and "engineer mode" shall be available through assignable passwords. On system startup, the "display only" security level shall automatically be entered. In the "display only" mode, information is available to be displayed on the screen but no changes may be made. In the "operator mode", changes may be made to process set points, times, etc.; however, the overall control concepts may not be modified. In the "supervisor mode", all operator functions can be modified and any special reports or critical process set points (data can be modified; however, the overall control concepts may not be modified). In the "engineer mode" level, all user modifiable parameters of the system shall be available for modification.

3.06 ALARM/EQUIPMENT STATUS REPORTING

A. The alarm log shall display all alarms as they occur. The alarm message shall include the time of occurrence, tag name, tag number, and whether it is a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identification number, and return to normal shall be displayed. All reports shall include the plant equipment number of the associated device.

B. The equipment status shall be logged whenever a change in status occurs (i.e., start, stop). The equipment status log shall include the time, equipment name, tag number, and the particular change in status.

3.07 REPORTS

A. Quantity and format of reports shall be determined at the historical data management and reports workshop and as a minimum shall include shift, daily, monthly and yearly reports. Provide a minimum of 5 reports.

B. The system shall be able to generate reports from online historical data files or prompt the user for the appropriate archived data files.

C. Reports shall be initiated automatically based upon time of day or manually upon operator request.

D. User interface displays for report generation shall be developed with easy recall of reports by entering time:day:year target values.

E. User interface displays shall allow the operator to define the destination of the report (e.g., display, printer, computer file, etc.) and when it is to be printed (e.g., immediately, on demand, or automatically at a specified time).

F. It shall be possible to print quality tags alongside the value.

G. Values for which there are no data available shall be identified with a special character. Thus, only values which are actually zero shall be printed as such.

H. Operational Report Types. The following operational report types shall be provided with the system:

1. Shift Operation Summary Report:
    a. An operator-adjustable time interval shift operation report shall summarize plant operation from the start and finish time of operation.
    b. The report format shall consist of the following: correct date, plant name, report name, page number, group headings, subheadings, point identification, and engineering units.

2. Daily Operation Summary Report
    a. The daily operation report shall summarize plant operation for the previous day. The printed information shall be the stored values (not averages) including scanned, lab, and manually entered data.
    b. The report format shall consist of the following: correct date, plant name, report name, page number, group headings, subheadings, point identifications, and engineering units.
    c. The daily minimum, average, maximum, and total where applicable shall also be calculated and printed for each point and stored.

3. Monthly Operation Summary Report:
    a. The monthly operation summary report shall summarize plant operation for the previous calendar month.
    b. The report format shall be arranged so that the first several pages shall conform to the requirements of the state regulatory agencies and may be separated from the rest of the monthly operation report for transmittal to the regulatory agency.
    c. The report format shall be similar to the daily operation summary report and shall consist of the following: month and year, plant name, report name, page number, group headings, sub-headings, point identifications, and engineering units.
    d. Monthly minimum, average, maximum, and totals, where applicable, shall also be printed for each column of points printed.

4. Annual Operation Summary Report:
    a. The annual operation summary report shall summarize plant operation for the previous calendar year. The report shall consist of scanned data, lab data, and manually entered data.
    b. The format of the report shall be identical with the monthly operation summary report except for replacing month with year in the heading and replacing date with calendar month.

3.08 TESTING

A. Refer to Section 13302.

B. Supplement to Field Testing requirements

1. Prior to leaving the site, use the Owner's programming computer to monitor all PLC processors online, make on-line changes, upload and download the processor to ensure programming software version compatibility.

2. Loop Tuning – All PID control loops (single or cascade) shall be tuned following device installation but prior to commencement of the Functional Demonstration Test.
   a. Optimal loop tuning shall be achieved either by auto-tuning software or manually by trial and error, Ziegler-Nichols step-response method, or other documented process tuning method.
   b. Determine and configure optimal tuning parameters to assure stable, steady state operation of final control elements running under the control PID. Each control loop that includes anti-reset windup features shall be adjusted to provide optimum response following startup from an integral action saturation condition.
   c. Tune all PID control loops to eliminate excessive oscillating final control elements. Loop parameters shall be adjusted to achieve a decay ratio of 1/4 or better. In addition, loop steady state shall be achieved at least as fast as the loop response time associated with critical damping.
   d. Loop performance and stability shall be verified by step changes to setpoint in the field.
   e. Submit loop tuning documentation as specified in Part 1 of this Section.

3.09 TRAINING

A. Refer to Section 13303 for general training requirements.

B. Furnish training as shown in the table below.

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Control System Overview Seminar	2	12	1	Management
Operator Training	8	12	1	Operations
System Reports	2	4	1	Maintenance

C. Control System Overview Seminar

1. Provide Control System Overview seminar for the Owner's personnel at the Owner's facility. The objective of this seminar is to provide personnel with an overview understanding of the Control System. The seminar material shall be targeted to the Owner's management, engineering, and other non-operations personnel. The seminar shall include, but not limited to, the following:

a. An overview of the Control system explaining how the hardware and software supplied under this Contract is used for the operation and control of the facilities.
b. A block diagram presentation of the Control system showing how and what information flow within the system and what each functional unit does.
c. An explanation of the operator interfaces including a demonstration of how to use an operator's workstation to monitor, control, navigate, display trends, and all other operational features of the system. Discussion of process control of individual processes shall be addressed outside of this course.
d. A walkthrough of the installed system explaining each of the items covered in the functional units' discussion. The features and functions of operator controls and interfaces shall be discussed.

D. Operator Control System Training (pre or post start-up)

1. Operator training shall cover plant operation with the control system and use of the HMI display screens, including at a minimum all the following items:
   a. Basics of HMI control and navigation.
   b. Alarming and Interlocks.
   c. Auto functionality of automated processes and HMI control.
   d. Failure modes of equipment and operator responses.

2. Operator training shall be held at the convenience of the Owner. This training may be held during the day, late at night, or very early in the morning to accommodate the Owner's shift schedule.

3. Operator training shall be introductory in nature during pre-startup training and more in-depth and detailed during post-startup training.

4. At a minimum, the following teaching aids shall be available for distribution during Operator training sessions:
   a. Preliminary O&M Manuals (pre-startup); Final O&M Manuals (post-startup).
   b. P&IDs.
   c. Daily syllabus.

5. Fifty percent of all Operator training shall be "hands on" utilizing the installed Control System to the fullest extent possible. Confirm the operability of the Control System before commencing training. Training performed using a non-functioning Control System shall be rejected and repeated.

E. System Reports

1. Provide training of how to run the reports, how to manually enter data, and how to print and reprint the reports.

2. Provide training on how to execute data queries that are outside of those defined in the reports.

3. Provide training on report configuration, database maintenance and backup, and repair of failed reports.

END OF SECTION 13306

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SECTION 13340
I&C INSTRUMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section covers the furnishing, installation, and services for instruments.

1.02 RELATED WORK

A. Refer to Section 13300 “Instrumentation & Controls – General Provisions.”

1.03 SUBMITTALS

A. Submit complete documentation of all field instruments using ISA-TR20.00.01-2001 (updated in 2004-2006) data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment.

B. Submit separate data sheets for each instrument including:

1. Plant Equipment Number and ISA tag number per the Drawings.
2. Product (item) name used herein and on the Drawings.
3. Manufacturers complete model number.
4. Location of the device.
5. Input/output characteristics.
6. Range, size, and graduations in engineering units.
7. Physical size with dimensions, enclosure NEMA classification and mounting details in sufficient detail to determine compliance with requirements.
8. Materials of construction for enclosure and wetted parts.
9. Instrument or control device sizing calculations where applicable.
10. Certified calibration data for all flow metering devices.
11. Two-wire or four-wire device type as applicable.

C. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.

D. Submit index and data sheets in electronic format as well as hard copies on 8-1/2" x 11" formats. Electronic format shall be in Microsoft Excel or Word. Submit electronic copy on CD-ROM or DVD disk.

1.04 MAINTENANCE

A. Refer to Section 13300.

1.05 INSTRUMENT TAGS

A. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as indicated in the Drawings, shall be provided on each piece of equipment supplied under this Section and related sections. Equipment shall be tagged before shipping to the site.

B. Provide 1/8-in by 3/8-in, Type 316 stainless steel button head machine screws.

C. All supplied instrument transmitters and instrument transmitter elements shall have a stainless steel identification tag attached to each transmitter and element prior to shipment. Tag shall be attached via stainless steel chain or stainless steel wire (24 gauge min) to a non-removable part of the device. The tag size shall be a minimum of 1.5 square inches. Tag shall include the ISA alphanumeric instrument number as indicated in the P&ID, loop, and detail drawings. The alphanumeric instrument number shall be stamped into the tag and shall have a minimum of 3/16-in high alphanumeric characters.

1.06 APPROVALS/CERTIFICATIONS

A. Instruments for hazardous locations shall have Factory Mutual (FM), Canadian Standards Association (CSA), and CENELEC approvals and certifications as specified herein and as indicated on the Drawings or in the Instrument Device Schedule. The instrument specifications in Part 2 state the Class, Division, and gas groups for FM/CSA approval, followed in parenthesis by the CENELEC certification; however, instruments provided are only required to have the approval/certification stated above. The instrument shall have a stainless steel tag identifying the relevant approval or certification.

1.07 MANUFACTURERS' START-UP AND TRAINING SERVICES

A. If indicated in the individual instrumentation paragraphs, the instrument manufacturer or manufacturer's certified service representative shall provide start-up and training services. This work shall not be done by the PCSS or AESS contractor.

B. The start-up services shall be to calibrate, oversee the installations of the sensor, and start-up the sensor/transmitter in order to provide reliable measurement at the instrument and to a remote system. The vendor shall work with the PCSS and AESS to verify the transmitter sends correct information to the remote system (i.e., that the scaling and units are the same at the instrument and on the remote operator interface).

C. While the instrument manufacturer or manufacturer's certified service representative is starting up the instrumentation, training shall be provided to the Owner's instrumentation technicians. The training shall be in how to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

PART 2 PRODUCTS

2.01 MAGNETIC FLOWMETER

A. Flow Element

1. Type:
   a. Pulsed DC type.

2. Function/Performance:
   a. Operating Temperature: Process liquid temperatures of 0 to 140 degrees F or greater dependent upon liner and an ambient of minus 30 to 150 degrees F.
   b. Radio Frequency Interference (RFI) protection: RFI protection shall be provided as recommended by the manufacturer.
   c. Pressure rating: Equal to piping system where meter is installed.
   d. Additional: Meter shall be capable of running empty indefinitely without damage to any component.

3. Physical:
   a. Metering Tube: Type 304 stainless steel or equivalent.
   b. Flanges: ANSI 150 lb. or DIN PN 16 carbon steel, as required by the piping system, unless otherwise indicated. ANSI 150 lb. or DIN PN 16 stainless steel flanges shall be used on all SS process pipes.
   c. Liner: Polyurethane or composite elastomer unless otherwise indicated on the Drawings or in the Instrument Device Schedule.
   d. Electrodes: Type 316 stainless steel standard minimum requirements. All electrodes to be compatible with process fluid as indicated on the Drawings or electrodes to be supplied as listed in the Instrument Device Schedule.
   e. For sludge, polymer, or any slurry application where the electrodes will be coated, a self-cleaning or a removable electrode option must be provided with that meter.
   f. Housing: For meters with remote mounted transmitters, meters below grade shall be suitable for submergence for up to 48 hours to a depth of 30 ft (9m). Meters above grade shall be NEMA 4X (IP65). Where hazardous areas are indicated on the Drawings, the equipment shall be rated for that area.
   g. Finish: All external surfaces shall have a chemical and corrosion resistant finish.

4. Power Requirements:
   a. Meter shall be 24 VDC powered instrument, receiving its power from transmitter.

5. Accessories/Documentation Required:
   a. Factory calibration: All meters shall be factory calibrated. A copy of the calibration report shall be included in the O&M manual.
   b. Grounding: Meter shall be grounded in accordance with the manufacturer's recommendation. Provide ground ring, ground wires, gaskets, etc., as required. All materials shall be suitable for the liquid being measured and must be compatible with process fluid and with the process pipe.
   c. For meters with remote mounted transmitters, signal cable for installation between the flow tube and the transmitter. Length shall be as required by installation as indicated on the Drawings.

B. Flow Converter/Transmitter:

1. Type:
   a. Micro-processor based, intelligent transmitter compatible with flow tube provided.
   b. Integral mount or mounted remote from the flow tube as shown on the drawings or as required by the physical location.

2. Functional/Performance:
   a. Accuracy (including flow tube): Plus/minus 0.5 percent of flow rate or better.
   b. Operating Temperature: -20 to 140 degrees F.
   c. Output: Isolated 4-20 mA with HART protocol. Current output adjustable over the full range of the instrument. Provide a dry contact to indicate reverse flow.
   d. Diagnostics: Self diagnostics with on screen display of faults.
   e. Display: Digital indicator displaying flow in engineering units indicated in the Instrument Device Schedule.
   f. Totalizer: A fully configurable totalizer integral to the transmitter. Totalized flow shall be displayed.
   g. Empty Tube Zero: The transmitter shall include a feature that will lock the output at zero when no flow is detected. The empty tube zero feature shall be enabled automatically when the transmitter detects no flow or manually through a contact input.
   h. Provide electrode cleaning unit to match flow element requirements.

3. Physical:
   a. Transmitter shall be suitable for surface or pipe stand mounting.
   b. Enclosure shall be NEMA 4X (IP65).

4. Power Requirements:
   a. The transmitter shall be 120 VAC powered instrument.

5. Accessories/ Required:
   a. Keypad where required for transmitter configuration.

C. Manufacturer:

1. ABB Instruments ProcessMaster.

2. Krohne Optiflux 2000 or 4000 Series.

3. Rosemount Series 8705 Meter and 8712 Transmitter for remote mounted transmitter, or 8732E meter/transmitter for integral mounted.

4. Or equal.

2.02 DIAPHRAGM SEAL – THREADED

A. Type:

1. Thread attached.

2. Welded Metal Diaphragm.

B. Function/Performance:

1. Maximum Pressure: Two times the maximum process pressure.

2. Operating Temperature: -40 to 100 degrees C.

C. Physical:

1. All Type 316L stainless steel construction.

2. Teflon gaskets and O rings on process connection.

3. Bleeding connection provided. NOTE: filling screw not recommended since it provides poor quality measurement if done incorrectly in the field.

D. Accessories Required:

1. Stainless steel armored capillary tubing as required for the installation.

E. Manufacturer(s):

1. Rosemount.

2. Ashcroft.

3. Ronningen-Petter Company.

4. Siemens 7MF4861

5. Equal.

2.03 ROTAMETER

A. Type:

1. PVC and Polysulfone tube rotameter (variable area flow meter) with flow rate visible by reading the top of the float assembly against an indicator scale in engineering units or percent of full scale.

B. Function/Performance:

1. Accuracy: Plus or minus 3 percent of full scale from 10 to 100 percent of full scale.

2. Repeatability: 0.5 percent of full scale.

3. Indicator: Indicates flow in engineering units or percent of full scale as indicated in the Instrument Device Schedule.

4. Turndown: 10:1, minimum.

C. Physical:

1. 1. 1/2" Female NPT threaded connections, rated for 150 PSIG.

2. Threaded connections shall be PVC or PVDF. Float shall be PVC or Teflon. O-rings shall be Viton or Teflon.

3. Indicator shall be NEMA 4X (IP65).

4. Provide sunshield for all rotameters installed in outdoor locations as indicated on the drawings.

D. Manufacturers:

1. King Instrument 7331 Series.

2. Flo-Corp MFVC Series.

3. Or equal.

2.04 PRESSURE SWITCH

A. Type:

1. Diaphragm actuated.

B. Function/Performance:

1. Repeatability: Better than 1 percent of full scale.

2. Setpoint: Field adjustable and set between 30 and 70 percent of the adjustable range.

3. Dead Band: Fixed unless adjustable dead band requirement is noted in the Instrument Device Schedule.

4. Reset: Unit shall be of the automatic reset type unless noted otherwise in the Instrument Device Schedule.

5. Over Range Protection: Over range protection to 150 percent of the maximum process line pressure.

6. Output: Single pole double throw (SPDT) unless requirement for double pole double throw (DPDT) switch is shown on the instrument device schedule. Switch rating shall be 10 A at 230 VAC.

C. Physical:

1. Housing: NEMA 4X (IP65) for non-hazardous areas. For installation in hazardous areas, housing shall be explosion proof approved for Class 1, Division 1, Groups C and D (EEx d IIB).

2. Switch Assemblies: Hermetically sealed switches.

3. Wetted Parts: Type 316L stainless steel diaphragm, viton seals, Type 316 stainless steel connection port.

D. Accessories/Options Required:

1. Shutoff Valve: Provide a Type 316 stainless steel shutoff valve. Valve shall be by D/A Manufacturing, Anderson Greenwood, or Equal.

2. Where indicate on the instrument device schedule, provide a Type 316 stainless steel snubber for pulsation dampening.

E. Manufacturer(s):

1. Static-O-Ring (SOR).

2. Ashcroft.

3. Mercoid.

4. Equal.

2.05 PRESSURE GAUGE

A. Type:

1. Bourdon tube actuated dial face pressure gauge.

B. Function/Performance:

1. Accuracy: Plus or minus 1.0 percent of span or better.

C. Physical:

1. Case: Phenolic shock resistant or Type 316 stainless steel for surface/stem mounting with a pressure relieving back. The case shall be vented for temperature/atmospheric compensation. Gauge shall be callable of being liquid filled in the field or at the factory.

2. Window: Clear acrylic or shatter proof glass.

3. Bourdon tube: Stainless steel.

4. Connection: 1/2 in. NPT.

5. Gauge size: Minimum 4-inch viewable.

6. Pointer travel: Not less than 200 degrees not more than 270-degree arc.

7. Range: As indicated in the instrument device schedule. Range may include inches of water vacuum.

D. Accessories/Options Required:

1. Shutoff valve: Each gauge shall have a process shutoff valve that can also be used as an adjustable pressure snubber.

2. Special scales: Engineer reserves the right to require special scales and/or calibration if the manufacturer's standard is not suitable for the application.

3. Gauges listed as liquid filled in the instrument device schedule shall be liquid filled at the factory.

E. Manufacturers:

1. Ashcroft.

2. Ametek US Gauge.

3. Weksler.

4. Or equal.

2.06 SPARE PARTS AND ACCESSORIES

A. Furnish following Accessories:

1. All mounting hardware required for pipe stand, surface, or other mounting.

2. Each instrument shall be provided with a manufacturer installed stainless steel tag identifying the instrument tag number.

PART 3 EXECUTION

3.01 GENERAL

A. Instrumentation and accessory equipment shall be installed in accordance with manufacturer instructions. The indicated locations of equipment, transmitters, alarms and similar devices indicated are approximate only. Exact locations of all devices shall be as approved by the Engineer during construction. Obtain in the field, all information relevant to the placing of process control equipment and in case of interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner at no additional cost to the Owner.

B. Provide brackets and hangers required for mounting of equipment.

C. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at only one ground point for each shield.

D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, ship material in sections sized to permit passing through restricted areas in the building. Provide on-site service to oversee the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. Certify that field wiring associated with the equipment is installed in accordance with best industry practice. Coordinate work under this Section with that of the electrical work specified under applicable sections of Division 16.

E. Provide sunshades for equipment mounted outdoors in direct sunlight. Sunshades shall include standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the

North or as required to minimize the impact of glare and ultraviolet exposure on digital readouts.

F. Unless specifically indicated, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, 5-valve manifolds for calibration, testing and blow down service shall also be provided. For chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

END OF SECTION 13340

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SECTION 15072
DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required, install, and test ductile iron pipe and fittings for plant mechanical piping as shown on the Drawings and as specified herein.

B. Mechanical piping shall include all piping and fittings installed above grade, in utility tunnel or gallery and shall exclude pipe in valve vaults, manholes, cleanouts and similar yard structures.

C. Mechanical piping shall be installed as shown on the Drawings. Provide pipe supports, hangers and couplings as required to achieve a complete pipe system.

D. Where the word "pipe" is used, it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.02 RELATED WORK

A. Delivery, Storage and Handling is included in Section 01600.

B. Valves and Appurtenances are included in Section 15100.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data required to establish compliance with the Section. Submittals shall include the following

1. Tabulated layout drawings showing actual pipe lengths, diameters, fittings and appurtenances.

2. Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance AWWA and ASTM standards and requirements specified herein.

1.04 QUALITY ASSURANCE

A. Each length of ductile iron pipe supplied for the project shall be hydrostatically tested at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture of the pipe wall. Certified test results shall be furnished in duplicate to the Engineer prior to time of shipment.

B. Ductile-iron pipe and fittings to be installed under this project shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.

C. Pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the Owner, at the Owner's expense.

D. Inspection of the pipe and fittings will also be made by the Engineer or representative of the Owner after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the specified requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job.

E. Pipe and fittings shall be permanently marked with the following information:

1. Manufacturer, date.

2. Size, type, class, or wall thickness.

3. Standard produced to (AWWA, ASTM, etc.).

1.05 DELIVERY, STORAGE AND HANDLING

A. See Section 01600 for general requirements.

B. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior surface or internal lining of the pipe.

C. Materials, if stored, shall be kept safe from damage. The interior of all piping, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times.

D. Pipe ends including flange faces shall be protected from damage. All openings shall be adequately covered to prevent entrance of dirt, water and debris, and keep the pipe interior clean.

E. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pipe:

1. Ductile iron pipe shall conform to AWWA C115 and C110. Flanged and groove end pipe shall be Thickness Class 52 as per AWWA C150.

2. Pipe shall be supplied in standard lengths as much as possible.

3. Ductile iron pipe shall be as manufactured by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; Clow Water System Company, or equal.

B. Joints:

1. Ductile iron pipe shall have flanged joints. Flange shall be flat face type, unless otherwise noted, meeting ANSI requirements either ANSI B16.1 Class 125 or Class 250.

2. Flange gasket shall be full face type SBR per AWWA C111 to provide positive sealing for the flanged ductile iron joints. Thickness shall be 1/8-in unless otherwise indicated.

3. Assembly bolts shall be square headed carbon steel machine bolts with hexagon nuts per ANSI B18.2. Thread shall conform to ANSI B1.1. Bolt length shall be such that after joints are assembled, the bolts shall protrude through the nuts, but not more than 1/2-in.

4. Sleeve type couplings shall be Dresser Style 38 or 138 as manufactured by Dresser Industries, or equivalent products of Smith-Blair, Romac Industries, Ford Meter Box Co or approved equal.

5. Flanged coupling adaptors shall be Smith-Blair Type 913, or equivalent products of Klamflex Pipe Couplings (PTY) LTD, Robar Industries LTD or approved equal.

C. Fittings:

1. Pipe fittings shall be ductile iron with a pressure rating of 250 psi. Fittings shall meet the requirements of AWWA C110 as applicable. Fittings shall have the same pressure rating, as a minimum, of the connecting pipe.

D. Interior Lining:

1. Ductile iron pipe and fittings shall have the same type of lining as specified or indicated on the Drawings.

2. For wastewater applications, if no lining material is defining on the Drawings, the ductile iron pipe and fittings shall have a cement mortar lining and asphaltic seal coat in accordance with AWWA C104 except that twice the standard thickness shall be provided. The cement shall be per ASTM C150.

E. Exterior Coatings:

1. Unless otherwise specified, all coatings shall be shop applied with "hold-backs" provided as required at pipe and fitting ends for satisfactory installation for joint connections in the field. Provide all necessary coating materials to perform field coating applications at joints. Unless otherwise noted, field applied coating material shall be compatible with or equal to the shop applied material. Field repair of pipe with damaged coating shall receive prior approval of the Engineer. If, in the opinion of the Engineer that the coating damage is beyond repair the pipe shall be replaced at the expense of the Contractor. All flange bearing surfaces shall be uncoated.

2. All exterior coating and linings shall be applied to the ductile iron surface that has been mechanically cleaned or brush blasted. Chemical cleaning or wiping with solvent as a preparation method is not acceptable.

3. Shop Prime Coat for Ductile Iron Pipe: (Epoxy, Polyamidoamine Shop Primer):

a. TNEMEC: Series N140 Pota-Pox-Plus.
b. Carboline: Carboguard 561.
c. Sherwin-Williams Company (The): Macropoxy 846 NSF Winter Grade Epoxy Mill White.
d. PPG PMC Aquapon HB Potable Water Epoxy Coating 95-132 Series or PPG PMC Amerlock 2 Epoxy.
e. Or equal.

4. Field Coating: Interior non-submerged ferrous metals:
   a. 1 coat Series 94-H20 Hydro-Zinc on properly prepared unprimed metal or for touch-up (2.0-3.0 DFT)
   b. 2 coats Series L69 (3.0 DFT)
   c. The following types of paints by Tnemec Co. have been used as a basis for coatings unless otherwise noted:
      1) Hi-build Epoxoline II (Series L69) – polyamidoamine epoxy.
      2) Hydro-Zinc (Series 94-H20) – organic vehicle zinc-rich (NSF Standard 61 certified).

F. Pipe Hangers and Supports:

1. Pipe hangers and supports shall be provided at suitable distance along the pipeline regardless whether they are shown or not shown on the Drawings.

PART 3 EXECUTION

3.01 PIPE INSTALLATION

A. General

1. Piping and fittings shall be installed true to alignment and rigidly supported. Anchorage shall be provided where required. Any damage to linings shall be repaired to the satisfaction of the Engineer before the pipe is installed. Each length of pipe shall be cleaned out before installation. All of manufacturer's recommendations shall be complied with.

2. Deflection at joints shall not exceed that recommended by the pipe manufacturer. Fittings, in addition to those shown on the Drawings, shall be provided, if required, in areas where conflict exists with the existing facilities.

3. When pipe cutting is acceptable to the Engineer, the cutting shall be done by abrasive saw, leaving a smooth cut at right angles to the axis of the pipe. Any damage to the lining shall be repaired to the satisfaction of the Engineer. Field cut ends shall be sealed with approved epoxy coatingin accordance with manufacturer's instructions.

B. Jointing

1. Flanged joints shall be made using gaskets, bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same ANSI Standard as the flanges.

2. Bolts in flanged joints or mechanical joints shall be tightened alternately and evenly.

3. Sleeve type couplings and grooved joints using split ring couplings shall be installed in accordance with the procedures recommended by their respective manufacturers.

C. Pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, submit a certification stating that such requirements have been complied with.

D. Sleeves of proper size shall be installed for all pipes passing through floors or walls. Sleeves shall be installed as shown on the Drawings. Where indicated on the Drawings or required for liquid or gas-tightness, the pipe shall be sealed with a mechanical seal similar to Link-Seal as manufactured by Thunderline Corporation, or equal.

E. Sleeves and wall pipes shall have thrust collar located at the mid-depth of wall.

F. Concrete inserts for hangers and supports shall be furnished and installed as recommended by the manufacturer as shown on the Drawings or as specified herein. The inserts shall be set in accordance with the requirements of the piping layout and their locations verified from approved piping layout drawings and the structural drawings.

3.02 TESTING

A. Piping shall be subject to acceptance tests. Provide all necessary utilities, labor and equipment for flushing and testing and dispose all waste after the test including water.

B. Pipe and fittings shall be pressure tested using water to 1.5 times the working pressure for one hour and the pipeline shall show no leakage.

C. Correct any leakage and repair any damage to the pipe and pipe appurtenances or to any structures resulting from, or caused by tests. All leaks shall be repaired and lines retested.

3.03 CLEANING

A. Clean the pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. All debris shall be removed from the pipeline. The lowest segment outlet shall be flushed last to assure debris removal.

END OF SECTION 15072

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SECTION 15100
VALVES AND APPURTENANCES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete and ready for operation and test all non-buried valves as shown on the Drawings and as specified herein.

B. The equipment shall include, but not be limited to, the following; however, not all items specified herein may be included in this project.

1. General Requirements.

2. Valve Actuators – Manual.

3. Valve Actuators – Powered.

4. Plug Valves.

5. Ball Valves.

6. Pressure Regulating Valves.

7. Solenoid Valves.

8. Flexible Connectors
   a. Dismantling Joint.
   b. Flexible Coupling.
   c. Split Restraint Harness.

1.02 RELATED WORK

A. Instrumentation, not specified herein, is included in Division 13.

B. Electrical work is included in Division 16.

C. Certain items similar to those specified in this Section may be specified to be furnished and installed with individual equipment or systems. In case of a conflict, those individual equipment or system requirements shall govern.

D. Electric valve operators of all types, rate of flow controllers (including modulating valves and operators) and other types of valves which are part of the automated instrumentation (such as some solenoid valves) if not included herein are included in Division 13. Valve operators shall, however, be mounted at factory on valves as specified herein, as part of the work of this Section.

1.03 SUBMITTALS

A. Submit to Engineer, in accordance with Section 01300, materials required to establish compliance with this Section. First submittal shall be valve schedule described herein. Approval

of valve schedule submittal is required prior to Contractor submitting any of equipment in this specification. Subsequent Equipment Submittals shall include at least the following:

1. Valve tag number.
2. Manufacturer and supplier.
3. Address at which equipment will be fabricated or assembled.
4. Drawings showing assembly details, materials of construction and dimensions.
5. Descriptive literature, bulletins, and/or catalogs of the equipment.
6. Total weight of each item.
7. A complete bill of materials.
8. Additional submittal data, where noted with individual pieces of equipment.
9. Individual electrical control schematics and wiring diagrams for each valve operator with external interfaces, identified exactly as detailed on Electrical and Instrumentation Drawings. Standard catalogue cut sheets that show typical wiring diagrams only are not acceptable. Valve actuators shall be coordinated with electrical requirements shown on Drawings and valves as specified herein.

B. Test Reports:

1. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS-SP-61 for valves.

C. Certificates:

1. For each valve specified to be manufactured, tested and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with appropriate standards, including certified results of required tests and certification of proper installation.

D. Manufacturer's Installation and Application Data.

E. Operating and Maintenance Data.

1. Operating and maintenance instructions shall be furnished to Engineer as provided in Section 01730. Instructions shall be prepared specifically for this installation and shall include required cuts, drawings, equipment lists, descriptions and other information required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.04 QUALITY ASSURANCE

A. Certifications:

1. Manufacturers shall furnish an affidavit of compliance with Standards referred to herein as specified herein. Refer to Part 3 for testing required for certain items in addition to that required by referenced standards.

B. Provide services of a qualified and factory-trained service representative of manufacturer to provide operational and maintenance instruction, for a one day, eight-hour period for each type of the following equipment:

1. Valve motor operators.

C. Inspection of units may also be made by Engineer or other representative of Owner after delivery. Equipment shall be subject to rejection at any time due to failure to meet any of specified requirements, even though submittal data may have been accepted previously. Equipment rejected after delivery shall be marked for identification and shall be removed from job site at once.

1.05 SYSTEM DESCRIPTION

A. Equipment and materials specified herein are intended to be standard for use in controlling flow of water, wastewater, sludge, air, and chemicals as noted on Drawings.

B. Valves, appurtenances and miscellaneous items shall be installed as shown on Drawings and as specified, so as to form complete workable systems.

C. Unless otherwise noted, powered valve operators shall have:

1. Valves larger than 3-in: electric operators 460 Volt, 3 Phase, 60 Hz.

2. Valves 3-inch and under: electric operators, 120 Volt, 1 Phase, 60 Hz.

3. Solenoid valves: 120 volt, single phase, 60 Hz, NEMA 4 enclosure, continuous duty Class F coils and manual operator. Solenoid valves for seal water systems shall be "fail open" design; others shall be "fail closed" unless otherwise noted on Drawings or in the Instrumentation specifications.

1.06 DELIVERY, STORAGE AND HANDLING

A. Reference is made to Section 01600 for additional information.

B. Packing and Shipping:

1. Care shall be taken in loading, transporting and unloading to prevent injury to the valves, appurtenances, or coatings. Equipment shall not be dropped. Valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Damage to the coatings shall be repaired as acceptable to Engineer.

2. Prior to shipping, ends of valves shall be acceptably covered to prevent entry of foreign material. Covers shall remain in place until after installation and connecting piping is completed.
   a. Valves 3-inch and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.
   b. Valves smaller than 3-inch shall be shipped and stored as above except that heavy cardboard covers may be used on the openings.
   c. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until the valve is installed and put into use.

d. Corrosion in evidence at the time of acceptance by the Owner shall be removed, or the valve shall be removed and replaced.

C. Storage and Protection:

1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping sections and manufacturer's information for further requirements.

1.07 MAINTENANCE

A. Special tools and the manufacturer's standard spare parts, if required for normal operation and maintenance, shall be supplied with the equipment in accordance with Section 01730 and where noted, as specified herein. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.

B. Provide one operations and maintenance manual for each type of valve and operator supplied under this specification in accordance with Section 01730.

C. Included within operations and maintenance manuals, provide a list of all spare and replacement parts with individual prices and location where they are available.

1.08 VALVE DESIGNATIONS AND SCHEDULE

A. Valves shall be identified by a unique valve tag as identified in valve schedule prepared by Contractor. Specific type of valve to be used will be identified by symbol and/or call out on Drawings. Contractor shall identify each valve by its assigned tag number on shop drawings and equipment submittals.

B. Contractor shall refer to the P&IDs and mechanical plans for type of each valve called out by abbreviation or drawing symbol. Prior to first valve submittal, Contractor shall submit a detailed valve schedule listing process valves to be furnished along with Contract Drawing P&IDs edited electronically which shall include valve tag numbers prepared by Contractor identifying each valve. Valve schedule shall include: valve tag number; valve designation; valve size; end connections and operator type. An excerpt of an EXAMPLE schedule is as follows:

Valve Tag.	Designation	Size	Ends	Operator	Notes
1000-1	BFV1	8-in	Flanged	Gear/Handwheel	Extra description as necessary
1000-2	BFV1	8-in	Flanged	Gear/Handwheel	
1005	PV1	6-in	Flanged	EM	

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT – GENERAL

A. Reference is made to Division 1 for additional requirements, including nameplates, provisions for temporary pressure gauges, protection against electrolysis and anchor bolts.

B. Use of a manufacturer's name and/or model or catalog number is for purpose of establishing standard of quality and general configuration desired.

C. Valves and appurtenances shall be of size shown on the Drawings or as noted and as far as possible equipment of same type shall be identical and from one manufacturer.

D. Valves and appurtenances shall have name of maker, nominal size, flow directional arrows, working pressure for which they are designed and standard referenced, cast in raised letters or via riveted stainless steel nameplate upon some appropriate part of the body.

E. Unless otherwise noted, items shall have a minimum working pressure of 150 psi or be of same working pressure as pipe they connect to, whichever is higher and suitable for pressures noted where they are installed.

F. Joints, size and material – unless otherwise noted or required by Engineer:

1. Except where noted, joints referred to herein shall be of same type, nominal diameter, material and with a minimum rating equal to pipe or fittings they are connected to.

2. Valves and appurtenances shall be of same nominal diameter as pipe or fittings they are connected to.

3. Valves exposed to view, or in vaults:
   a. Plastic valves in chemical service – solvent cement, or flanged ends.
   b. 3-inch and smaller – threaded ends, unless noted otherwise herein or on Drawings.
   c. 4-inch and larger – flanged ends.

G. Provide special adaptors as required to ensure compatibility between valves, appurtenances, and adjacent pipe.

H. No alternative materials will be considered for approval unless complete documentation is provided regarding their satisfactory long-term use in similar conditions; in addition, the consideration of any substitution will be considered only if superiority of proposed materials is the intent of substitution, and only if sufficient evidence is provided to document that superiority.

2.02 VALVE ACTUATORS – GENERAL/ MANUAL

A. Geared actuators shall be suitable for all weather service, with mechanical shaft seals, shall be permanently greased, or shall have provisions for greasing. Actuators for submerged duty shall be so rated, with certification by manufacturer for submerged service.

B. Valve manufacturer shall supply, mount, and test all actuators on valves at factory. Valves and their individual actuators shall be shipped as a unit.

C. Unless otherwise noted on Drawings, valves shall be manually actuated; non-buried valves shall have an operating wheel, handle or lever mounted on operator; those with operating nuts shall have a non-rising stem with an AWWA 2-inch nut; At least two tee handles shall be provided for operating nuts. Unless otherwise noted, operation for valves shall be CCW open.

D. Except as otherwise shown on Drawings or specified herein, valves 3-in diameter or larger, with valve hand wheel center line located 7-ft or more above operating floor, shall be provided with chain wheel operators complete with chain guides and hot dipped galvanized steel chain, which loop within 4-ft of operating floor.

E. Actuators shall be capable of moving valve from full open to full close position and in reverse and holding valve at any position part way between full open or closed.

F. Each operating device shall have cast on it the word "OPEN" and an arrow indicating direction of operation.

G. Gear Actuators:

1. Unless otherwise noted, gear actuators shall be provided for the following: plug and ball valves larger than 3-inch diameter; where specified and/or indicated on Drawings; where manual operator effort is greater than 40 lbs rim pull.

2. Actuators shall be capable of being removed from valve without dismantling the valve or removing valve from the line.

3. Gear actuators for quarter turn valves shall be of worm or helical worm gear type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on output shaft. Where shown on Drawings, a two-inch cast-iron operating nut shall be provided. Actuators shall conform to AWWA C504 except where more stringent requirements are provided hereinafter. Gearing shall be machine cut steel designed for smooth operation. Bearings shall be permanently lubricated, with bronze bearing bushings provided to take thrusts and mechanical shaft seals to contain lubricants. Housings shall be sealed to exclude moisture and dirt, allow reduction mechanisms to operate in lubricant and be constructed of cast iron, ASTM A 126, Grade B, or of ductile iron, ASTM A 536. Gear housing bodies for thermoplastic valves may be cast aluminum or fabricated steel to reduce weight. Gear actuators shall indicate valve position and have adjustable stops.

4. Manual Input torque to produce required valve operating torque for worm and travelling nut gear operators shall not exceed 80 ft-lbs. In addition, hand wheel rim pull shall not exceed 20 lbs for valve sizes up to 12 inches, 40 lbs for valve size between 14 and 20 inches, 60 lbs for valve size 24 and greater. Minimum hand wheel size shall be 8 inches for up to 12-inch valve size, 12 inches for up to 16 inch valve size, 18 inches for up to 20 inch size.

5. Gear actuators for multi turn valves shall be of bevel or spiral bevel type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on output shaft. Gearing shall be machine cut steel designed for smooth operation. Bearings shall be permanently grease lubricated, with dual anti-friction ball bearings on output shaft and mechanical shaft seals to contain lubricants. Output flange of primary gear reducer shall be designed to meet an appropriate MSS or ISO standard to allow mounting to secondary gear reducer. Ring gear shall ride on ball bearings. Stem nut shall be bronze alloy, shouldered, and ride on needle bearings. Housing components shall be O-ring sealed to exclude moisture and dirt, constructed of cast iron, ASTM A 126, Grade B, or of ductile iron, ASTM A 536. Gear housing bodies for thermoplastic valves may be cast aluminum or fabricated steel to reduce weight. Manual operator input effort to the hand wheel shall be a

maximum of 30 lbs for operating the valve from full open to full close, under any conditions. Maximum hand wheel size shall be 24-inch diameter.

H. Additional valve actuator requirements are included with the individual valve types and as noted herein.

I. Position indication and direction of opening arrows shall be embossed, stamped, engraved, etched, or raised castings. Decals or painted indications shall not be allowed.

J. Unless otherwise noted, valves larger than 3-in nominal diameter shall be provided with position indicators at the point of operation.

2.03 VALVE ACTUATORS – POWERED

A. General:

1. Operated on 480-volt power.

2. Actuators shall conform to AWWA Standard C540, insofar as applicable and as herein specified. Actuators shall be O-ring sealed, watertight to standard NEMA 4X/6, submersion to 6 feet for 30 minutes. Actuators installed in vaults below grade and elsewhere subject to submergence shall be watertight to standard NEMA 6P/IP68, 15 ft for 72 hours minimum. Actuators installed in hazardous locations as noted on the Electrical Drawings and/or area classification sheets of the Architectural Drawings shall be FM certified explosion proof for Class 1 Division 1 & 2, Groups C & D and also meet the standard NEMA 4X/6 rating.

3. Valve service/operation shall be as indicated on the P&IDs and as specified in the Process Control Strategies in Section 13305.

4. 480 Volt powered actuators shall be Rotork IQ/IQM; Limitorque MX; EIM TEK 2000; AUMA SA/SAR. Actuators shall be configured as required to provide for part turn or multi-turn and be coupled with gearboxes as required to obtain the speed and operating torque as required for the valve or gate it controls.

5. Modulating actuators shall contain proportional control unit and be capable of 1200 starts per hour, open-closed valve actuators shall not require a proportional control unit and be capable of 60 starts per hour.

6. Where shown on Instrumentation Drawings, actuators shall have a digital control module, to allow valves or gates to be positioned remotely via a 2-wire non-proprietary field bus protocol. Digital control module shall be equipped with serial communication ports to allow actuation to be linked by a two-wire local area network utilizing Modbus function code (report by exception) and arranged in a self-healing ring configuration, with multi-drop taps to each actuator.

B. 480 Volt Powered Actuators for Part Turn or Multi-Turn Valve Operation:

1. Operation:
   a. Capabilities shall be provided to position valve (or gate) locally via Local/Off/Remote selector switch and Open/Stop/Close push buttons.

b. For on/off service, when in remote, actuator shall accept one remote signal to open valve or gate and a second remote signal to close valve or gate.
c. For modulating service, when in remote actuator shall accept a 4-20mADC position control signal and shall position valve 0-90 degrees or gate 0-100% of travel in proportion to control signal.
d. Unless stated otherwise in valve specifications, actuator and gearing size shall be designed to operate valve at a disc speed of one-foot travel per minute of operation. For quarter turn valves, valves shall rotate from stop to stop in 30 seconds per foot of throat diameter.

2. Functional:
   a. Motor operated valve controller shall include motor, operator unit gearing, limit switch gearing, limit switches, control power transformer, position transmitter (when required), torque switches, bored and key-wayed drive sleeve for non-rising stem valves, declutch lever and auxiliary handwheel as a self-contained unit. Valve contacts shall be capable of handling the current equivalent of a NEMA 1 size starter.
   b. Reversing starters shall be integral with actuator and shall be solid-state starters for modulating service. Electro-mechanical reversing starters shall be acceptable for open-close service and shall be mechanically and electrically interlocked.
   c. Limit switches and gearing shall be an integral part of valve control. Limit switch gearing shall be made of bronze or stainless steel and shall be fully lubricated, intermittent type and totally enclosed to prevent dirt and foreign matter from entering gear train. Limit switches shall be of adjustable type capable of being adjusted to trip at any point between fully opened valve and fully closed valve. Limit and torque switches shall be provided for stopping valve in both directions. Mid-travel switches shall be provided as required. Set position shall not be lost if over travel occurs in either manual or electric modes of operation.
   d. Valve position transmitter shall be a gear actuated, two-wire device, producing 4-20 mADC signal proportional to 0-90-degree valve position or to 0-100% of valve travel. Transmitter shall be provided with easily accessible zero and span adjustment potentiometers. Valve actuator shall be provided with a local digital or mechanical indicator integral with operator with a 0-100 percent scale. DC power supply shall be provided integral with operator and powered from 110-volt AC internal transformer. Positioner board shall provide repeatable accuracy to 0.25 percent of span. There shall be separate trim pots on positioner board for zero, span and dead band adjustment.
   e. Speed of actuator shall be responsibility of system supplier with regards to hydraulic requirements and response compatibility with other components within control loop. Each valve controller shall be provided with a minimum of two limit switch functions, one for opening and one for closing. Each limit switch will have two normally open and two normally closed contacts. Gear limit switches shall be geared to driving mechanism and in step at all times whether in motor or manual operation. Provision shall be made for two extra sets of limit switches as described above, each to have two normally open and two normally closed contacts. Each valve controller shall be equipped with a double torque switch. Torque switch shall be adjustable and responsive to load encountered in either direction of travel. Limit and torque switch contacts shall be silver inlay type.
   f. Each actuator shall include monitor relays to remotely indicate fault signal for indication of power failure, phase failure, thermal switch tripped, torque switch tripped between travel stops and Local-Off-Remote selector switch position.

3. Physical:

a. Operator shall be equipped with open-stop-close pushbuttons, a local-off-remote selector switch and indicating lights mounted on operator. Where operator will not be situated between 2-ft-0-in and 7-ft-0-in above operator platform, and where shown on Drawings provide a separate remote valve operating station.
b. Motor shall operate on 460-volt, 60 hertz, 3 phase power and shall be sized by actuator manufacturer to provide the required output torque for service intended. Motor shall have Class F insulation, with a duty rating of at least 15 minutes at 40 degrees C ambient temperature. Motor shall be specifically designed and built by actuator manufacturer for electric actuator service. Commercially available motors shall not be acceptable. Actuator shall include a device to ensure that motor runs with correct rotation for required direction of valve travel regardless of connection sequence of the power supply.
c. Operators utilizing multiple reduction power gearing shall consist of spur, helical, or bevel gearing and worm of hardened alloy steel, and the worm gear shall be alloy bronze. Operators utilizing single-stage reduction shall be single-stage worm gear totally enclosed in a fully lubricated gearcase, with filling and drain plugs. Non-metallic, aluminum, or cast gearing shall not be allowed. Output shaft shall incorporate thrust bearings of the ball or roller type at the base of the actuator.
d. An operating wheel shall be provided for manual and/or emergency operation, engaged when motor is declutched by a lever or similar means, the drive being restored to power automatically by starting the motor. Operating wheel drive shall be mechanically independent of motor drive, and any gearing shall be such as to permit emergency manual operation, using a 40-pound force in a reasonable time. Clockwise operation of handwheel shall give closing movement of valve unless otherwise stated.
e. Each actuator shall be supplied with a start-up kit including installation instructions, wiring diagrams, and spare cover screws and seals to provide for losses during commissioning.
f. Continuous mechanical dial indication of valve and position shall be provided. Mechanical dial position indicator shall be in step with actuator at all times in both hand wheel and motor operation. For modulating applications, mechanical dial position indicator shall include graduations of 0-100 percent scale.

4. Wiring and Terminals:
   a. Internal wiring shall be of tropical grade PVC insulated stranded cable of 5-amp minimum rating for control circuits and of appropriate size for the motor 3 phase power. Each wire shall be clearly identified at each end.
   b. Terminals shall be of stud type embedded in a terminal block of high tracking-resistance compound. The 3-phase power terminals shall be shrouded from control terminals by means of an insulating cover.
   c. Terminal compartment shall be separated from inner electrical components of actuator by means of a watertight seal. Terminal compartment of actuator shall be provided with three threaded cable entries.
   d. Each actuator shall be provided with a commissioning kit consisting of a wiring diagram and installation and operation manual. A separate wiring diagram shall be provided inside the terminal cover. No special tools, devices or parts shall be required for commissioning.
   e. Actuators shall have separately sealed motor and control compartments. Operators shall have space heaters in their limit switch, motor, and control compartments.

5. Remote Control Stations:

a. Where shown on Drawings, or where specified in Equipment Specifications, valve actuators shall be furnished with control stations suitable for mounting remotely from, but, in vicinity of actuator. Remote mount control station shall include a Local - Off - Remote selector switch, Open - Stop - Close pushbuttons and Open - Close indicating lights. Control station operators shall be heavy duty devices mounted in a cast iron, cast aluminum, or stainless steel NEMA 4X enclosure suitable for wall mounting. Wire gage and device quality shall meet or exceed the requirements of Division [16][26]. Local - Off - Remote selector switch shall have auxiliary contacts for remote indication of switch position. Local - Off - Remote selector switch shall have provisions for padlocking in the "Off" position. Additional functionality and/or devices to those specified above are detailed on Instrumentation P&IDs and/or Electrical Control Schematic drawings. Refer to Drawings for confirmation of scope of the Remote Control Stations.

6. Performance Test:
   a. Each actuator shall be shop performance tested, and individual test certificates shall be supplied without additional charge to Owner. Test certificates shall be submitted prior to shipment of valve actuators. Test equipment shall simulate a typical valve load, and the following parameters shall be recorded:
      1) No load current.
      2) Current at maximum torque setting.
      3) Stall current.
      4) Torque at maximum torque setting.
      5) Stall torque.
      6) Test voltage and frequency.
      7) Flash test voltage.
      8) Actuator output speed.

2.04 WATER PRESSURE-REDUCING VALVES

A. Water Regulators

1. Manufacturers: CLA-VAL Automatic Control Valves, Newport Beach, CA; GA Industries Inc., Cranberry Township, PA; Ross Valves, Troy, NY.

2. Standard: ASSE 1003.

3. Pressure Rating: 150 psig.

4. Size: 1/2 inch.

5. Design Flow Rate: Coordinate with pump manufacturer.

6. Design Inlet Pressure: 70 to 100 psig.

7. Design Outlet Pressure Setting: 60 psig.

8. Body: Bronze with chrome-plated finish.

9. End Connections: Threaded.

2.05 GATE VALVES

A.

A. Gate Valves 3 inch and Smaller:

1. General Requirements:
   a. ASME Compliance:
      1) ASME B1.20.1 for threads for threaded end valves.
      2) ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   b. NSF Compliance: NSF 61 Annex G for valve materials for potable-water service.
   c. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
   d. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
   e. Valve Sizes: Same as upstream piping unless otherwise indicated.

2. Bronze Gate Valves:
   a. Bronze Gate Valves, NRS, Class 125:
      1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
         a) American Valve, Inc.
         b) Apollo Flow Controls; Conbraco Industries, Inc.
         c) Crane; a Crane brand.
         d) NIBCO INC.
         e) Stockham; a Crane brand.
      2) Description:
         a) Standard: MSS SP-80, Type 1.
         b) CWP Rating: 200 psig (1380 kPa).
         c) Body Material: Bronze with integral seat and screw-in bonnet.
         d) Ends: Threaded or solder joint.
         e) Stem: Bronze.
         f) Disc: Solid wedge; bronze.
         g) Packing: Asbestos free.
         h) Handwheel: Malleable iron, bronze, or aluminum.

2.06 PLUG VALVES:

A. Plug valves shall be of offset disc type, 1/4 turn, non-lubricated, serviceable (able to be repacked) under full line pressure and capable of sealing in both directions at rated pressure. Disc shall be completely out of flow path when open. Plug valves specified herein shall be manufactured by DeZurik; M&H Valve; or approved equal. Manufacturers named or otherwise, shall comply completely with this Section.

1. Minimum port area shall be 80 percent when measured by percent cross-sectional area of equivalent size (nominal same diameter) pipe.

2. Plug valves shall be capable of passing "pigging" cleaning equipment (using a Girard or similar cleaning pig of full nominal pipeline diameter) in either direction and manufacturer shall so certify that this may be done without use of special equipment.

B. Valves shall be rated at minimum 175 psi WOG (Water, Oil and Gas) working pressure for sizes 4-in to 12-in inclusive and at minimum 150 psi WOG working pressure for sizes 14-in and larger and shall be capable of providing drop tight shut-off to full valve rating with pressure on either side of plug.

1. Plug valves under this Paragraph shall be performance, leakage and hydrostatically tested in accordance with AWWA C517, except as modified herein.

2. At above rated minimum working pressures, valves shall be certified by manufacturer as permitting zero leakage for a five-minute duration with full pressure applied in either direction.

3. At direction of Engineer, valve manufacturer may be requested to perform a valve seat leakage test, witnessed by Engineer to prove compliance with this Section.

C. Valve bodies shall be of cast iron, 30,000 psi tensile strength, ASTM A 126, Grade B, or of ductile iron, ASTM A 536 and of top entry, bolted bonnet design, cast with integral flanges conforming to connecting piping. Exposed bolts, nuts, and washers shall be zinc or cadmium-plated, except for submerged valves, which shall have Type 316 stainless steel hardware.

D. Valve Plug:

1. Buna N coated, cast iron ASTM A 126, Grade B, or ductile iron, ASTM A 536, Grade 65-45-12.

2. Removable without removing valve from the line.

3. Integral upper and lower shaft with seals on upper and lower journals to prevent entrance of solids into journals.

4. One piece.

E. Shaft bearings shall be permanently lubricated stainless steel or bronze at both upper and lower stem journals. Operator shaft shall have easily replaceable seals, which shall be externally adjustable and repackable without removing bonnet from valve or shall have self-adjusting packing.

F. Valve seating surface shall provide full 360-degree seating by contact of a resilient seating material on plug mating with welded-in high nickel content overlay seating surface in body.

1. Seating design shall be resilient and of continuous interface type having consistent opening and closing torques and shall be non-jamming in closed position. Screw-in seats shall not be acceptable.

2. Plugs shall have a full resilient facing of neoprene or Buna-N.

G. Valves 6 inches and larger shall be actuated via gearbox and hand wheel, unless mechanized, which shall require gearbox and actuator. A suitably sized steel actuator mounting bracket shall be provided to provide an air gap between actuator and valve stem seal. Under no circumstance shall gear box be mounted directly to top body flange such that leakage could directly enter gear box.

H. Plug valves shall be installed so that direction of flow through valve and shaft orientation is in accordance with manufacturer's recommendations. Unless otherwise noted, shaft shall be horizontal, with plug opening up.

2.07 BALL VALVES: TAG TYPE NOTED BELOW

A. Brass Ball Valves, One-Piece:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. KITZ Corporation.

2. Description:
   a. Standard: MSS SP-110.
   b. CWP Rating: 400 psig (2760 kPa).
   c. Body Design: One piece.
   d. Body Material: Forged brass or bronze.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass or stainless steel.
   h. Ball: Chrome-plated brass or stainless steel.
   i. Port: Reduced.

B. Iron Ball Valves, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. American Valve, Inc.
   b. Apollo Flow Controls; Conbraco Industries, Inc.
   c. WATTS.
   d. Zurn Industries, LLC.

2. Description:
   a. Standard: MSS SP-72.
   b. CWP Rating: 200 psig (1380 kPa).
   c. Body Design: Split body.
   d. Body Material: ASTM A126, gray iron.
   e. Ends: Flanged or threaded.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel.
   i. Port: Full.

2.08 SOLENOID VALVES:

A. Solenoid valves shall be packless piston type direct acting for sizes less than 1-in and internal pilot operated for sizes 1-in and larger, 2-way or 3-way, valves and shall be ASCO Valve; Red Hat by Automatic Switch Co., similar by Circle Seal Controls-Atkomatic Valve Co. or equal for air and water service.

B. Valves shall be energized to open, except for valves on water seal lines to pumps which shall be energize to close.

C. Valves shall have forged brass bodies, NPT end connections of connected piping Type 304 stainless steel internal parts, and Buna-N or Ethylene Propylene valve seats. Valves shall have a minimum 150 psig safe working pressure and zero minimum operating pressure differential. Connections shall be threaded.

D. Solenoid valves size 2-inch and larger shall be full bore bronze body, Type 430 stainless steel plunger, copper coil class A encapsulated, Type 302 stainless steel spring, wash-down safe, equal to type A as manufactured by Magnatrol Valve Corp., Hawthorne, NJ or equal. Solenoid valves shall have a manual override actuated by a handle levered plunger mounted on bottom of valve body. These valves shall be mounted in a horizontal run of piping, with solenoid up in vertical position.

E. Note that solenoid valves may be shown on Electrical and/or Mechanical Drawings, or may only be specified, but if so specified or shown, shall be provided. Solenoid valves located in hazardous classified areas shall be provided with electrical enclosures which satisfy electrical classification as specified or shown on Electrical Drawings.

2.09 FLEXIBLE CONNECTORS

A. General

1. Where flexible connectors are indicated on the Drawings, they are provided to permit pipe dismantling for equipment removal and to provide for minor misalignment which may occur in pipe installation unless otherwise specified or indicated on drawings. Any of the following flexible connectors may be used by the Contractor for these locations subject to the characteristics of the connector.

B. Dismantling Joint

1. Dismantling joints shall be self-contained flanged restrained joint fittings furnished as a complete assembly (spigot piece, flange adaptor, tie bars and gasket) allowing for up to 2 inches of longitudinal adjustment. Design pressure rating shall be equal or greater than that of the mating flange with an inside diameter matching that of the mating flange. All bolts and nuts shall be 316 stainless steel with removable locking device.

2. All exterior surfaces shall be shop primed and shop painted prior to delivery on site. Contractor shall perform prime and/or paint touch up in the field in accordance with Division 9.

3. Dismantling joints shall be Viking Johnson Dismantling Joint, Romac DJ400, JCM Industries JCM 309, or approved equal.

C. Flexible Coupling

1. Provide plain end type ends to be joined by sleeve couplings as stipulated in AWWA C219.
   a. Join welds on ends by couplings without pipe stops. Grind flush to permit slipping coupling in at least one direction to clear pipe joint.
   b. Outside diameter and out-of-round tolerances shall be within limits specified by coupling manufacturer.
   c. Provide lugs in accordance with ASTM A36.
   d. Provide hardened steel washers in accordance with ASTM A325.
   e. Plastic plugs shall be fitted in coupling to protect bolt holes.
   f. Nuts and bolts
      Provide bolts and bolt-studs in accordance with ASTM A307 and ANSI B1.1 with hexagonal or square heads, coarse thread fit, threaded full length with ends chamfered or rounded.
      Project ends 1/4-in beyond surface of nuts.
      Hexagonal nuts with dimensions in accordance with ANSI B18.2 and coarse threads in accordance with ANSI B1.1.

2. Middle ring of each mechanical coupling shall have a thickness at least equal to that specified for size of pipe on which coupling is to be used and shall not be less than 10-inch long for pipe 30-inch and larger and not less than 7-inch long for pipe under 30-inch in diameter.
   a. Omit pipe stop from inner surface of middle rings of couplings whenever necessary to permit removal of valves, flowmeters and other installed equipment.
   b. Provide pipe stops in other couplings.

3. Clean and shop prime with manufacturer's standard rust inhibitive primer.

4. Furnish gaskets of a composition suitable for exposure to the fluid service.

5. Where shown on the Drawings, anchor sleeve-coupled joints with harness bolts. Weld harness lugs to steel pipe.
   a. Joint harness bolts shall be of sufficient length, with harness lugs placed so that coupling can be slipped at least in one direction to clear joint. Provide harnesses of sufficient number and strength to withstand test pressure as recommended in AWWA M-11.
   b. Each harness shall have a minimum of two 5/8-in diameter bolts.

6. Unless otherwise specified with the individual type of pipe, sleeve couplings (mechanical couplings) shall be Victaulic Depend-O-Lok E x E (unrestrained) or F x F (self-restrained); ITT (formerly Smith Blair) Style 411; Dresser Style 38; Romac Style 501 similar models by Baker or equal, with the pipe stop removed.

7. Similar insulation type couplings shall be provided at the face of buildings, between different type metals or where otherwise noted.

8. In addition to those locations noted on the Drawings, sleeve couplings shall be provided on all piping where it connects with a structure or buried directly under a structure at the structure's expansion joints. Special treatment will be required where pipe is encased in

concrete, utilizing minimum 3-inch thick styrofoam placed perpendicular to the horizontal centerline of the coupling.

2.10 HARNESSING AND RESTRAINT

A. Split Restraint Harness

1. Where harnessed couplings or adapters are noted, they shall conform to AWWA Manual M11 except as modified by the Drawings or this Section.

2. Unless otherwise noted, size and material for tie rods, clamps, plates and hex nuts shall be as shown on the Drawings, or, if not shown on the Drawings, shall be as required in AWWA Manual M11. Manufactured restraining clamp assemblies shall be as manufactured by Stellar Corporation, Columbus, OH, or equal.

3. Restrained joints (such as welded, locking mechanical joints) shall be of the type specified with the individual type of pipe. If not specified, restrained (locking) mechanical joint pipe shall be of the manufacturer's standard design utilizing a locking device (ring or ears) integrally cast with the pipe.

4. For Ductile Iron Pipe: EBAA Iron, Inc. Megalug 1100CH series.

5. The Contractor shall be responsible for anchorage including restraint as noted elsewhere in Division 15.

2.11 SURFACE PREPARATION AND SHOP COATINGS

A. Notwithstanding any of these specified requirements, coatings and lubricants in contact with potable water shall be certified as acceptable for use with that fluid.

B. If manufacturer's requirement is not to require finished coating on interior surfaces, then manufacturer shall so state and no interior finish coating will be required, if acceptable to Engineer.

C. Exterior surface of various parts of valves, operators, floor-stands and miscellaneous piping shall be thoroughly cleaned of all scale, dirt, grease or other foreign matter and thereafter one shop coat of an approved rust-inhibitive primer such as Inertol Primer No. 621 shall be applied in accordance with instructions of paint manufacturer or other primer compatible with finish coat provided.

D. Unless otherwise noted, interior ferrous surfaces of valves shall be given a shop finish of an asphalt varnish conforming to AWWA C509, (except mounting faces/surfaces) or epoxy conforming to AWWA C550 with a minimum thickness of 6 mils.

E. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating. Mounting surfaces shall be especially coated with a rust preventative.

F. Special care shall be taken to protect uncoated items and plastic items, especially from environmental damage.

2.12 FACTORY INSPECTION AND TESTING

A. Factory inspection, testing and correction of deficiencies shall be done in accordance with the referenced standards and as noted herein.

B. See Division 1 for additional requirements. Also refer to Part 1, especially for required submission of test data to Engineer.

C. In addition to tests required by referenced standards, the following shall also be factory tested:

1. Pressure regulating valves shall be factory tested at specified pressures and flows.

2. All types of air and vacuum valves.

PART 3 EXECUTION

3.01 INSTALLATION – GENERAL

A. Valves and appurtenances shall be installed per manufacturer's instructions in locations shown, true to alignment and rigidly supported. Damage to above items shall be repaired to satisfaction of Engineer before they are installed.

B. Install brackets, extension rods, guides, various types of operators and appurtenances as shown on Drawings, or otherwise required. Before setting these items, check Drawings and figures which have a direct bearing on their location. Contractor shall be responsible for proper location of valves and appurtenances during construction of the work.

C. Materials shall be carefully inspected for defects in construction and materials. Debris and foreign material shall be cleaned out of openings, etc. Valve flange covers shall remain in place until connected piping is in place. Operating mechanisms shall be operated to check their proper functioning and nuts and bolts checked for tightness. Valves and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to Owner.

D. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified, and Contractor shall certify such. Also note additional requirements in other parts of this Section.

E. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing same procedures as specified under applicable type connecting pipe joint and valves and other items shall be installed in proper position as recommended by manufacturer. Contractor shall be responsible for verifying manufacturers' torqueing requirements for all valves.

3.02 INSTALLATION OF MANUAL OPERATIONAL DEVICES

A. Unless otherwise noted, operational devices shall be installed with units of factory, as shown on Drawings or as acceptable to Engineer to allow accessibility to operate and maintain item and to prevent interference with other piping, valves, and appurtenances.

B. For manually operated valves 3-inch in diameter and smaller, valve operators and indicators shall be rotated to display toward normal operation locations.

C. Floor boxes, valve boxes, extension stems and low floor stands shall be installed vertically centered over operating nut, with couplings as required and elevation of box top shall be adjusted to conform to elevation of finished floor surface or grade at completion of Contract. Boxes and stem guides shall be adequately supported during concrete placement to maintain vertical alignment.

3.03 INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

A. See also Division 1. Take care not to over pressure valves or appurtenances during pipe testing. If unit proves to be defective, it shall be replaced or repaired to satisfaction of Engineer.

B. Functional Test: Prior to plant startup, items shall be inspected for proper alignment, quiet operation, proper connection and satisfactory performance. After installation, manual valves shall be opened and closed in presence of Engineer to show valve operates smoothly from full open to full close and without leakage. Valves equipped with electric, pneumatic or hydraulic actuators shall by cycled five times from full open to full closed in presence of Engineer without vibration, jamming, leakage, or overheating. Pressure control and pressure relief valves shall be operated in presence of Engineer to show they perform their specified function at some time prior to placing piping system in operation and as agreed during construction coordination meetings

C. Various pipelines in which valves and appurtenances are to be installed are specified to be field tested. During these tests any defective valve or appurtenance shall be adjusted, removed, and replaced, or otherwise made acceptable to Engineer.

D. Various regulating valves, strainers, or other appurtenances shall be tested to demonstrate their conformance with specified operational capabilities and deficiencies shall be corrected or device replaced or otherwise made acceptable to Engineer.

3.04 CLEANING

A. Items including valve interiors shall be inspected before line closure, for presence of debris. At option of Engineer, internal inspection of valve and appurtenances may be required any time that likelihood of debris is a possibility. Pipes and valves shall be cleaned prior to installation, testing disinfection and final acceptance.

END OF SECTION 15100

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SECTION 16110
RACEWAYS, BOXES, FITTINGS AND SUPPORTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install complete raceway systems as shown on the Drawings and as specified herein.

B. Raceways and conductors are not shown completely on the Drawings, including but not limited to raceways and conductors: between switches, receptacles, low voltage power, control, and signal systems, except where they are required to pass through restricted or designated spaces. Conduit and wiring descriptions are indicated on the one line diagrams, riser diagrams and panelboard schedules. Home runs indicated, are to assist the Contractor in identifying raceways to be installed concealed or exposed. Raceways and conductors shall be provided for complete and operating systems. Raceways indicated to be run exposed on the Drawings shall be run near the ceilings or along the walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes and hoists, lighting fixtures, doors and hatches, etc. Raceways indicated to be run concealed shall be run in the center of concrete floor slabs, in partitions, or above hung ceilings, as required.

C. Raceways traversing from an unclassified to a classified area shall be sealed with compound filled conduit sealing fittings to prevent the passage of air and/or vapors from one area to another.

1.02 SUBMITTALS

A. Submit, in accordance with Section 01300, the manufacturers' names and product designation or catalog numbers with marked cut sheets of all materials specified.

PART 2 PRODUCTS

2.01 RACEWAYS AND FITTINGS

A. Steel Conduit and Fittings:

1. Rigid metal conduit (GRS), couplings, factory elbows and fittings shall be heavy wall steel tubing with a hot-dipped galvanized finish inside and out after threading and shall comply with ANSI C 80.1 and UL/6.

2. Acceptable manufacturers:
   a. Allied Tube & Conduit Corp.
   b. Wheatland Tube.
   c. Western Tube and Conduit Corporation.
   d. Or equal.

3. Rigid metal conduit fittings shall be of the threaded type, and shall be steel or malleable iron, with a hot-dipped galvanized finish. Threadless fittings and split couplings are not allowed except in specific applications as approved by the Engineer.

4. Acceptable manufacturers:
   a. Appleton Electric Co.
   b. O-Z Gedney Co.
   c. RACO Inc.
   d. Gould/Efcor.
   e. Steel City.
   f. Or equal.

B. Aluminum Conduit and Fittings:

1. Rigid Aluminum conduit, couplings, factory elbows and fittings shall be 6063 alloy and shall comply with ANSI C80.5.

2. Acceptable manufacturers:
   a. American Conduit by SAPA.
   b. Allied Tube & Conduit Corp.
   c. Wheatland Tube.
   d. Or equal.

C. PVC Coated Rigid Steel Conduit and Fittings:

1. PVC coated rigid steel conduit shall be heavy wall steel tubing with a hot-dipped galvanized finish inside and out after threading with a minimum 0.040-in thick, polyvinyl chloride coating permanently bonded to it and an internal chemically cured urethane or enamel coating. The rigid steel conduit shall comply with ANSI C80.1 and UL/6 prior to coating.

2. PVC coated couplings, factory elbows and fitting shall be furnished with a PVC coating bonded to steel the same thickness as used on the PVC coated conduit. The ends of all couplings, fittings, etc. shall have a minimum of one pipe diameter in length of PVC overlap.

3. Acceptable manufacturers:
   a. "Ocal" as manufactured by Thomas & Betts.
   b. "Plasti-Bond Red" as manufactured by Robroy Industries.
   c. Perma-Cote.
   d. Or equal.

D. Non-Metallic Conduit and Fittings:

1. PVC conduit shall be rigid polyvinyl chloride schedule 40. Rigid PVC conduit shall comply with NEMA TC-2 and UL/651 and shall be sunlight resistant, rated for use with 90 degree C conductors in exposed and direct or concrete encased applications.

2. Connectors, couplings, fittings and ancillary materials shall be supplied by the conduit manufacturer. Connectors, fittings and ancillary materials shall be rated for the environment for which they are installed.

3. Acceptable manufacturers:
   a. CANTEX Inc.
   b. Allied Tube & Conduit Corp.

c. Prime Conduit.
d. Or equal.

E. Liquid-tight Flexible Metal Conduit, Couplings and Fittings:

1. Liquid-tight flexible metal conduit shall be square locked, galvanized steel flexible conduit with a moisture proof, flame resistant, polyvinyl chloride jacket, for use with rigid metal conduit systems. Sealtite, Type UA, manufactured by Anamet Electrical, Inc.; AFC Cable Systems; Electri-Flex Co.; or equal.

2. Liquid-tight conduit fittings shall be hot-dipped mechanically galvanized, positive grounding, screw in type. Provide external bonding lugs on sizes 1-1/4-in and larger. Box connectors shall have insulated throats as manufactured by the Thomas & Betts Co.; Crouse-Hinds Co., O-Z Gedney; or equal.

3. Acceptable Manufacturers:
   a. AFC Cable Systems.
   b. ANAMET Electrical Inc.
   c. Electri-flex Co.
   d. Thomas & Betts.
   e. Crouse Hinds Co.
   f. O-Z Gedney.
   g. Or equal.

2.02 BOXES AND FITTINGS

A. Dry and Damp Location Boxes and Fittings:

1. Outlet boxes shall be zinc-galvanized, extra depth, pressed steel with knockouts and of size and type suitable for the intended application.

2. Boxes that are less than 100 cubic inches in size used for junction or pull boxes shall be zinc galvanized pressed steel not less than 14 USS gauge with appropriate blank covers, minimum size 4-11/16-inch square by 2-1/8-inch deep.

3. Boxes that are 100 cubic inches and larger shall be constructed of hop dip galvanized sheet steel without knockouts. Covers shall be secured with round head brass machine screws. All joints shall be welded and ground smooth.

4. Terminal cabinets shall be NEMA 12 sheet steel unless otherwise shown on the Drawings. Boxes shall be painted and have continuously welded seams. Welds shall be ground smooth and galvanized. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Terminal boxes shall be furnished with latching hinged doors, terminal mounting straps and brackets. Terminal blocks shall be rated not less than 20A, 600V.

5. Acceptable Manufacturers:
   a. Appleton.
   b. Raco.
   c. Steel City.
   d. Hoffman.

e. Electromate Division of Robroy Ind.
f. Wiegmann.

B. Wet Location Boxes and Fittings:

1. NEMA 4X terminal boxes, junction boxes, pull boxes, etc., shall be Type 316 stainless steel unless otherwise shown on the Drawings. Boxes shall have continuously welded seams and mounting feet. Welds shall be ground smooth. Boxes shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be gasketed and fastened with stainless steel clamps. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20 Amps, 600 Volt.

2. Cast or malleable iron device boxes shall be Type FD. Boxes and fittings shall have cadmium-zinc finish with cast covers and stainless steel screws.

3. Cast aluminum device boxes shall be Type FD. Boxes and fittings shall be copper free aluminum with cast aluminum covers and stainless steel screws.

4. Acceptable Manufacturers:
   a. Appleton.
   b. Crouse-Hinds.
   c. Steel City.
   d. Hoffman.
   e. Electromate – Division of Robroy Ind.
   f. Or equal.

C. Corrosive Location Boxes:

1. NEMA 4X PVC coated outlet boxes shall be used with PVC coated conduit shall be furnished with a PVC coating bonded to the metal, the same thickness as used on the coated steel.

2. Acceptable manufacturers:
   a. "OCAL" as manufactured by Thomas & Betts.
   b. "Plasti-Bond Red" as manufactured by Robroy Industries.
   c. Triangle PWC Inc.
   d. Or equal.

3. NEMA 4X terminal boxes, junction boxes and pull boxes shall be Type 316 stainless steel with stainless steel hardware and gasketed covers. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20 Amps, 600 Volt.

4. Acceptable Manufacturers:
   a. Hoffman.
   b. Stahlin – Division of Robroy Ind.
   c. English Electric.
   d. Or equal.

D. Hazardous (Classified) Location Boxes:

1. Explosion-proof boxes shall be designed for Class 1, Group D, Division 1 hazardous locations, and shall also have O-ring seals to meet NEMA 7 requirements. Boxes and covers shall be aluminum, with stainless steel hinges and stainless steel bolts; Type EJB-N4 as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Adalet-PLM, or equal.

E. Miscellaneous Fittings:

1. Flexible couplings shall be type ECGJH as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Killark Electric Manufacturing Co. or equal.

2. Conduit hubs shall be as manufactured by Myers Electric Products, Inc. or equal.

3. Conduit wall seals for new concrete walls below grade shall be O.Z./Gedney Co., Type WSK; Linkseal; Spring City Electrical Manufacturing Co., Type WDP, or equal.

4. Conduit wall seals for cored holes shall be Type CSMC as manufactured by the O.Z./Gedney Co., or equal.

5. Conduit wall and floor seals for sleeved openings shall be Type CSMI as manufactured by the O.Z./Gedney Co., or equal.

6. Combination expansion-deflection fittings embedded in concrete shall be Type XD as manufactured by the Crouse-Hinds Co.; Type DX as manufactured by O.Z./Gedney Co.; Type DF as manufactured by Appleton Electric Co., or equal.

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.

8. Explosion proof fittings shall be as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; O.Z./Gedney Co., or equal.

9. Conduit sealing bushings shall be O.Z./Gedney, Type CSB, or equal.

10. Grounding bushings shall be malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs as manufactured by Crouse Hinds/Cooper, Series HGLL; Appleton, Series GIB; O.Z./Gedney, Type HBLG, or equal.

2.03 HARDWARE

A. Conduit Mounting Equipment:

1. In dry indoor areas, hangers, rods, backplates, beam clamps, channel, etc. shall be galvanized iron or steel.

2. PVC coated steel channel with stainless steel hardware shall be used in areas designated "WET", “DAMP”, and "CORROSIVE" on the Drawings and in outdoor locations.

3. Furnish any and all necessary supports, brackets, conduit sleeves, racks and bracing as required. All boxes and hardware shall be galvanized zinc plated steel except that stainless steel shall be used in areas designated as "WET" or "CORROSIVE" on the Drawings.

B. Conduit Identification Plates:

1. Conduit identification plates shall be embossed stainless steel with stainless steel band, permanently secured to the conduit without screws.

2. Identification plates shall be as manufactured by the Panduit Corp., or equal.

C. Wall and Floor Slab Opening Seals:

1. Wall and floor slab openings shall be sealed with a UL approved expending material which equals or exceeds the fire rating of the wall or floor construction as manufactured by the Thomas & Betts Corp.; Pro Set Systems; Neer Mfg. Co.; Specified Technologies, Inc., or equal.

D. Conduit Supports:

1. Trapezes:
   a. In dry indoor areas, beams, channels, struts, hangers, bracing, rods, beam clamps, accessories and components shall be galvanized steel.
   b. PVC coated steel beams, channels, struts with stainless steel hangers, bracing, rods, beam clamps, accessories and components shall be used in areas designated "WET", "DAMP" and "CORROSIVE" where indicated and in outdoor locations.

2. Flush Mounted Supports:
   a. In dry indoor areas, channels, struts, accessories and components shall be galvanized steel.
   b. PVC coated steel channels, struts with stainless, accessories and components shall be used in areas designated "WET", "DAMP" and "CORROSIVE" where indicated and in outdoor locations.

3. Conduit Racks:
   a. In dry indoor areas, conduit racks, accessories and components shall be galvanized steel.
   b. PVC coated steel conduit racks with stainless, accessories and components shall be shall be used in areas designated "WET", "DAMP" and "CORROSIVE" where indicated and in outdoor locations.

4. Conduit Hangers:
   a. In dry indoor areas, conduit clamps, rods, beam clamps, bracing, accessories and components shall be galvanized steel.
   b. Stainless steel conduit clamps, rods, beam clamps, bracing, accessories and components shall be used in areas designated "WET", "DAMP" and "CORROSIVE" where indicated and in outdoor locations.

5. Adjustable steel and plastic band hangers, adjustable band hangers, adjustable swivel ring hangers and J-hangers shall not be allowed.

6. All hangers, bracing, rods, beam clamps, accessories and components shall be as manufactured by the Carpenter & Paterson Inc.; Grinnell Corporation; B-Line Systems Inc., or equal.

7. Design of supplemental structural steel required for attachment to the building structural support system shall be the full responsibility of the Support Engineer.

PART 3 EXECUTION

3.01 RACEWAY APPLICATIONS

A. Refer to Table 16110-1 for specific raceway application requirements.

B. All conduit of a given type shall be the product of one manufacturer.

C. Refer to Section 16600 for underground applications.

3.02 BOX APPLICATIONS

A. Unless otherwise specified herein or shown on the Drawings, all boxes shall be metal.

B. Exposed switch, receptacle and lighting outlet boxes and condulet fittings shall be cast or malleable iron, except that cast aluminum shall be used with aluminum conduit and non-metallic PVC shall be used with PVC.

C. Concealed switch, receptacle and lighting outlet boxes shall be pressed steel.

D. Terminal boxes, junction boxes and pull boxes shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16000.

E. Boxes flush in block, brick or tile walls shall be located at a course line and provided with square tile covers. Flush boxes shall not project beyond the finished surfaces nor shall surfaces project more than 1/8-in beyond the box enclosure. Wiring devices located in close proximity to each other shall be installed in one solid gang box with single cover.

F. All conduit bodies and pulling outlets shall comply with NEC wire bending space requirements. Mogul type fittings shall be used for sizes 2-1/2-inch and larger.

TABLE 16110-1
Raceway Application Guidelines

Location/Circuit Type	Raceway Type
All locations Class 2 and 3 signal wiring and 4-20 mA instrumentation cables, non-fiber (copper) Ethernet.	Exposed – Galvanized rigid steel (GRS) conduit. Use PVC coated rigid steel conduit in corrosive areas. Concealed – Galvanized rigid steel (GRS) conduit. Underground – Galvanized rigid steel (GRS) conduit in concrete reinforced ductbank. Use PVC coated steel conduit for single conduit direct burial applications.
Clean, dry finished areas - offices, administrative areas, lobbies, control room, lunch room, toilets, and laboratories, etc.	Conceal raceways in walls and above hung ceilings in rooms and areas that have finished interiors where possible. Exposed conduit for power, lighting, switch, and receptacle circuits – Galvanized rigid steel (GRS). Concealed conduits for power, lighting, switch, and receptacle circuits – Galvanized rigid steel (GRS).
Clean, dry non-finished areas – electrical rooms, generator rooms, mechanical rooms, shops, dry storage, etc.	Exposed conduit for power wiring, lighting, switch, and receptacle circuits – Galvanized rigid steel (GRS). Concealed conduit for power wiring, lighting, switch, and receptacle circuits – Schedule 40 PVC conduit when embedded within concrete floor slabs. GRS when embedded within masonry block walls.
Process areas – non-corrosive, non-hazardous locations designated as DAMP or WET on the Drawings.	Exposed conduit for power wiring, lighting, switch, and receptacle circuits – Rigid aluminum or galvanized rigid steel (GRS). Concealed conduit for power wiring, lighting, switch, and receptacle circuits – Schedule 40 PVC conduit when embedded within concrete floor slabs. GRS when embedded within masonry block walls.
Corrosive areas – chemical storage and handling areas, underground vaults, within tanks or clearwells, filter pipe galleries and locations where designated corrosive on the Drawings.	Exposed conduit for power wiring, lighting, switch, and receptacle circuits – PVC coated rigid steel. Concealed conduit for power wiring, lighting, switch, and receptacle circuits - Schedule 40 PVC conduit when embedded within concrete floor slabs or structures.
Hazardous areas – all locations – Class 1, Division 1 and 2.	Exposed conduit for power wiring, lighting, switch, and receptacle circuits – PVC coated rigid steel . Concealed conduit for power wiring, lighting, switch, and receptacle circuits – Galvanized rigid steel (GRS).
Outdoor areas – all locations.	Exposed conduit for power wiring, lighting, switch, and receptacle circuits – PVC coated rigid steel. PVC conduit shall not be used exposed. Concealed conduit for power wiring, lighting, switch, and receptacle circuits – Schedule 40 PVC conduit when embedded within concrete structures.

3.03 FITTINGS APPLICATIONS

A. Combination expansion-deflection fittings shall be used where exposed conduits cross structure expansion joints or in straight runs where expansion is anticipated. Combination expansion-deflection fittings shall be installed where embedded conduits cross existing structural expansion joints. Provide bonding jumpers around fittings.

B. All underground conduit penetrations at walls or other structures shall be sealed watertight. Conduit wall seals and sleeves shall be used in accordance with the manufacturer's installation instructions and the details shown on the Drawings.

C. Conduit sealing bushings shall be used to seal conduit ends exposed to the weather and at other locations shown on the Drawings.

D. Insulated throat grounding bushings shall be used where specified herein, in Section 16660 and where conduits stub up into electrical equipment such as MCC's, switchgear, etc.

3.04 INSTALLATION

A. No conduit smaller than 3/4-inch electrical trade size shall be used, nor shall any have more than the equivalent of three 90 degree bends in any one run. Pull boxes shall be provided as required by the NEC after every 270 degrees of bends and for straight run not to exceed 200 feet or as directed.

B. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.

C. All conduit which may under any circumstance contain liquids such as water, condensation, liquid chemicals, etc., shall be arranged to drain away from the equipment served. If conduit drainage is not possible, conduit seals shall be used to plug the conduits. The ends of all conduits shall be temporarily plugged to exclude dust, moisture and debris from entering during construction.

D. Conduit ends exposed to the weather shall be sealed with conduit sealing bushings.

E. Conduits noted as spare shall be capped or plugged at both ends with easily removable fittings.

F. Conduit terminating in NEMA 3R, 4, 4X and 12 enclosures shall be terminated with Myers type conduit hubs.

G. Conduit terminating in pressed steel boxes shall have double locknuts and insulated bushings.

H. Conduits containing equipment grounding conductors and terminating in sheet steel boxes shall have insulated throat grounding bushings.

I. Conduits shall be installed using threaded fittings except for PVC.

J. The use of running threads is prohibited. Where such threads are necessary, a 3-piece union shall be used.

K. All direct buried conduits shall be PVC Coated rigid steel

L. Rigid galvanized steel conduits which have been field cut and threaded shall be painted with cold galvanizing compounds.

M. PVC coated rigid galvanized steel conduit and elbows shall be used for pad-mounted transformer stub-ups.

N. In hazardous locations, conduits terminating at boxes enclosing circuit opening equipment shall be sealed at the entrance to the enclosure with approved compound filled sealing fittings to prevent passage of explosive or combustible gases through the conduits. All conduits leading from or entering hazardous locations shall be similarly sealed at points of exit or entrance. Exposed conduits passing through hazardous locations shall be sealed at both the entrance to and the exit from the hazardous locations. A sealing compound installation schedule shall be submitted to the owner. Each installation shall be signed off by the Contractor and each fitting shall be legibly marked with red paint to indicate that the sealing compound has been installed.

O. Conduit sealing and drain fittings shall be installed in all hazardous (classified) areas designated Class 1, Division 1, and Class 1, Division 2.

P. Conduit sealing and drain fittings shall be installed on all conduits entering and leaving any area containing noxious gases to prevent contamination into clean areas via the conduit system. A sealing compound installation schedule shall be submitted to the Owner. Each installation shall be signed off by the Contractor and each fitting shall be legibly marked with red paint to indicate that the sealing compound has been installed.

Q. Liquid-tight flexible metal conduit shall be used for all motor terminations, electric actuators, the primary and secondary of transformers, and other equipment where vibration is present or may require removal. The length of liquid-tight flexible metal conduit shall not exceed 36". Non-metallic flexible conduit shall only be allowed for use with rigid PVC conduit systems.

R. Flexible couplings shall be used in hazardous locations for all motor terminations and other equipment where vibration is present.

S. Aluminum fittings and boxes shall be used with aluminum conduit. Aluminum conduit shall not be imbedded in concrete. Aluminum conduit shall be isolated from other metals with plastic sleeves or plastic-coated hangers. Strap wrenches shall be used for tightening aluminum conduit.

T. PVC coated rigid steel conduit shall be used as a transition section where concrete embedded conduit stubs out of floor slabs or through below grade walls or where conduit installed under building slabs on grade stub out of floors. The PVC coated rigid steel conduit shall extend a minimum of 3-in into and out of the floor slab, concrete pad, or wall to allow for proper threading of the conduit.

U. PVC conduit to non-metallic box connections shall be made with PVC socket to male thread terminal adapters with neoprene O-ring and PVC round edge bushings.

V. PVC conduit shall be supported with non-metallic clamps, PVC coated steel racks and stainless steel hardware.

W. Expansion fittings shall be used on exposed runs of PVC conduit where required for thermal expansion. Installation and number of fittings shall be as recommended by manufacturer.

X. PVC boxes, conduit fittings, etc., with integral hubs shall be solvent welded directly to the PVC conduit system.

Y. Non-metallic boxes with field drilled or punched holes shall be connected to the PVC conduit system with threaded and gasketed PVC Terminal Adapters.

Z. Conduit supports, other than for underground raceways, shall be spaced at intervals not exceeding the distance required by the NEC to obtain rigid construction.

AA. Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on fabricated channel trapeze type racks with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-inch diameter. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a minimum of 1/2-inch clearance between wall and equipment.

BB. Conduit Supports (Other than Underground Raceways):

1. Trapezes:
   a. Conduit support trapezes shall be vertically supported every 10-ft or less, as required to obtain rigid conduit construction.
   b. Lateral seismic restraints (Sway Bracing) shall be spaced 30-ft or less.
   c. Horizontal seismic restraints shall be spaced at 40-ft or less. There shall be at least one horizontal restraint per horizontal run.
   d. Attachment to structural steel shall be by beam clamps or welded beam attachment. C-clamps will not be allowed for vertical hangers. Side beam clamps with beam hooks shall be used for seismic restraint only.
   e. Attachment to concrete shall be cast-in-place inserts, cast-in place welded plates with welded studs or stainless steel adhesive anchors.

2. Flush Mounted Supports:
   a. Support shall be spaced 10-ft or less, as required to obtain rigid conduit construction.
   b. Attachment to concrete shall be with cast-in-place inserts, cast-in place welded plates with welded studs or stainless adhesive anchors.

3. Conduit Racks:
   a. Support shall be spaced 10-ft or less, as required to obtain rigid conduit construction.
   b. Horizontal seismic restraints shall be spaced at 30-ft or less.
   c. Attachment to concrete shall be with cast-in-place inserts, cast-in place welded plate with welded studs or stainless adhesive anchors.

4. Conduit Hangers;
   a. Conduit hangers shall be vertical supported 10-ft or less, as required to obtain rigid conduit construction.
   b. Lateral seismic restraints (Sway Bracing) shall be spaced 20-ft or less.
   c. Horizontal seismic restraints shall be spaced at 30-ft or less. There shall be at least one horizontal restraint per horizontal run.
   d. Attachment to structural steel shall be by beam clamps or welded beam attachment. C-clamps will not be allowed for vertical hangers. Side beam clamps with beam hooks shall be used for seismic restraint only.

e. Attachment to concrete shall be cast-in-place inserts, cast-in-place welded plates with welded studs or stainless steel adhesive anchors.

5. All reinforcing bars shall be located by the Electrical Subcontractor with the use of a rebar locator prior to installing adhesive capsule type anchors. Mark the location of all reinforcing bars in an area bounded by a line drawn at least 18-in from the edge of the support bearing/weld plates on all four sides of the bearing/weld plates prior to fabricating and installing bearing/weld plates.

6. Where interference occurs, adjust anchor locations to clear reinforcing bars and alter support configuration at no additional cost to the Owner.

CC. Miscellaneous steel for the support of boxes, transformers, starters, contactors, panels and conduit shall be furnished and installed. Channel supports shall be ground smooth and fitted with plastic end caps.

DD. Steel channels, flat iron and channel iron shall be furnished and installed for the support of all electrical equipment and devices, where required, including all anchors, inserts, bolts, nuts, washers, etc., for a rigid installation. Channel supports shall be ground smooth and fitted with plastic end caps.

EE. All conduits on exposed work, within partitions and above suspended ceilings, shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduits shall be run perfectly straight and true.

FF. Where conduits pass through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke in accordance with UL requirements and the details shown on the Drawings. The sealing method shall have a UL fire rating, which equals or exceeds the fire rating of the wall or floor construction.

GG. Conduits shall not cross pipe shafts, access hatches or vent duct openings. They shall be routed to avoid such present or future openings in floor or ceiling construction.

HH. Conduits passing from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc., shall be sealed with "Duxseal" as manufactured by Manville or seal fitting to prevent the accumulation of condensation.

II. Conduits shall be located a minimum of 3-in from steam or hot water piping. Where crossings are unavoidable, the conduit shall be kept at least 1-in from the covering of the pipe crossed.

JJ. Mandrels shall be pulled through all existing conduits which will be reused and through all new conduits prior to installing conductors.

KK. 3/16-in polypropylene pull lines shall be installed in all new conduits noted as spares or designated for future equipment. Conduit noted as spare shall be capped or plugged at both ends with easily removable fittings.

LL. Where no type or size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of NEC Article 314. Enclosure type and material shall be as specified herein.

MM. Pull or junction boxes shall be furnished and installed where shown on the Drawings, in every 200 feet of straight conduit runs or in runs where more than the equivalent of four 90 degree bends occur or at any point necessary for wire pulling and splicing. Splices shall not be made in pulling elbows.

NN. A conduit identification plate shall be installed on all power, instrumentation, alarm and control conduits at each end of the run and at intermediate junction boxes, manholes, etc. Conduit plates shall be installed before conductors are pulled into the conduits. Exact identification plate location shall be coordinated with the Engineer at the time of installation to provide uniformity of placement and ease of reading. When a master conduit numbering system is used, the conduit tag numbers shall be exactly as shown on the drawings, if a master conduit numbering system is not used the conduit identification tags shall provide detailed "to" and "from" information.

END OF SECTION 16110

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SECTION 16120
WIRES AND CABLES (600 VOLT MAXIMUM)

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish, install and test all wire, cable and appurtenances as shown on the Drawings and as specified herein.

B. Install and test vendor furnished cables and I/O cables furnished under other Divisions.

1.02 SUBMITTALS

A. Submit, in accordance with Section 01300, product data of proposed wire.

B. Installed unapproved wire shall be removed and replaced at no additional cost to the Owner.

1.03 DELIVERY, STORAGE AND HANDLING

A. Carefully handle all conductors to avoid kinks and damage to insulation.

1.04 WARRANTY

A. Manufacturer shall warrant cable against defects for a period of one year from date of Substantial Completion and shall remove and replace defective cables at its own expense during this warranty period.

PART 2 PRODUCTS

2.01 GENERAL

A. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper.

B. Conductors shall be stranded.

C. Except for control, signal and instrumentation circuits, wire smaller than No. 12 AWG shall not be used.

D. Wire shall have 600 Volt insulation except where indicated otherwise.

E. Conductors installed in plenums shall be marked PLENUM RATED.

F. Wire of a given type shall be the product of a single manufacturer.

G. All terminations shall receive an anti-corrosion lubricant after wire is terminated.

2.02 BUILDING WIRE

A. Wire for circuits not exceeding 150 Volts to ground shall be NEC type XHHW-2 as manufactured by The Okonite Co.; General Cable.; Encore Wire Corporation; Southwire Co.; or equal.

B. Wire for circuits over 150 Volts to ground within buildings and structures shall be NEC type XHHW-2 as manufactured by The Okonite Co.; General Cable.; Encore Wire Corporation; Southwire Co.; or equal.

C. Wire for circuits over 150 Volts to ground used underground or for service entrance shall be NEC type RHH-RHW-2/USE-2, flame retardant and CT rated per IEEE 1202 as manufactured by The Okonite Co.; General Cable.; Encore Wire Corporation; Southwire Co.; or equal.

D. Bare copper ground wire shall be stranded, annealed copper wire ASTM B3.

E. Equipment grounding conductors shall be NEC Type THW green and sized in accordance with NEC Table 250-122. Ground grid conductors shall be insulated unless shown otherwise on the Drawings.

2.03 CONTROL, STATUS AND ALARM WIRE

A. Wire shall be No.14 AWG NEC type THHN/THWN, stranded as manufactured by The Okonite Co.; General Cable.; Encore Wire Corporation; Southwire Co.; or equal.

2.04 INSTRUMENTATION WIRE

A. Wire for process instrumentation signals (i.e., 1-5 VDC, 4-20 mADC), R.T.D., potentiometer and similar signals shall be:

1. Single pair cable: Conductors: 2 No. 16 stranded and twisted on 2-in lay.

   a. Insulation: PVC with 600 Volt, 90 degrees C rating.
   b. Shield: 100% Aluminum/polyester foil with drain wire.
   c. Jacket: PVC with UL Subject 1277 TC, UL 1581 and manufacturers' identification.
   d. Max overall diameter: 0.345-in.
   e. Miscellaneous: UL Listed as Instrument Tray Cable/Power Limited Tray Cable (PLTC) for use in accordance with Article 727 and Article 725 of the NEC.
   f. Manufacturers: Belden Cable; Manhattan; General Cable; The Okonite Co.; or equal

2. Local Area Network (LAN) Ethernet cable: Unshielded twisted pair cable shall be designed for use with a high speed (10/100/1000 Mbps) Ethernet 10/100/1000 BASE-T/TX communications network. Twisted pair cable shall have a nominal impedance 100 ohms at one MHz, a maximum attenuation of 8 dB per 1000 feet at one MHz. Twisted pair cable must have frequency tested up to 250 MHz or more. Twisted pair cable shall be plenum rated and shall have a minimum of four 23 AWG solid copper conductor pairs. All 10/100/1000 BASE-T/TX (RJ-45) terminations on twisted pair cable shall be done in a professional and workman like manner. Terminations shall provide for proper strain relief on cable jacket. Strain relief on wire and/or wire insulation shall not be acceptable. Category 6 cable shall be as manufactured by Belden; Phoenix; or equal.

2.05 SPLICES (POWER CONDUCTORS)

A. Unless otherwise indicated on the Drawings, splices shall not be made in cables without prior written approval of Engineer. Where splicing is approved by Engineer, splicing materials for 600 Volt splices shall be made with long barrel, tin plated copper compression (hydraulically pressed) connectors and insulated with heavy wall heat shrinkable tubing. Conductivity of

completed connections shall be not less than that of uncut conductor. Insulation resistance of completed connections of insulated conductors shall be not less than that of uncut conductor.

B. Wire lugs shall be tin plated copper, long barrel compression type (hydraulically pressed) for wire sizes No. 8 AWG and larger. Lugs for No. 10 AWG and smaller wire shall be locking spade type with insulated sleeve. Lugs shall be as manufactured by the Thomas and Betts Co.; Burndy; Amp; or equal.

C. Compression type connectors shall be insulated with a heat shrink boot or outer covering and epoxy filling. Splice kits shall be as manufactured by Raychem (Tyco); Ideal Industries; 3M Co. or equal.

D. Solderless pressure connectors shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air. Connectors shall be sized according to manufacturer's recommendations. Connectors shall be UL listed and CSA approved, as manufactured by King Innovation; Ideal Industries, Inc., or equal.

2.06 MOTOR CONNECTIONS

A. Motor connections shall be ring type mechanical compression terminations installed on branch circuit wires and motor leads and secured with bolt, nut and spring washer. Connections shall be insulated with a Raychem Type RVC, roll-on stub insulator; Thomas & Betts, Shrink-Kon MSCV20; or equal. For wire sizes N0. 8 and larger, long barrel, tin plated copper compression (hydraulically pressed) type connections (Burndy Co., or equal) shall be installed on branch circuit wires and motor leads. Connections shall be insulated with heavy duty heat shrinkable material (Raychem Corp., or equal).

2.07 TERMINATION AND SPLICES (CONTROL, STATUS AND ALARM CONDUCTORS)

A. Termination connectors shall be of locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.

B. Insulated compression type connectors shall be of the expanded vinyl insulated parallel or pigtail type as manufactured by Ideal Industries; 3M Co.; Panduit Corp., or equal.

C. Solderless pressure connectors shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air. Connectors shall be sized according to manufacturer's recommendations. Connectors shall be UL listed and CSA approved, as manufactured by King Innovation; Ideal Industries, Inc., or equal.

2.08 TERMINATIONS (INSTRUMENTATION CABLES)

A. Termination connectors shall be of locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp., or equal.

2.09 WIRE AND CABLE MARKERS

A. Wire and cable markers shall be "Omni-Grip" as manufactured by the W.H. Brady Co.; Thomas & Betts Co., SMS; 3M Co., STD-TAG; or equal.

B. Wire and cables with diameters exceeding the capacity of the "Omni-Grip" shall be marked with pre-printed, self-adhesive vinyl tapes as manufactured by the W.H. Brady Co.; Panduit Corp.; 3M Co.; or equal.

2.10 DIRECT BURIED CABLE WARNING TAPE

A. Tape shall be 6-in wide, red polyethylene not less than 0.0035-in thick. Tape shall be W.H. Brady Co., Catalog No. 91296; Harris Industries Inc. VT Series; Seton; or equal.

2.11 WALL AND FLOOR SLAB OPENING SEALS

A. Wall and floor slab openings shall be sealed with UL approved expanding material which equals or exceeds fire rating of wall or floor construction such as "FLAME-SAFE" as manufactured by the Thomas & Betts Corp.; Pro Set Systems; Neer Mfg. Co.; Specified Technologies, Inc.; or equal.

PART 3 EXECUTION

3.01 PREPARATION (NOT USED)

3.02 INSTALLATION

A. Uniquely identify wires and cables at each end and in manholes, hand holes, and pull boxes with wire and cable markers.

B. Use lubrications to facilitate wire pulling. Lubricants shall be UL approved for use with the insulation specified.

C. Crimping tools used in securing the conductor in compression type connectors or terminal lugs shall be those made for that purpose and for conductor sizes involved. Crimping tool shall be ratchet type which prevents tool from opening until crimp action is completed. Such tools shall be a product of connector manufacturer.

D. Install an equipment grounding conductor in raceways.

E. Seal openings in slabs and walls through which wires and cables pass.

F. Pull cables from direction that requires least tension. Use a feed-in tube and sheave designed for cable installation. Use sheaves with radii that exceed cable manufacturer's recommended minimum bending radius. Use a dynamometer and constant velocity power puller. Velocity should not be less than 15-ft./min. or more than 50-ft./min. Do not exceed cable manufacturer's maximum recommended tension.

G. If cable cannot be terminated immediately after installation, install heat shrinkable end caps.

H. Fireproof exposed cables in manholes, vaults, pullboxes, switchgear and other areas not protected by conduit where medium voltage cables are present. Use fire-proofing tape and glass tape in accordance with manufacturer's instructions. Fire-proofing tape shall be installed with one half-lapped layer of Scotch Brand 77 Electric Arc and Fireproofing Tape (3M Corp., or equal). Tape shall be secured with a two-layer band of Scotch Brand 69 Glass Electrical Tape (3M Corp., or equal) over the last wrap.

3.03 WIRE COLOR CODE

A. Wire shall be color coded or coded using electrical tape in sizes where colored insulation is not available. Where tape is used as the identification system, it shall be applied in junction boxes, manholes, and other accessible intermediate locations as well as at each termination.

B. The following coding shall be used:

System	Wire	Color
240/120 Volts	Neutral	White
Single-Phase, 3 Wire	Line 1	Black
	Line 2	Red
208Y/120, Volts	Neutral	White
3 Phase, 4 Wire	Phase A	Black
	Phase B	Red
	Phase C	Blue
480Y/277 Volts	Neutral	White
3 Phase, 4 Wire	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow

C. Neutral or ground wires that terminate in a Panelboard and require color tape shall have color tape extend at least 6 inches from termination point.

3.04 TERMINATIONS AND SPLICES

A. Power conductors: Unless otherwise indicated on the Drawings, no splices may be made in cables without prior written approval of the Engineer. Where splicing is approved, terminations shall be die type or set screw type pressure connectors as specified. Splices (where allowed) shall be die type compression connector and waterproof with heat shrink boot or epoxy filling for copper conductors # 4 AWG and larger. Splices shall be solderless pressure connectors with insulating covers for copper conductors # 6 AWG and smaller.

B. Control Conductors: Termination on saddle-type terminals shall be wired directly with a maximum of two conductors. Termination on screw type terminals shall be made with a maximum of two spade connectors. Splices (where allowed) shall be made with insulated compression type connectors.

C. Instrumentation Signal Conductors (including graphic panel, alarm, low and high level signals): terminations same as for control conductors. Splices allowed at instrumentation terminal boxes only.

D. Except where permitted by the Engineer no splices will be allowed in manholes, handholes, or other below grade located boxes.

E. Splices shall not be made in push button control stations, control devices (i.e., pressure switches, flow switches, etc.), conduit bodies, etc.

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3.05 INSTRUMENTATION CABLES

A. Instrumentation cables shall be installed in rigid steel raceways as specified. Circuits shall be installed as twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required.

B. Terminal blocks shall be provided at instrument cable junction and circuits shall be identified at such junctions.

C. Shielded instrumentation wire, coaxial, data highway, I/O and fiber optic cables shall be run without splices between instruments, terminal boxes, or panels.

D. Ground shielding on instrumentation wires at one end only as recommended by instrument manufacturer and isolated at other locations. Terminal blocks shall be provided for inter-connecting shield drain wires at junction boxes. Where individual circuit shielding is required, each shield circuit shall be provided with its own block.

E. Install shielded instrumentation wire in conduit and pull boxes that contain only shielded instrumentation wire. Instrumentation cables shall be separated from other (i.e., power, control, etc.) cables in manholes by enclosing them within rigid steel raceways and boxes.

F. Shielded cable terminations at each end shall be provided with heat shrinkable tubing placed over the exposed shield and conductors. Tubing shall extend 1 inch minimum over jacket end and extend 0.5 inch minimum from jacket end over exposed conductors.

3.06 FIELD TESTING

A. Test 600 Volt wire insulation with a megohm meter after installation and prior to termination. Make tests at not less than 1000 Volts DC. Test duration shall be one minute. Submit a written test report of results to the Engineer. Notify the Engineer in writing 48 hours prior to testing.

B. Field testing and commissioning shall be done in accordance with latest revision of the "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" published by the International Electrical Testing Association (NETA Standard ATS-1999) unless otherwise modified by this Section. Minimum wire insulation resistance shall not be less than 250 Megohms.

END OF SECTION 16120

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SECTION 16141
WIRING DEVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, and equipment and install wiring devices as shown on the Drawings and as specified herein.

B. Provide all interconnecting conduit and branch circuit wiring for receptacle circuits in accordance with the NEC.

1.02 RELATED WORK

A. Outlet boxes are included in Section 16110.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 16000.

1.04 REFERENCE STANDARDS

A. Wiring devices shall comply with the requirements of the National Electric Code (NEC) and shall be Underwriters Laboratories (UL) labeled.

PART 2 PRODUCTS

2.01 MATERIALS

A. Wall switches shall be heavy duty, specification grade, toggle action, flush mounting quiet type. All switches shall conform to the latest revision of Federal Specification WS 896. Wall switches shall be suitable for the area classification indicated and shall be of the following types and manufacturer:

1. Single pole, 20 Amp, 120/277 Volt – Cooper Wiring Devices; Hubbell Wiring Devices-Kellems; Pass & Seymour, Inc., or equal.

2. Three way, 20 Amp, 120/277 Volt – Cooper Wiring Devices, Hubbell Wiring Devices-Kellems; Pass & Seymour, Inc., or equal.

B. Receptacles shall be heavy duty, specification grade of the following types and manufacturer or equal. Receptacles shall conform to Fed Spec WC596-F.

1. Duplex, 20 Amp, 125 Volt, 2 Pole, 3 Wire; Cooper Wiring Devices; Hubbell Wiring Devices-Kellems; Pass & Seymour, Inc., or equal.

2. Weatherproof/corrosion resistant single, 20 Amp, 125 Volt, 2 Pole, 3 Wire, with cover; Crouse-Hinds Co., Catalog No. WLRS-5-20; Appleton Electric FSKJ520; Pass & Seymour, or equal.

3. Corrosion resistant duplex, 20 Amp, 125 Volt, 2-pole, 3-wire, high visibility yellow nylon face, nickel plated brass or copper alloy power contacts, Cooper-Arrow/Hart Catalog No. 5362CRY; Hubbell Catalog No. HBL53CM62; Bryant-Electric Catalog No. BRY5362CR; or equal.

4. Ground fault interrupter, duplex, 20 Amp, 125 Volt, 2 Pole, 3 Wire, GFCI feed thru type with "test" and "reset" buttons. Cooper Wiring Devices; Hubbell Wiring Devices-Kellems; Pass & Seymour, Inc., or equal.

C. Device Plates

1. Plates for indoor flush mounted devices shall be of the required number of gangs for the application involved and shall be as follows:
   a. Where permitted in other areas of the plant, flush mounted devices in cement block construction shall be Type 302 high nickel (18-8) stainless steel of the same manufacturer as the devices.

2. Plates for indoor surface mounted device boxes shall be cast metal of the same material as the box, Crouse-Hinds No. DS23G and DS32G; Appleton FSK1DRC, FSK1TSEC; Pass & Seymour or equal.

3. Oversized plates shall be installed where standard plates do not fully cover the wall opening.

4. Device plates for switches mounted outdoors or indicated as weatherproof shall be gasketed, cast aluminum with provisions for padlocking switches "On" and "Off", Crouse Hinds No. DS185; Appleton FSK1VS; Pass & Seymour, or equal.

5. Multiple surface mounted devices shall be ganged in a single, common box and provided with an adapter, if necessary, to allow mounting of single gang device plates on multi-gang cast boxes.

6. Engraved device plates shall be provided where required.

7. Weatherproof, gasketed cover for GFI receptacle mounted in a FS/FD box shall be Cooper Crouse-Hinds; RACO (Hubbell); Pass & Seymour, Inc., or equal.

8. Weatherproof non-metallic ‘Not Attended/While-In-Use’ cover, UV & corrosion resistant polycarbonate back & cover, deep cover, gasketed, horizontal or vertical mounting as required, single or double gang as required, lockable hasp, as manufactured by Thomas & Betts (Red Dot); Cooper Wiring Devices (Arrow Hart); Carlon; or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Switch and receptacles outlets shall be installed flush with the finished wall surfaces in areas with stud frame and gypsum board construction, in dry areas with cement block construction or when raceways are shown as concealed on the Drawings.

B. Do not install flush mounted devices in areas designated DAMP, WET, or CORROSIVE on the Drawings. Provide surface mounted devices in these areas.

C. Where individual ground fault interrupter type receptacles are shown on the Drawings connected to the same circuit, the Contractor shall provide all ground fault interrupter type receptacles. Use of one ground fault interrupter type receptacle to protect downstream conventional receptacles is unacceptable.

D. Provide corrosion resistant receptacles and 'While-In-Use' weatherproof covers in areas designated CORROSIVE on the Drawings.

E. Convenience outlets shall be 18 inches above the floor unless otherwise required or shown on the Drawings.

F. Convenience outlets installed in rooms designated as WET or where equipment may be hosed down shall be mounted minimum 48-inch above deck or grade (or as shown on the Drawings) and shall be weather & tamper resistant, ground fault circuit interrupter type, installed within a 'While-In-Use' weatherproof cover.

G. Convenience outlets mounted outdoors shall be mounted minimum 48-inch above deck or grade (or as shown on the Drawings) and shall be weather & tamper resistant, ground fault circuit interrupter type, installed within a 'While-In-Use' weatherproof cover.

H. Switches for lighting shall be mounted 48-inch above the finished floor unless otherwise noted or required.

I. The location of all devices is shown, in general, on the Drawings and may be varied within reasonable limits so as to avoid any piping or other obstruction without extra cost, subject to the approval of the Engineer. Coordinate the installation of the devices for piping and equipment clearance.

END OF SECTION 16141

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SECTION 16191
MISCELLANEOUS EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all miscellaneous equipment as shown on the Drawings and as specified herein.

1.02 EQUIPMENT LIST

A. This Section provides the requirements for miscellaneous equipment typically employed in a facility, however, not all components specified in this Section are necessarily utilized on this project.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, detailed catalog information or drawings describing electrical and physical characteristics of all equipment specified in sufficient detail to show compliance with the Drawings and Specifications.

1.04 REFERENCE STANDARDS

A. Equipment enclosures shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16000.

PART 2 PRODUCTS

2.01 MATERIALS

A. Disconnect Switches

1. Disconnect switches shall be heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle. All current carrying parts shall be copper

2. NEMA 4X enclosures shall be type 316 stainless steel.

3. NEMA 7 enclosures shall be cast aluminum.

4. Switches shall be as manufactured by the Square D Co.; General Electric; Eaton Electrical, or equal.

B. Control Stations

1. Control stations shall be heavy-duty type, with full size (30mm) operators. Stop buttons shall have a lockout latch that can be padlocked in the open position.

2. NEMA 4X enclosures shall be Type 316 stainless steel.

3. NEMA 7 enclosures shall be cast aluminum.

4. Control stations shall be Square D Class 9001, similar by Eaton Electrical; General Electric Co., or equal.

C. Control Relays

1. Control relays shall be heavy duty machine tool type, with 10 Amp, 300 Volt convertible contacts. Number of contacts and coil voltage shall be as shown on the Drawings. General use relays shall be General Electric Co., Catalog No. CR120B; similar by Square D Co.; Allen-Bradley Co., or equal. Latching relays shall be General Electric Co., Catalog No. CR120BL; similar by Square D Co.; Allen-Bradley Co., or equal.

2. Time delay relays shall be pneumatic, 600 Volt, 20 Amp contacts, with calibrated knob operated adjustment. On delay and off delay types and timing ranges shall be as shown on the Drawings. Relays shall be Agastat Model 7012 or 7022; similar by Square D Co.; Eaton Electrical, or equal.

3. Thermister relays shall be solid state, with one normally open contact and one normally closed contact, suitable for use on a 120V, 60Hz power supply. Thermistor relays shall be Siemens model 3RN2012-1BW30 or approved equal.

D. Detectable Warning Tape

1. Each ductbank section shall be marked by means of a detectable warning tape (tracer tape) as shown on the Drawings. The detectable warning tape shall be capable of being detected or located by either conductive or inductive location techniques.

2. The detectable warning tape shall consist of 5 mil (.005-in) overall thickness; five-ply composition; ultra-high molecular weight; virgin polyethylene; acid; alkaline and corrosion resistant; with 150 pounds of tensile break strength minimum per 6-inch width.

3. The top side of the tracer tape shall be color banded red for electrical and high voltage lines, and orange for signal, communication, telephone and fire alarm lines. Tracer tape shall be 4-inch wide with four color bands. The tape shall be inscribed with the warning message for the utility such as "CAUTION – ELECTRICAL LINED BURIED BELOW". Tape shall be as manufactured by Mutual Industries, Inc.; Terra Tape, Div. of Reef Industries Inc., or equal.

E. Terminal Blocks

1. Terminal blocks shall be NEMA type rated at 20 amperes minimum, 600 Volt, channel mounted, with tubular screw and pressure plate.

2. Terminal blocks shall be Bulletin 1492 as manufactured by the Allen-Bradley Co.; ABB; Kukla, or equal.

F. Intrinsically Safe Relays

1. Intrinsically safe relays shall be solid state type with 5 Amp output contacts, suitable for use on a 120 Volt, 60 Hz power supply and shall be FM approved for pilot devices in Class I, Division 1, Group D hazardous atmospheres.

2. Intrinsically safe relays shall be Warrick Conductivity Sensors, Model 17A1X0 as manufactured by Gems Sensors and controls; or approved equal

G. Corrosion Inhibitors

1. All equipment enclosures, terminal boxes, etc., located in a corrosive rated area (where shown on the Drawings) that contains electrical or electronic equipment or terminal strips shall be furnished with an internally mounted, chemically treated corrosion inhibitor pad.

2. The corrosion inhibitor pads shall be as manufactured by Hoffman Engineering Co.; 3M; AGM Container Controls, or equal.

H. Equipment Identification Nameplates

1. All field mounted electrical equipment such as disconnects, push button stations, etc., shall be provided with a weather resistant engraved laminoid equipment identification nameplate screwed or bolted adjacent to the device. Nameplate shall identify the mechanical equipment controlled exactly as shown on the electrical singleline drawings.

I. Equipment Mounting Stands

1. Equipment mounting stands shall be custom fabricated from 1/4-in steel plate and 4-in hot dipped galvanized steel channel, as shown on the Drawings. For NEMA 4X areas or where stainless steel enclosures are required mounting stands and channels shall be Type 316 stainless steel.

J. Arc Flash Protection Warning Signs

1. Provide field-affixed arc flash warning labels on all switchboards, panelboards, industrial control panels, and motor control centers in accordance with National Electrical Code Article 110.16.

2. As a minimum, warning signs shall state "WARNING: Arc Flash and Shock Hazard, Appropriate PPE required", and shall be designed in accordance with ANSI Z535.4-1998. Where available from the equipment manufacturer, additional information including Flash Hazard boundary, incident energy, voltage shock hazard, PPE required, etc. shall be provided.

K. Electric Warning Sign

1. Provide and install using stainless steel fasteners a total of 4 restrictive signs that conform with OSHA regulations for accident prevention. Size of sign: 10-in high by 14-in wide. Sign shall state "DANGER HIGH VOLTAGE". Sign shall be constructed of High Performance Plastic (HPP) by the Seton Name Plate Corp.; Global Equipment Co.; World-wide Sign Co., or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mounting Stands

1. Field mounted disconnects, pushbutton control stations, alarm panels, wireways, contactors, terminal boxes, junction and pull boxes shall be mounted on galvanized or stainless steel stands as specified. Where clearance requirements for stands may not be maintained, the Engineer may direct electric control equipment to be wall-mounted adjacent to the driven equipment, but in no case shall the distance from the drive motor to the control station exceed 3-ft, all at no additional cost to the Owner.

2. All floor mounting stands, bracing, anchor bolts and appurtenances furnished to support equipment loads, dynamic loads, wind loads and seismic forces shall conform to the latest applicable requirements of the State Building Code in effect at the time of Bid.

3. All wall mounted brackets, bracing, bolts and appurtenances to support equipment loads dynamic loads, wind loads and seismic forces shall conform to the latest applicable requirements of the State Building Code in effect at the time of Bid.

4. Channel supports shall be ground smooth and fitted with plastic end caps.

3.02 FIELD TESTING

A. Before supplying power to the alarm panels, the following tests shall be done: Verify that all wiring connection interfaces that are required are present. Check for secure connections. Using a continuity device, verify that all discrete inputs and output to and from the control panel are wired in correct polarity and are operating in the correct state of operation (normally open or closed state). Check for any direct short circuits across all voltage supply sources. As each of the above tests are performed, the Electrical Contractor shall highlight and initial each circuit that is tested. This set of prints shall be signed and left inside the enclosure.

B. Check mechanical interlocks for intended operation. Make any adjustments required.

C. In the event of an equipment fault in the panel, notify the Engineer immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor and Engineer. Repair or replace the equipment as directed by the Engineer prior to placing the equipment back into service at no additional cost to the Owner.

END OF SECTION 16191

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SECTION 16600
UNDERGROUND SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install a complete underground system of raceways and handholes as shown on the Drawings and as specified herein.

B. Where referred in this Section, raceways are underground conduits; ductbanks are a collection of underground raceways. Underground system is the collection of underground raceways and handholes.

C. The Contractor shall be responsible for setting handholes at the proper elevation such that the pitch of raceways will be towards handholes and away from structures, vaults and buildings.

D. Ductbanks shall be encased in steel reinforced concrete up to the building, structure, vault, handhole unless otherwise specified or shown on the Drawings.

1. Ductbank and handhole depths vary. Coordinate with other utilities, yard piping, yard structures and field conditions to determine required depths and install raceways and handholes at that required depth at no additional cost to the Owner.

2. Ductbank routing and handhole locations shown on the Drawings are diagrammatically depicted. Coordinate with other utilities, yard piping, yard structures and field conditions to determine required paths and depths at no additional cost to the Owner.

E. Excavation, bedding material, forms, concrete, reinforcing, and backfill, and surface restoration for underground raceways shall be furnished and installed under Division 16.

F. Groundwater control shall be provided by Division 16.

1.02 RELATED WORK

A. Raceways are specified under Section 16110.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data, for the following:

1. Handholes.

2. Plastic duct spacers.

3. Handhole frames, covers and chimney rings.

4. Buoyancy calculations.

5. Warning tape.

PART 2 PRODUCTS

2.01 MATERIALS

A. Raceways indicated to be in underground ductbanks shall be polyvinyl chloride conduit encased in steel reinforced concrete, except that rigid steel conduit shall be used for shielded signal wiring, analog I/O and copper or non-fiber optic data highway wiring. Refer to Section 16110 and detail drawings for material requirements.

B. Raceways indicated to be direct buried shall be PVC Coated rigid steel conduit. Refer to Section 16110 and detail drawings for material requirements.

C. Precast handholes shall be designed as specified below for precast concrete structures. Manufacturer shall provide buoyancy calculations to the Engineer for approval.

1. Refer to the drawings for inside dimensions, headroom requirements and minimum thickness of concrete for precast reinforced concrete structures.

2. Structural design calculations shall be prepared and stamped by a professional engineer registered in the State of Illinois.

3. Design Criteria
   a. Precast Concrete
      1) Minimum compressive strength shall be 5,000 psi at 28 days.
      2) Maximum water to concrete ratio shall be 0.40 by weight.
      3) Minimum cement content shall be 600 lbs of cement per cubic yard of concrete.
   b. Manufactured Products
      1) Conform to ACI 318.
      2) Products shall support their own weight, weight of soil above at 130 pcf and a live load equal to AASHTO H20 applied to top slab. Depth of soil will be calculated from finished grade.
      3) Cast base slab and walls together to form a monolithic base section.
      4) Structure walls shall be designed for an equivalent lateral fluid pressure of 90 pcf. Originate pressure diagram at finished ground surface. Include lateral pressure from vehicles in accordance with AASHTO.
      5) Consider discontinuities in structure produced by openings and joints. Provide additional reinforcing around openings. Frame openings to carry full design loads to support walls.
      6) Prevent flotation, with ground water level at finished ground surface, by dead weight of structure and soil load above structure. Do not consider skin friction, soil friction, or weight of equipment or contents in structure. Factor of safety against buoyancy shall be 1.15. If a concrete slab is required to prevent flotation, design the slab and provide anchorage of the structure to the slab.
      7) Design structure with a minimum number of joints.
      8) Provide lifting hooks for the top slab.
      9) Locate access openings, knockouts, and penetrations as indicated.

4. The date of manufacture, name and trademark of manufacturer shall be marked on the inside of each precast section.

5. Provide integrally cast knock-out panels in precast concrete manhole and handhole sections at locations indicated and with sizes indicated. Knock-out panels shall have no steel reinforcing.

6. Seal tongue and groove joints of precast handhole sections with rubber O-ring gasket. O-ring gasket shall conform to ASTM C443. In lieu of the O-ring gasket, a flexible joint sealant may be used. Sealant shall be Kent Seal No. 2; ConSeal No. 2; Ram-Nek or equal. Completed joints shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.

7. Dampproofing shall be Hydrocide 648 by Sonneborn Building Products; Dehydratine 4 by A.C. Horn, Inc.; RIW Marine Liquid by Toch Brothers; or equal.

D. Precast handholes shall be as manufactured by Chase Precast Corp.; Rotondo Company, Inc.; American Precast Co., or equal and constructed to dimensions as shown on the Drawings.

E. Handhole frames and covers shall be cast iron, heavy duty type for Class H-20 wheel loading as manufactured by Neenah; LeBaron; Vulcan or equal. Covers shall be marked and sized as shown on the Drawings.

F. Ground rods and other grounding materials and methods shall be as specified in Section 16660.

G. Bell ends and plastic duct spacers shall be as manufactured by Carlon; Underground Devices Inc. or equal.

H. Pull line for spare conduits shall be 1/8-in nylon rope.

I. Detectable Warning Tape

1. Each ductbank section shall be marked by means of a detectable warning tape (tracer tape) as shown on the Drawings. The detectable warning tape shall be capable of being detected or located by either conductive or inductive location techniques.

2. The detectable warning tape shall consist of 5 mil (.005-in) overall thickness; five-ply composition; ultra-high molecular weight; virgin polyethylene; acid; alkaline and corrosion resistant; with 150 pounds of tensile break strength minimum per 6-in width.

3. The top side of the tracer tape shall be color banded red for electrical and high voltage lines, and orange for signal, communication, telephone and fire alarm lines. Tracer tape shall be 4-in wide with four color bands. The tape shall be inscribed with the warning message for the utility such as "CAUTION – ELECTRICAL LINED BURIED BELOW." Tape shall be as manufactured by Mutual Industries, Inc.; Terra Tape, Div. of Reef Industries Inc. or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install raceways to drain away from buildings. Raceways between handholes shall drain toward the handholes. Raceway slopes shall not be less than 3-in per 100-ft.

B. Steel reinforce and concrete encase all ductbanks. See ductbank detail on the Drawings.

C. Lay raceway lines in trenches on mats of bank gravel not less than 6-inch thick and graded as per Paragraph 3.02A.

D. Use plastic spacers located not more than 4-ft apart to hold raceways in place. Spacers shall provide not less than 2-inch clearance between raceways and edge of concrete envelope. Power system raceways shall be separated by 7.5-inch center-to-center. Non-power system raceways shall be separated by 4.5-inch center-to-center.

E. The minimum cover for raceway banks shall be 24-inch unless otherwise indicated on the detail drawings.

F. Make raceway entrances to buildings, structures and vaults (except handholes) with rigid steel conduit not less than 10-ft long.

G. Conduits run below floor slabs in slab-on-grade construction shall be steel.

H. Raceway terminations at manholes shall be with end bells for PVC conduit and insulated throat grounding bushings for steel conduit.

I. Where bends in raceways are required, use long radius elbows, sweeps and offsets. Elbows and sweeps are to be rigid steel or PVC-coated rigid steel where shown on the drawings.

J. Swab all raceways clean before installing cable.

K. Plug and seal spare raceways watertight at all buildings and structures.

L. Seal the ends of raceways and make watertight at all manholes, buildings, and structures.

M. Train cables in handholes and support and restrain them on racks and hooks. Furnish inserts on all handhole walls for mounting future racks as well as racks required for present installation.

N. PVC-coated rigid galvanized steel elbows shall be used for all stub-ups through concrete floors, walls and slabs.

O. A pull line shall be installed and left in all spare raceways.

P. Install detectable warning tape in all ductbanks as shown on the Drawings. Where trench exceeds 24-inch width, provide additional detectable tape runs to mark each side of the ductbank in addition to the one in the center.

Q. Handhole Installation

1. Place bases on 12-inch bed screened gravel or crushed stone as shown on the drawings. Set base grade so that a minimum grade adjustment of 4-inch of grade ring is required to bring the manhole and handhole frame and cover to final grade.
   a. Use HDPE grade rings to adjust frame and cover to final grade.

2. Set precast sections plumb with a 1/4-inch maximum out-of-plumb tolerance. Seal joints of precast sections with either a rubber O-ring set in a recess or a flexible joint sealant used in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with

non-shrink grout and finished flush with the adjoining surfaces. Caulk the inside of leaking barrel section joints with non-shrink grout. If leaks appear in the manholes or handholes the inside joints shall be cleaned out and remade in a manner that will result in a watertight joint.

3. Allow joints to set for 24 hours before backfilling. Backfilling shall be performed by bringing the fill up evenly on all sides.

4. Plug holes in concrete with non-shrink grout or non-shrink grout in combination with concrete plugs. Finish flush on the inside.

5. Cut holes in precast sections to accommodate conduits prior to setting manhole and handhole sections in place.

R. Dampproofing

1. Coat outer surfaces of precast manholes and handholes with two coats of dampproofing in accordance with manufacturer's instructions.

3.02 CLEANING

A. All new manholes and handholes shall be thoroughly cleaned of all silt, debris and foreign matter prior to final inspection.

B. Dewater existing manholes and handholes. Maintain dry conditions while repairs and modifications are made.

C. Modifications and repairs to cracks shall be made in accordance with the manufacturer’s instructions.

D. Clean out existing ducts to be reused with a duct rodder before installing new cables.

E. Remove all debris from manholes and handholes after the work is completed.

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SECTION 16660
GROUNDING SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code (NEC), as shown on the Drawings and as specified herein.

B. All raceways, conduits, and ducts shall contain equipment grounding conductors sized in accordance with the NEC. Minimum sizes shall be No. 12 AWG.

PART 2 PRODUCTS

2.01 MATERIALS

A. Conduit shall be as specified under Section 16110.

B. Wire shall be as specified under Section 16120.

C. Grounding conduit hubs shall be malleable iron type, and of the correct size for the conduit, as manufactured by Thomas & Betts Co.; Catalog No. 3940 Series, similar by Burndy; O.Z. Gedney Co., or equal.

D. Buried grounding connections shall be by Cadweld process, or equal exothermic welding system.

1. Molds, cartridge materials and accessories shall be provided in kit form and selected per the manufacturer's written instructions for specific types, sizes and combinations of conductors and connected items. Molds and powder shall be furnished by the same manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment grounding conductors with all feeders and branch circuits.

B. Metal conduits stubbed into a motor control center or floor mounted electrical enclosure shall be terminated with insulated grounding bushings and connected to the motor control center or electrical enclosure ground bus. Bond boxes mounted below motor control centers to the motor control center ground bus. Size the grounding wire in accordance with NEC Table 250-122, except that a minimum No. 12 AWG shall be used.

C. Liquid tight flexible metal conduit in sizes 1-1/2-inch and larger shall have bonding jumpers. Bonding jumpers shall be external, run parallel (not spiraled) and fastened with plastic tie wraps.

D. Ground transformer neutrals to the nearest available grounding electrode with a conductor sized in accordance with NEC Article 250-66.

E. All equipment enclosures, motor and transformer frames, conduits systems, exposed structural steel, and all other equipment and materials required by the NEC to be grounded, shall be grounded and bonded in accordance with the NEC.

F. Seal exposed connections between different metals with No-Oxide Paint Grade A, or equal.

G. Lay all underground grounding conductors slack and, where exposed to mechanical injury, protect by pipes, or other substantial guards. If guards are iron pipe, or other magnetic material, electrically connect conductors to both ends of the guard. Make connections as specified herein.

H. Care shall be taken to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

I. All grounding type receptacles shall be grounded to the outlet boxes with a No. 12 THW green conductor connected to the ground terminal of the receptacle and fastened to the outlet box by means of a grounding screw.

J. Molds used for welding shall be new. The number of welds made per mold shall not exceed manufacturer's recommendations.

K. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters and HVAC equipment. Use braided-type bonding straps.

3.02 INSPECTION AND TESTING

A. Inspect the grounding and bonding system conductors and connections for tightness and proper installation.

B. Test all grounded cases and metal parts associated with the electrical equipment for continuity with the ground system.

END OF SECTION 16660

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SECTION 16950
ELECTRICAL SYSTEM TESTING AND SETTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall engage the services of a the equipment manufactures as required for the purpose of performing inspections and tests as herein specified.

B. The equipment manufacturer shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.

C. It is the purpose of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

D. The tests and inspections shall determine suitability for energizing equipment.

E. Test systems and equipment furnished under Division 16 and repair or replace all defective work and equipment. Refer to the individual equipment sections for additional specific testing requirements.

F. Field testing and commissioning shall be performed in accordance with the latest revisions of NETA Standard ATS "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" unless otherwise modified by these Sections.

G. A typed test report for each component tested shall be submitted to the Owner for the project record files as indicated.

H. Make adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

I. In addition to the specific testing requirements listed in the individual Sections, perform the additional testing, inspections and adjust settings as specified herein.

J. Testing shall be scheduled and coordinated with the Owner at least 2 weeks in advance.

K. Provide qualified test personnel, instruments and test equipment.

L. Provide a test report verifying compliance with the testing requirements included under Division 16.

M. Before proceeding with the energization of equipment, notify the Owner to schedule the start-up of the equipment.

1.02 RELATED WORK

A. Electric motors are provided under Divisions 01

B. Control panels are provided with the driven equipment under Divisions 11, 13, and 15.

1.03 SUBMITTALS

A. Test Report

1. The test report shall include the following:
   a. Summary of project.
   b. Listing of equipment tested.
   c. Test results.
   d. Recommendations.

2. Furnish copies of the complete report to the owner/engineer's representative as directed in the contract documents.

B. The report shall include a Table of Contents, a technical data sheet for each component (i.e., cable, circuit breaker, transformer, relay, etc.) tested. The Table of Contents shall include the name of each component, location, the major piece of equipment the component is located within, and a sheet number on which the technical information is presented. Each data sheet shall include a unique sheet number, the name of the component under test, the major piece of equipment in which the component is located and the weather conditions at the time of the test including the temperature and relative humidity at the time of the test. The firm doing the testing shall include, in the report, their opinion whether or not the equipment being tested complies with the specification and recommended measures to correct the deficiency. Any discrepancies shall be noted in the concluding summary of the report. Test report forms shall be in compliance with NETA standards. Three complete copies shall be provided. Reports shall be signed by the person in responsible charge of the field testing, an officer of the firm performing the tests and an officer of the Electrical Contracting Firm.

1.04 APPLICABLE CODES, STANDARDS AND REFERENCES

A. All inspections and tests shall be in accordance with the following codes and standards except as provided otherwise herein:

1. National Electrical Manufacturers Association – NEMA

2. ASTM International – ASTM

3. Institute of Electrical and Electronic Engineers – IEEE

4. InterNational Electrical Testing Association – NETA Acceptance Testing Specifications (ATS) - Latest Revision

5. InterNational Electrical Testing Association – NETA Maintenance Testing Specifications (MTS) - Latest Revision

6. American National Standards Institute – ANSI C2: National Electrical Safety Code

7. State and local codes and ordinances

8. Insulated Cable Engineers Association – ICEA

9. Association of Edison Illuminating Companies - AEIC

10. Occupational Safety and Health Administration – OSHA

11. National Fire Protection Association – NFPA
    a. ANSI/NFPA 70: National Electrical Code.
    b. ANSI/NFPA 70B: Electrical Equipment Maintenance.
    c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces.
    d. ANSI/NFPA 78: Lightning Protection Code.
    e. ANSI/NFPA 101: Life Safety Code.

B. All inspections and tests shall utilize the following references:

1. Project design specifications.

2. Project design drawings.

3. Manufacturer's instruction manuals applicable to each particular apparatus.

4. Project list of equipment to be inspected and tested.

1.05 DIVISION OF RESPONSIBILITY

A. The Contractor shall perform routine insulation-resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.

B. The Contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the specific power requirements.

C. The Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

D. The testing firm shall notify the Owner/Engineer's representative prior to commencement of any testing.

E. Any system, material, or workmanship which is found defective on the basis of acceptance tests shall be reported to the owner/engineer's representative.

F. The testing firm shall maintain a written record of all tests and, upon completion of project, shall assemble and certify a final test report.

G. Safety and Precautions

1. Safety practices shall include, but are not limited to, the following requirements:
    a. Occupational Safety and Health Act (OSHA).
    b. Accident Prevention Manual for Industrial Operations, National Safety Council (NSC).
    c. Applicable state and local safety operating procedures.
    d. Owner's safety practices (Lockout/Tagout).
    e. National Fire Protection Association - NFPA 70E.
    f. National Fire Protection Association - NFPA 79.
    g. American National Standards for Personnel Protection.

2. All tests shall be performed with apparatus de-energized. Exceptions must be thoroughly reviewed to identify safety hazards and devise adequate safeguards.

3. The testing firm shall have a designated safety representative on the project to supervise the testing operations with respect to safety.

1.06 TEST EQUIPMENT REQUIREMENTS

A. Suitability of Test Equipment

1. All test equipment shall be in good mechanical and electrical condition.

2. Selection of metering equipment should be based on a knowledge of the waveform of the variable being measured. Digital multi-meters may be average or RMS sensing and may include or exclude the dc component. When the variable contains harmonics or dc offset and, in general, any deviation from a pure sine wave, average sensing and average measuring RMS scaled meters may be misleading. Use of RMS measuring meters is recommended.

3. Field test metering used to check power system meter calibration must have an accuracy higher than that of the instrument being checked.

4. Accuracy of metering in test equipment shall be appropriate for the test being performed.

5. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.

B. Test Instrument Standards

1. All equipment used for testing and calibration procedures shall exhibit the following characteristics:
   a. Maintained in good visual and mechanical condition
   b. Maintained in safe operating condition

2. Test equipment should have operating accuracy equal to, or better than, the following limits:
   a. Portable multi-meters should be true RMS measuring.
   b. Multi-meters should have the following accuracy limits, or better:
      1) AC voltage ranges: .75% +/-3 last single digits @ 60 Hz
      2) AC current ranges: .90% +/-3 last single digits @ 60 Hz, including adapters, transducers
      3) DC voltage ranges: .25% +/-1 last single digit
      4) DC current ranges: .75% +/-1 last single digit
      5) Resistance ranges: .50% +/-1 last single digit
      6) Frequency range: .10% +/-1 last single digit @ 60 Hz
   c. Clamp-on ammeters: ac current +/-3% of range +/-1 last single digit @ 60 Hz
   d. Dissipation/power factor field equipment
      1) +/-0.1% power factor for power factor values up to 2.0%
      2) 5% of the reading for power factor values above 2.0%
   e. Low-range dc resistance equipment: 1.0% of reading, +/-2 last single digits
   f. Transformer turns-ratio test equipment: 0.5% or better @ 60 Hz

g. Ground electrode test equipment: +/-2% of range
h. Insulation test sets: 0-1000V dc +/-20% of reading at mid-scale
i. Electrical load survey equipment
    1) +/-5% total error, including sensors
    2) 1% resolution
    3) Current transformers +/-2% of range @ 60 Hz
    4) Voltage transformers +/-0.5% of range @ 60 Hz
j. Liquid dielectric strength test equipment: +/-2% of scale
k. Infrared scanning equipment: sensitivity of 2 degrees C
l. Phase shifting equipment: +/-1.0 degree C over entire range
m. High-current test equipment: +/-2% of range
n. DC high potential test equipment: +/-2% of full scale
o. AC high potential test equipment (60 Hz): +/-2% of full scale

C. Test Instrument Calibration

1. The testing firm shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

3. Instruments shall be calibrated in accordance with the following frequency schedule:
    a. Field instruments: 6 months maximum.
    b. Laboratory instruments: 12 months.
    c. Leased specialty equipment: 12 months (Where accuracy is guaranteed by lessor).
    d. Dated calibration labels shall be visible on all test equipment.
    e. Records, which show date and results of instruments calibrated or tested, must be kept up-to-date and available upon request.
    f. Up-to-date instrument calibration instructions and procedures shall be maintained for each test instrument.
    g. Calibrating standard shall be of higher accuracy than that of the instrument tested.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PREPARATION

A. Testing shall be scheduled and coordinated with the Owner at least 2 weeks in advance.

3.02 ACCEPTANCE TESTING

A. Provide acceptance testing for all equipment provided under Division16 in accordance with the individual specification sections.

B. Provided acceptance testing for all motors provided under Divisions 11, 13, 15.

3.03 ACCEPTANCE TESTING

A. Tests all electrical equipment, both new and existing, so that it is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications prior to energizing equipment.

B. Test systems and equipment furnished under Division 16 and repair or replace all defective work and equipment. Refer to the individual equipment sections for additional specific testing requirements.

C. Make adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

D. Mechanical inspection, testing and settings of circuit breakers, protective relays, disconnect switches, motor starters, overload relays, control circuits and equipment for proper operation.

E. Check and record the full load current draw of each motor. Check ampere rating of thermal overloads for motors and submit a typed record to the Owner of the same, including MCC cubicle location and driven load designation, motor service factor, horsepower, and Code letter. If incorrectly sized thermal overloads are installed replace same with the correct size overload.

F. Check power and control power fuses for the correct type and ratings. Replace fuses if they are found to be of the incorrect size.

G. Check settings of the motor circuit protectors. Adjust settings to lowest setting that will allow the motor to be started when under load conditions.

H. Check motor nameplates for correct phase and voltage.

I. Check rotation of motors prior to testing the driven load. Disconnect the driven equipment if damage could occur due to wrong rotation. If the rotation of the motor shaft is not correct, for the driven equipment, change the motor connections at the motor terminal box.

J. Check interlocking, control and instrument wiring for each system and/or part of a system to prove that the system will function properly as indicated by control schematic and wiring diagrams.

K. Inspect each piece of equipment in areas designated as HAZARDOUS to ensure that equipment of proper rating is installed. In the case where HAZARDOUS rated equipment is installed outdoors or in "WET" locations, verify that equipment furnished is also rated for use in WET locations and that conduit and equipment drains are provided. If equipment is not properly rated advise the Owner.

L. Verify proper phase sequence connection at transformers, equipment, and panels.

M. Verify all circuit breaker ratings and settings are as required by the Contract Documents or as amended during shop drawing review. Advise the Owner of discrepancies and make changes as directed by the Owner.

N. Verify grounding of instrumentation equipment and line surge protection equipment.

O. Test and calibrate protective relays and circuit breakers.

P. Megger test all low voltage power system cable.

END OF SECTION 16950

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