



Technical Specifications

IFB#026-45 Hall County- Spout Springs Water Reclamation Facility Expansion to 1.6 MGD



Prepared By:

CEC

CIVIL ENGINEERING CONSULTANTS, INC.

Civil & Environmental Engineering

4994 Lower Roswell Road, Suite 18, Marietta, GA 30068

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**SECTION 00 11 13
ADVERTISEMENT FOR BIDS**

The County of Hall, Georgia (Owner) is soliciting BIDS for the construction of the following project:

**HALL COUNTY – SPOUT SPRINGS WATER RECLAMATION FACILITY,
EXPANSION TO 1.6 MGD**

This project shall include the construction of the construction of the Hall County Spout Springs Water Reclamation Facility, Expansion from 0.75MGD to 1.6 MGD. Work includes new headworks, new SBR, post equalization basin with pumping, new disk filters, new UV disinfection, new aerobic digesters, upgrading of plant drain pump station, new plant water booster pumping system , vacuum truck receiving station and all other work as shown on the Contract Drawings and/or as specified herein including. The SBR, UV disinfection system and filter system equipment has been pre-selected for this project.

SEALED BIDS will be accepted at the Hall County Government Center (HCGC) located on the 4th floor, Finance Training Room, 2875 Brown Bridge Road, Gainesville, GA 30504, no later than Thursday, August 22, 2024, by 2:00pm EST, then publicly opened and read aloud. Bidders may attend but are not required to do so.

Schedule of Events:

Date IFB Issued: Thursday, July 18, 2024

Mandatory Pre-Bid Site Meeting: Friday, August 2, 2024, at 10:00am

Bidder's Questions Due: Friday, August 9, 2024, by 4:00pm

Answers to Questions Due: Friday, August 16, 2024

Bid Due Date: Thursday, August 22, 2024, by 2:00pm

Bids must be submitted in a sealed, non-transparent envelope and clearly marked on the outside with the words, **"IFB # 026-45 Hall County - Spout Springs Water Reclamation Facility, Expansion to 1.6 MGD"**, along with Bidder's name, address, phone number and contact person.

Bid Documents: All Bid Documents are available for digital download at <https://cecincga.com> under the 'Bid Information' tab. Please email David Gauker at david@cecincga.com to be added to the Plan Holders list and eligible to submit a bid for the project. **Hard copies of the Contract Documents will be available from Civil Engineering Consultants for two-hundred dollars (\$200.00).**

Pre-Bid Conference: A mandatory pre-bid conference for the Project will be held on Friday, August 2, 2024. Bids will not be accepted from Bidders who do not attend the mandatory pre-bid conference.

Mandatory Pre-Bid Site Meeting: Spouts Springs Water Reclamation Facility, located at 6818 Spout Springs Road, Flowery Branch, GA 30542.

Contractor Questions: All questions pertaining to the Project and Bid Documents must be submitted electronically. Questions must be submitted by **Thursday, August 9, 2024**. All Contractor questions should be made in writing to Lacey Wolford at lacey@cecincga.com.

**HALL COUNTY – SPOUT SPRINGS WRF
EXPANSION TO 1.6 MGD**

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A satisfactory Bid Bond (in the amount of 5% of the Bid), executed by the Bidder, and an acceptable surety company listed in the latest issue of U.S. Treasury Circular 570, will accompany each BID. The Owner reserves the right to reject any or all Bids or to waive any informality in the bidding, to evaluate Bids, and to accept any Bid, which in his opinion, may be for his best interest.

The successful Bidder for this Contract will be required to furnish a satisfactory Performance Bond and a Labor and Material Payment Bond, with a corporate surety **licensed to do business in the State of Georgia with a rating of not less than A-** and approved by the OWNER and listed in the latest issue of U.S. Treasury Circular 570, each in the amount of 100% of any awarded contract. Performance and Payment Bonds are NOT required to bid but will be required after award.

Instructions to Bidders: For all further requirements regarding Bid submittal, qualifications, procedures, and contract award, refer to the Instructions to Bidders that are included in the Bidding Documents.

**SECTION 00 21 13
INSTRUCTIONS TO BIDDERS**

BIDS will be received by Hall County, herein called the "OWNER", Thursday August 22, 2024, by 2:00pm.

Each BID must be submitted in a sealed envelope, addressed to Hall County located at 2875 Brown Bridge Road, Gainesville, Ga 30504. Each sealed envelope containing a BID must be plainly marked on the outside as BID for the **IFB # 026-45 HALL COUNTY – SPOUT SPRINGS WATER RECLAMATION FACILITY, EXPANSION TO 1.6 MGD** and the envelope should bear on the outside, the name of the BIDDER, his address, his license number (if applicable). If forwarded by mail, the sealed envelope containing the BID must be enclosed in another envelope addressed to the OWNER at 2875 Brown Bridge Road, Gainesville, Ga 30504.

All BIDS must be made on the required BID Form. All blank spaces for BID prices must be filled in, in ink or typewritten, and the BID Form must be fully completed and executed when submitted. Only one (1) copy of the BID Form is required.

The OWNER may waive any informalities or minor defects or reject any and all BIDS. Any BID may be withdrawn prior to the above scheduled time for the opening of BIDS or authorized postponement thereof. No BIDS will be received or accepted after the above specified date and time for the opening of BIDS, unless otherwise extended by an Addendum. BIDS submitted after the designated hour will be deemed invalid and returned unopened to the BIDDER. No BIDDER may withdraw a BID within 90 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.

A mandatory pre-bid meeting will be held at the time and location indicated in the Advertisement for Bid. Representatives of the Owner and Engineer will be present to discuss the Project. Bids will not be accepted from Bidders who do not attend the conference. It is each Bidder's responsibility to sign in at the pre-bid conference to verify its participation. Bidders must sign in using the name of the organization that will be submitting a Bid. A list of qualified Bidders that attended the pre-bid meeting and are eligible to submit a Bid for this Project will be posted on the designated website.

Information presented at the pre-bid conference does not alter the Contract Documents. Owner will issue Addenda to make any changes to the Contract Documents that result from discussions at the pre-bid conference. Information presented, and statements made at the pre-bid conference will not be binding or legally effective unless incorporated in an Addendum.

The BIDDER must meet the minimum project experience requirements stated in the Advertisement for Bids. Those requirements are as follows:

1. Minimum of three (3) projects in the last five (5) years involving similar work.
2. Proposed Project Superintendent shall have been directly involved in at least one of the above-mentioned projects.
3. To demonstrate current qualifications to perform the Work, each Bidder must submit the following with their Bid:
 - a. Section 00 41 13 – Bid Form
 - b. Section 00 43 13 – Bid Bond
 - c. Section 00 45 13 – Statement of Bidder's Qualifications
 - d. Section 00 45 20 – Oath of Successful Bidder
 - e. Section 00 45 47 – Security and Immigration Compliance Act Certification
 - f. Section 00 45 48 – Contractor Affidavit

BIDDERS must satisfy themselves of the amount of required work and materials by a review of the plans and specifications and including ADDENDA. After BIDS have been submitted, the BIDDER shall not assert that there was a misunderstanding concerning the quantities of WORK or of the nature of the WORK to be done. Any request for interpretation of Contract Documents or ADDENDA shall be made to the Engineer, in writing.

Each BID must be accompanied by a BID Bond payable to the OWNER for five percent of the total amount of the BID. As soon as the BID prices have been compared, the OWNER will return the BID Bonds of all except the three (3) lowest responsible BIDDERS. When the Agreement is executed, the Bonds of the two (2) remaining unsuccessful BIDDERS will be returned. If no Award has been made within 90 days after the opening of BIDS, the BIDDERS may request return of their BID Bonds, if they have not been notified of the acceptance of his/her or their BID. The BID Bond of the successful BIDDER will be retained until the Performance Bond has been executed and approved, after which, it will be returned. The BID Bond shall be secured by a guaranty or a surety company, listed in the latest issue of U.S. Treasury Circular 570, licensed to do business in the State of Georgia.

The party to whom the Contract is Awarded will be required to execute the Agreement and obtain the Performance Bond and the Payment Bond within ten (10) calendar days from the date when NOTICE OF AWARD is delivered to the BIDDER. The NOTICE OF AWARD shall be accompanied by the necessary Agreement and bond forms. In case of failure of the BIDDER to execute the Agreement, the OWNER may, at his option, consider the BIDDER in default, in which case the BID BOND accompanying the bid shall become the property of the OWNER.

The NOTICE TO PROCEED shall be issued within ten (10) days of the execution of the Agreement by the OWNER. Should there be reasons why the NOTICE TO PROCEED cannot be issued within such period the time may be extended by mutual agreement between the OWNER and CONTRACTOR. If the NOTICE TO PROCEED has not been issued within the 10-day period, or within the period mutually agreed upon, the CONTRACTOR may terminate the Agreement without further liability on the part of either party.

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

The OWNER reserves the right to add to and/or delete from the Contract after it has been Awarded. BIDS may be held by the OWNER for a period not to exceed (90) days from the date of the opening of BIDS for the purpose of reviewing the BIDS, prior to Awarding the Contract.

A conditional or qualified BID will not be accepted.

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

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

The specifications contained herein are intended to provide performance and material requirements for the execution and completion of this Project.

The number and trade names given for any products are taken from various manufacturer catalogs as stated and shall be construed as being descriptive only of type, style, and quality of material required. Material of other reputable manufacturers of equal quality, type and style may be acceptable only if approved by the Engineer.

The CONTRACTOR, in signing his BID on the whole or any portion of the WORK, shall conform to the following requirements:

- (a) BIDS which are not signed by individuals making them shall have attached thereto a power of attorney evidencing authority to sign the BID in the name of the person for whom it is signed.
- (b) BIDS which are signed for a partnership shall be signed by all of the partners or by an attorney-in-fact. If a BID is signed by an attorney-in-fact, there should be attached to the BID a power of attorney executed by the partners evidencing authority to sign the BID.

- (c) BIDS which are signed for a corporation shall have the correct corporate name thereof and the signature of the President or other authorized officer of the corporation manually written below the corporate name following the wording "By _____". The Corporation seal shall also be affixed to the BID and the signature shall be attested by the Secretary.

The Award of the Contract will be made to the lowest responsive, responsible BIDDER, based on the BID Form with the lowest TOTAL BID PRICE. The BIDDER to whom the Award is made will be notified at the earliest possible date. The OWNER reserves the right to reject any and all BIDS and to waive any informality in BIDS whenever such rejection or waiver is in its interest.

BIDDER must agree to commence work on or before a date to be specified in a written "NOTICE TO PROCEED" of the OWNER. The Contract Time for Substantial Completion shall be 510 consecutive calendar days. BIDDER must also agree to pay as Liquidated Damages the sum of \$500.00 dollars per day for each consecutive calendar day thereafter as hereinafter provided in the General Conditions.

Any questions should be directed to Lacey Welford in writing to lacey@cecincga.com. The last day for submission of questions shall be Friday, August 9, 2024 by 4:00 pm EST.

END OF SECTION

SECTION 00 41 43
BID FORM

BID SUBMITTED BY: _____
(Typed or printed name of organization)

BID ADDRESSED TO: **Hall County, Georgia**
Purchasing Department
2875 Browns Bridge Road, 4th Floor.
Gainesville, Georgia 30504

1. The undersigned BIDDER proposes and agrees, if this BID is accepted, to enter into an agreement with the OWNER in the form included in the Contract Documents to perform and furnish all WORK as specified or indicated in the contract Documents for the TOTAL BID AMOUNT and within the BID times indicated in this BID and in accordance with the other terms and conditions of the Contract Documents. The Project will be awarded based on the Lowest Responsive TOTAL BID AMOUNT.
2. BIDDER accepts all of the terms and conditions of the Advertisement for Bids and Information for Bidders, including without limitation those dealing with the disposition of the BID security. This BID will remain subject to acceptance for ninety (90) days after the day of BID opening, or for such longer period of time that BIDDER may agree to in writing upon request of the OWNER. BIDDER will sign and deliver the required number of counterparts of the Agreement with the Bonds, Certifications of Insurance, and other documents required by the Bidding Requirements within ten (10) days after the date of the OWNER's Notice of Award.
3. In submitting this BID, BIDDER represents, as more fully set forth in the Agreement, that:
 - (a) BIDDER has examined and carefully studied the Bidding Documents, the other related data identified in the Bidding Documents, and the following Addenda receipt of all which is hereby acknowledged (list Addenda by Addendum Number and Date):

<u>Addendum No.</u>	<u>Date Received</u>	<u>Addendum No.</u>	<u>Date Received</u>
_____	_____	_____	_____
_____	_____	_____	_____

- (b) BIDDER has visited the site and attended the mandatory pre-bid meeting and are familiar with and is satisfied as to the general, local and site conditions that may affect cost, progress, performance and furnishing of the WORK, and BIDDER has not relied upon any oral representations by employees or agents of OWNER or ENGINEER.
 - (c) BIDDER is familiar with and is satisfied to all federal, state, and local Laws and Regulations that may affect cost, progress, performance and furnishing of the WORK.

- (d) BIDDER has carefully studied all reports of explorations and tests of subsurface conditions at or contiguous to the site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or continuous to the site (except Underground Facilities) which have been identified in the Supplementary Conditions of the General Conditions. BIDDER acknowledges that such reports and drawings are not Contract Documents and may not be complete for BIDDER's purposes. BIDDER acknowledges that OWNER and ENGINEER do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Bidding Documents with respect to Underground Facilities at or contiguous to the site.
- (e) BIDDER has obtained and carefully studied (or assumes responsibility for having done so) all such additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the WORK or which relate to any aspect of the means, methods, techniques, sequences and procedures of construction to be employed by BIDDER and safety precautions and programs incident thereto.
- (f) BIDDER does not consider that any additional examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this BID for performance and furnishing of the WORK in accordance with the times, price and other terms and conditions of the Contract Documents.
- (g) BIDDER is aware of the general nature of WORK to be performed by OWNER and OTHERS at the site that relates to WORK for which this BID is submitted as indicated in the Contract documents.
- (h) BIDDER has correlated the information known to BIDDER, information and observations obtained from visits to the site, reports and drawings identified in the Contract Documents and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.
- (i) BIDDER has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that BIDDER has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to BIDDER, and the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the WORK for which this BID is submitted.
- (j) This BID is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, associates, organization or corporation; BIDDER has not directly or indirectly induced or solicited any other BIDDER to submit a false or sham BID; BIDDER has not solicited or induced any person, firm or corporation to refrain from bidding; and BIDDER

has not sought by collusion to obtain for itself any advantage over any other BIDDER or over OWNER.

4. UNIT PRICES have been computed in accordance with the General Conditions. All specific cash allowances are included in the price(s) and have been computed in accordance with the General Conditions.

BIDDER acknowledges that quantities are not guaranteed and are solely for the purpose of comparison of BIDS, and final payment for all Unit Price BID items will be based on actual quantities provided, determined as provided in the Contract Documents.

5. BIDDER declares that he understands that the quantities shown on the bid are subject to adjustment by either increase or decrease, and that should the quantities of any of the items or WORK be increased, the undersigned proposes to do the additional work at the Unit Prices stated herein; and should the quantities be decreased, BIDDER also understands that payment will be made on actual quantities at the Unit Price bid and will make no claim for anticipated profits for any decrease in the quantities and that actual quantities will be determined upon completion of WORK, at which time adjustment will be made to the Contract Amount by direct increase or decrease.
6. BIDDER will complete the WORK in accordance with the Contract Documents for the prices listed in the following Bid Schedule.

**SPOUT SPRINGS WATER RECLAMATION FACILITY,
EXPANSION TO 1.6 MGD**

BID SCHEDULE

All bid items shall include all costs for furnishing all labor, materials, equipment, supplies, allowances, and all other costs, including permit fees, taxes, insurance, miscellaneous costs, overhead, and profit incurred for the Work complete in place and ready for continuous service.

The Bids shall be shown in both words and figures. In case of a discrepancy, the amount shown in words shall govern. In the event of a discrepancy between the unit price bid and the extension, the unit price will be deemed intended by the bidder and the extensions adjusted. In the event of a discrepancy between the sum of the extended amounts and the bid total, the sum of the extended amounts shall govern.

Total Bid Amount: Bidder will complete the Work in accordance with the Contract Documents for the following lump sum prices, together with Allowances and Unit Prices.

PART 1 - BASE BID: SPOUT SPRINGS EXPANSION TO 1.60 MGD					
<u>Item</u>	<u>Description</u>	<u>Unit</u>	<u>Qty.</u>	<u>Unit Price(figures)</u>	<u>Total Unit Price (figures)</u>
1a.	General Construction of the Spouts Springs WRF Expansion to 1.6 MGD per Contract Documents including all work shown on the Drawings and as specified, exclusive of those items listed below in 1b and 1c, and Allowances	LS	1	\$ _____	\$ _____
1b.	For furnishing the SBR, filter, controls and equipment identified in Appendix A equipment. Installation included in item 1a.	LS	1	\$ _____	\$ _____

1c.	For furnishing the UV disinfection equipment identified in Appendix B. Installation included in item 1a.	LS	1	\$ _____	\$ _____
Total Price Part 1 – Items (1a +1b + 1c): \$ _____ (figures)					
Total Price Part 1 – Cost in Words: \$ _____ _____ (words)					

PART 2 - ALLOWANCE COSTS

The Bidder shall include in the Total Bid price the lump sum allowances identified below. Payment will be in accordance with the General Conditions. Any unused balance of the allowances shall revert to the Owner upon completion of the project. Contractor is entitled to overhead and profit on any unused balance.

<u>Item</u>	<u>Description</u>	<u>Unit</u>	<u>Approx. Qty.</u>	<u>Unit Price</u>	<u>Total Price</u>
1.	Allowance for correction of unforeseen utility conflicts and utility relocation	LS	1	\$ <u>50,000.00</u>	\$ <u>50,000.00</u>
2.	Owner Contingency	LS	1	\$ <u>300,000.00</u>	\$ <u>300,000.00</u>
3.	Landscape Allowance	LS	1	\$ <u>40,000.00</u>	\$ <u>40,000.00</u>
4.	Pista Grit Equipment Inspection	LS	1	\$ <u>15,000.00</u>	\$ <u>15,000.00</u>
5.	Electrical Service	LS	1	\$ <u>100,000.00</u>	\$ <u>100,000.00</u>
6.	Spare Parts	LS	1	\$ <u>20,000.00</u>	\$ <u>20,000.00</u>

7. Metal Canopy Allowance	LS	1	\$ <u>400,000.00</u>	\$ <u>400,000.00</u>
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8. Plant Reuse System Upgrade	LS	1	\$ <u>75,000.00</u>	\$ <u>75,000.00</u>
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Total Price Part 2 – Items (1-8):	\$ 1,000,000.00			
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Total Price Part 2 – Cost in Words:	One Millon dollars
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PART 3- UNIT PRICE BIDS

Bidder will provide the following Work at the indicated installed unit prices.

<u>Item</u>	<u>Description</u>	<u>Unit</u>	<u>Approx. Qty.</u>	<u>Unit Price</u>	<u>Total Price</u>
1.	DIP Pipe	Ton	1	\$ _____	\$ _____
2.	DIP Fittings	Ton	1	\$ _____	\$ _____
3.	Stone Stabilization	Tons	10	\$ _____	\$ _____
4.	Silt Fence Type Sd-1	LF	500	\$ _____	\$ _____
5.	Silt Fence Type Sd-1 Removal	LF	500	\$ _____	\$ _____
6.	Construction Exits	EA	1	\$ _____	\$ _____
7.	Permanent Grassing	AC	1	\$ _____	\$ _____
8.	Riprap	SY	500	\$ _____	\$ _____
9.	Erosion Control Monitoring	LS	1	\$ _____	\$ _____
10.	Concrete Wash Out	LS	1	\$ _____	\$ _____

Total Price Part 3 – Items (1 - 10, inclusive):	\$
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Total Price Part 3 – Cost in Words:
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The amount of Total Price for Part 3 shall be shown in both figures and words. In case of a discrepancy, the amount shown in words shall govern. In the event of a discrepancy between the Unit Price bid and the extension, the Unit Price will be deemed intended by the Bidder and the extension adjusted. In the event of a discrepancy between the sum of the extended amounts and the Bid total, the sum of the extended amounts shall govern.

PART 4- BID SUMMARY

All work shown and specified in the Contract Documents

Description	Amount in Figures
Part 1 - Base Bid	\$ _____
Part 2 - Allowance Items	\$ <u>1,000,000.00</u>
Part 3 – Unit Pricing	\$ _____
Total Bid Amount	\$ _____

Total Bid Amount in Words: (Parts 1+2+3) _____

In case of a discrepancy, the amount shown in words shall govern. In the event of a discrepancy between the sum of the extended amounts and the bid total, the sum of the extended amounts shall govern.

- BIDDER agrees that the WORK will be Substantially Completed within 510 consecutive calendar days, from the date when the Contract Time commences to run as provided in the General Conditions or 30 days after delivery of all materials and major equipment and will be completed and ready for final payment in accordance with the General Conditions.***

BIDDER accepts the provisions of the Agreement as to Liquidated Damages in the event of failure to complete the WORK within the time(s) specified in the Agreement.

- The following documents are attached and made a condition of this BID:
 - Required Bid Security in the form of Bid Bond.
 - The address of BIDDER is indicated below.

BIDDER'S NAME: _____

Primary Contact Person: _____

Secondary Contact Person: _____

Bidder's Street Address: _____

Bidder's Mailing Address (if different from above): _____

Bidder's Telephone Number: _____

Bidder's Fax Number: _____

3. Terms used in this BID which are defined in the General Conditions will have the meanings indicated in the General Conditions.

THIS BID SUBMITTED on _____, 20__.

A Corporation

Corporation Name: _____ (SEAL)

State of Incorporation: _____

Type (General Business, Professional, Service, Limited Liability): _____

By: _____
(Signature)

Title: _____

Attest: _____ (CORPORATE SEAL)
(Signature)

Business Address: _____

Telephone Number: _____

Fax Number: _____

Date of Qualification to do business is: _____

PART 5–BASE BID MAJOR EQUIPMENT SCHEDULE

The Base Bid shall include the costs for the circled Manufacturers/Suppliers listed in this Major Equipment Schedule, exclusive of any additive or deductive Alternate Bid Items. Should a Bidder fail to indicate which manufacturer or supplier its Bid is based on, or circle more than one listed manufacturer/supplier per equipment item, the Bidder shall provide the first listed manufacturer/supplier (A) for its Bid for the amount included in the Total Bid at no increase in the Contract amount. The Contractor shall submit working drawings in accordance with the General Conditions for any

modifications to the Contract Drawings required due to the submittal of the base bid manufacturers/suppliers. The Bidder is aware that the Owner will award the Contract without consideration of Alternate manufacturers/suppliers.

The Major Equipment Schedule lists the base bid equipment manufacturer/supplier as applicable for major equipment items and key suppliers for the Project. The Bidder must indicate which named manufacturer/supplier it intends to provide by circling one of the manufacturers/suppliers listed.

Specification Section	Equipment Description	Manufacturer/Supplier
43 11 33	Rotary Positive Displacement Blowers	A. Aerzen
43 23 13	Self-Priming Centrifugal Pump	A. Gorman-Rupp B. Pentair Water
43 23 15	Duplex Skid Mounted Self-Priming Centrifugal Pump	A. Gorman-Rupp
43 24 00	Centrifugal Chopper Pump	A. Hayward Gordon B. Trillium Flow Technologies
43 25 00	Submersible Wastewater Pumps	A. Flygt B. Homa
43 26 00	Vertical Mult-Stage Water Pumps	A. Gould
46 21 12	Vac Truck Receiving Station	A. JWC
46 21 13	Chain and Rake Bar Screen	A. JWC B. Vulcan C. Headworks
46 23 23	Grit Removal Equipment	A. Smith and Loveless
46 51 21	Coarse Bubble Diffused Aeration System	A. Sanitaire B. Aquarius Technologies C. EDI
46 53 53	Sequential Batch Reactor System	A. Aqua Aerobics

Specification Section	Equipment Description	Manufacturer/Supplier
46 61 41	Disk Filters	A. Aqua Aerobics
46 66 56	Ultraviolet Disinfection Equipment	A. Trojan
46 73 19	Floating Supernate Decanter	A. Parkson

PART 6– MAJOR EQUIPMENT MANUFACTURERS SUBSTITUTION AS AN ADDITIVE OR DEDUCTIVE ALTERNATE

Any Manufacturer, including those not listed as an acceptable manufacturer, may be listed as an additive or deductive alternate substitution. However, the base bid will be evaluated on the major equipment listed in Part 5.

The Bidder understands that **after a Contract is awarded**, the Owner may, at its sole discretion, select items of any Manufacturer listed in the following additive or deductive substitute tabulation. The Bidder agrees to furnish and install any additive or deductive alternative substitutions for the price indicated. The BID will be adjusted accordingly.

The Engineer may require detailed information to be submitted for preliminary evaluation of a substitute Manufacturer. This information could include technical and performance details of the equipment and other information deemed necessary by the Engineer and/or described in the Contract Documents.

If an offered substitution included items of equipment of any Manufacturer that may require any modification to or deviation from the Drawings, the undersigned agrees to prepare and submit detailed Drawings to the Engineer showing all modifications to structures, piping, electrical, mechanical, and instrumentation work, required to adapt the plans to the equipment selected. The Bidder further understands that the Engineer will review said detailed drawings of modifications and either approve them or indicate changes necessary to comply with the project requirements. Detailed drawings that are not approved will be revised and resubmitted to the Engineer for approval. If the Engineer determines that the substitute equipment cannot be approved, the original Base Bid equipment shall be provided. The prices listed in the following additive or deductive substitute tabulation are “installed” prices and take into consideration any changes that may be required to the original design.

Specification Section	List Equipment Vendor	Circle to Indicate Additive or Deductive Substitution	Add (Deduct) Price From Base Bid (in words)
43 25 00 Submersible Wastewater Pumps		Add Deduct	 \$

Specification Section	List Equipment Vendor	Circle to Indicate Additive or Deductive Substitution	Add (Deduct) Price From Base Bid (in words)
46 21 12 Vac Truck Receiving Station		Add Deduct	\$
43 24 00 Centrifugal Chopper Pump		Add Deduct	\$
43 26 00 Vertical Multi-Stage Water Pumps		Add Deduct	\$
*		Add Deduct	\$
*		Add Deduct	\$

*Contractor write in

All BID Items shall include all costs for furnishing all labor, materials, equipment, supplies, allowances, and all other costs including permit fees, taxes, insurance, miscellaneous costs, overhead and profit incurred for the WORK, complete in place and ready for continuous service.

END

**SECTION 00 43 13
BID BOND**

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned,
_____ as PRINCIPAL, and
_____ as SURETY, are held and firmly bound unto
Hall County, Georgia, hereinafter called the "Local Public Agency", in the penal sum of
_____ Dollars,
(\$ _____) lawful money of the United States, for the payment of which sum well and
truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns,
jointly and severally, firmly by these presents.
THE CONDITION OF THIS OBLIGATION IS SUCH, that Whereas the Principal has submitted the
Accompanying Bid, dated _____, 20__ for the construction of

**HALL COUNTY – SPOUT SPRINGS WATER RECLAMATION FACILITY,
EXPANSION TO 1.6 MGD**

NOW, THEREFORE, if the Principal shall not withdraw said Bid within the period specified therein
after the opening of the same, or, if no period be specified, within thirty (30) days after the said
opening and shall within the period specified therefore, or if no period be specified, within ten (10)
days after the prescribed forms are presented to him for signature, enter into a written Contract with the
Local Public Agency in accordance with the Bid as accepted, and give bond with good and sufficient
surety or sureties, as may be required, for the faithful performance and proper fulfillment of such
Contract, or in the event of the withdrawal of said Bid within the period specified, or the failure to
enter into such Contract and give such bond within the time specified, if the Principal shall pay the
Local Public Agency the difference between the amount specified in said Bid and the amount for
which the Local Public Agency may procure the required work or supplies or both, if the latter be in
excess of the former, than the above obligation shall be void and of no effect, otherwise to remain in
full force and virtue.

IN WITNESS WHEREOF, the above-bounded parties have executed this instrument under their
several seals this _____ day of _____, 20__, the name and corporate seal of each corporate party
being hereto affixed, and these presents signed by its undersigned representative, pursuant to authority
of its governing body.

In presence of:

_____(SEAL)
(Individual Principal)

(Address, Zip Code)

_____(SEAL)
(Partnership)

(Address, Zip Code)

By: _____

(Corporate Principal)

(Address, Zip Code)

By: _____
(Affix Corporate Seal)

(Corporate Surety)

By: _____
(Affix Corporate Seal)

Countersigned by:

Attorney-in-Fact, State of _____

State of _____

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the _____, Secretary of the Corporation named as Principal in the within bond; that _____, who signed the said bond on behalf of the Principal was then _____ of said corporation; that I know his signature, and his signature thereto is genuine; and that said bond was duly signed, sealed, and attested to for and in behalf of said corporation by authority of this governing body.

(Corp.)

_____ (Seal)

Title _____

**SECTION 00 45 13
STATEMENT OF BIDDER'S QUALIFICATIONS**

All questions must be answered, and the data given must be clear and comprehensive. This statement must be notarized. If necessary, questions may be answered on separate attached sheets. The Bidder may submit any additional information desired. Attach all additional sheets to this statement. (Sample "Project Information Form" contained at the end of this Section.)

1. Name of Bidder: _____
2. Permanent main office address and phone number: _____
3. When organized: _____
4. How many years have you been engaged in the contracting business under your present firm or trade name: _____
5. Contracts on hand (list major contracts, total number, and dollar value) _____

6. Have you ever failed to complete any work awarded to you? If so, where, and why? _____

7. Have you ever defaulted on a contract? If so, where, and why? _____

8. Attach a list of the most important projects recently completed by your company which are similar in scope to this Project. (Complete a "Project Information Form" attached, for each Project listed.) See the Advertisement for Bid and the Instructions to Bidders for required minimum project experience.
9. List your major equipment available for this Contract. _____

10. Background and experience of the Principal members of your organization, including officers. Attach resume(s)

11. Background and experience of the Project Manager who will be assigned to this Project. Attach resume.
12. Background and experience of the Superintendent who will be assigned to this Project. Attach resume.
13. Any history of litigation, arbitration, or other related mediation actions for the proposed Project Manager, Project Superintendent, or referenced Projects? _____

14. The undersigned hereby authorizes and requests any person, firm, or corporation to furnish any information requested by the Owner in verification of the recitals comprising this Statement of Bidder's Qualifications.

I certify that I am _____ of the Bidder, and that the answers to the foregoing questions and statements contained therein are true and correct.

BIDDER: _____

By: _____
(name signed)

(name printed or typed)

Title: _____

Date: _____

Subscribed and sworn to me this ____ day of _____, 20 ____.

NOTARY PUBLIC: _____
(name signed)

(name printed or typed)

Commission Expires: _____
(Date)

(SEAL)

PROJECT INFORMATION FORM

STATEMENT OF BIDDER'S QUALIFICATIONS

SECTION 00 45 13

Page 2 of 3

(Attach Copies for Three (3) Projects)

Project Title: _____

Project Description: _____

Project Owner:

1. Owner Name: _____

2. Address: _____

3. Contact Person: _____

4. Phone Number: _____

Contractor Project Manager:

1. Company Name: _____

2. Contractor Project Manager: _____

3. Phone Number: _____

Contract Amount:

1. Initial: _____

2. Final: _____

3. Reason if Different: _____

Contract Time

1. Initial: _____

2. Final: _____

3. Completion Date: _____

4. Reason if Different: _____

**SECTION 00 45 20
CONTRACTOR AFFIDAVIT AND
OATH OF SUCCESSFUL BIDDER**

Personally appeared before me, the undersigned officer, duly authorized to administer oaths,
_____, (insert name), who, after being duly sworn, deposes as follows:

I, _____, (insert name), am a competent adult, and I have personal knowledge of the facts set forth in this Affidavit and Oath which I make for any lawful use or purpose.

I, _____ (insert name) swear or affirm that I have not prevented or attempted to prevent competition in bidding or submitting a bid for this Project by any means whatsoever. I swear or affirm that I have not prevented or endeavored to prevent anyone from making a Bid for this Project by any means whatsoever, I swear I have not caused or induced any other person to withdraw a Bid for this Project. I swear or affirm that I have not violated O.C.G.A. §36-91-21(d) in any way, directly or indirectly.

We, the undersigned, to the best of our knowledge, affirm that no other officers, agents, or other persons acted for or represented the Contractor in the bidding for and procurement of this Contract.

I hereby declare under penalty of perjury that the foregoing is true and correct. Executed on _____, 20__ in _____ (city), _____ (state).

By: _____
Signature

Print Name of Affiant

Print Title of Affiant

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

NOTARY PUBLIC

My Commission Expires:

SECTION 00 45 47
SECURITY AND IMMIGRATION
COMPLIANCE ACT CERTIFICATION

Pursuant to the Georgia Security and Immigration Compliance Act of 2006, Contractor understands and agrees that compliance with the requirements of OCGA 13-10-91 and Georgia Department of Labor Rule 300-10-1 et. seq. are conditions of Agreement. Contractor further agrees that such compliance shall be attested through execution of Contractor Affidavit and Agreement required by Georgia Department of Labor Rule 300-10-1-.07, or a substantially similar contractor affidavit. Contractor's fully executed affidavit is attached and is incorporated into this Agreement by reference herein.

By initialing in the appropriate line below, Contractor certifies that the following employee number category as identified in OCGA 13-10-91 is applicable to Contractor:

1. _____ 500 or more employees.
2. _____ 100 or more employees.
3. _____ Fewer than 100 employees.

Contractor understands and agrees that, in the event Contractor employs or contracts with Subcontractor in connection with this Agreement, Contractor shall:

1. Secure from each Subcontractor an indication of the employee-number category as identified in OCGA 13-10-91; and
2. Secure from each Subcontractor an attestation of Subcontractor's compliance with OCGA 13-10-91 and Georgia Department of Labor Rule 300-10-1-.02 by causing each Subcontractor to execute the attached Subcontractor Affidavit required by Georgia Department of Labor Rule 300-10-1-.08, or a substantially similar subcontractor affidavit. Contractor further understands and agrees that Contractor shall require the executed Subcontractor Affidavit to become a part of the agreement between Contractor and each Subcontractor. Contractor agrees to maintain records of each Subcontractor attestation required hereunder for inspection by Owner.

BY: Authorized Officer or Agent

Date

Title of Authorized Officer or Agent if Contractor

Printed Name of Authorized Officer or Agent

Subscribed and Sworn Before Me on this
_____ day of _____, 20____

Notary Public
My Commission Expires: _____

**SECTION 00 45 48
CONTRACTOR AFFIDAVIT**

By executing this affidavit, the undersigned Contractor verifies its compliance with O.C.G.A. § 13-10-91, stating affirmatively that the individual, firm, or corporation which is engaged in the physical performance of services on behalf of the _____ (Public Employer) has registered with, is authorized to use, and uses the federal work authorization program commonly known as E-Verify, or any subsequent replacement program, in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91. Furthermore, the undersigned Contractor will continue to use the federal work authorization program throughout the contract period, and the undersigned contractor will contract for the physical performance of services in satisfaction of such contract only with Subcontractors who present an affidavit to the Contractor with the information required by O.C.G.A. § 13-10-91(b). Contractor hereby attests that its federal work authorization user identification number and date of authorization are as follows:

Federal Work Authorization Number
(EEV / E-Verify User Identification Number)

Date of Authorization

Name of Contractor

Name of Project

Name of Public Employer

I hereby declare under penalty of perjury that the foregoing is true and correct.
Executed on _____, 20__ in _____ (City), _____ (State).

Signature of Authorized Officer or Agent

Printed Name and Title of Authorized Officer or Agent

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

Notary Public

My Commission Expires:

[NOTARY SEAL]

**SECTION 00 45 49
SUBCONTRACTOR AFFIDAVIT**

By executing this affidavit, the undersigned Subcontractor verifies its compliance with O.C.G.A. § 13-10-91, stating affirmatively that the individual, firm, or corporation which is engaged in the physical performance of services on behalf of the _____ (Public Employer) has registered with, is authorized to use, and uses the federal work authorization program commonly known as E-Verify, or any subsequent replacement program, in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91. Furthermore, the undersigned Subcontractor will continue to use the federal work authorization program throughout the contract period and the undersigned Subcontractor will contract for the physical performance of services in satisfaction of such contract only with sub-subcontractors who present an affidavit to the contractor with the information required by O.C.G.A. § 13-10-91(b). Subcontractor hereby attests that its federal work authorization user identification number and date of authorization are as follows:

Federal Work Authorization Number
(EEV / E-Verify User Identification Number)

Date of Authorization

Name of Subcontractor:

Name of Contractor

Name of Project

Name of Public Employer

I hereby declare under penalty of perjury that the foregoing is true and correct.
Executed on _____, 20__ in _____ (City), _____ (State).

Signature of Authorized Officer or Agent

Printed Name and Title of Authorized Officer or Agent

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

Notary Public

My Commission Expires:

[NOTARY SEAL]

SECTION 00 51 00
NOTICE OF AWARD

DATE OF ISSUANCE: _____
OWNER: HALL COUNTY, GEORGIA
ENGINEER: CIVIL ENGINEERING CONSULTANTS, INC.
PROJECT: SPOUT SPRINGS WATER RECLAMATION FACILITY,
EXPANSION TO 1.6 MGD
CONTRACTOR: _____
CONTRACTOR'S
ADDRESS: _____

DESCRIPTION OF WORK: **SPOUT SPRINGS WATER RECLAMATION FACILITY,
EXPANSION TO 1.6 MGD**

The OWNER has considered the BID submitted by you for the above described WORK.

You are hereby notified that the Owner has accepted your BID for items in the amount of \$XXXXXXXX.

You are required, by the General Information for Contractor, to execute the Agreement and certificates of insurance within ten (10) days from the date of this Notice to you.

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

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

OWNER: HALL COUNTY, GEORGIA
BY *(signature)*: _____
NAME *(printed)*: _____
TITLE: _____

ACCEPTANCE OF NOTICE: Receipt of the above NOTICE OF AWARD is hereby acknowledged by

CONTRACTOR: _____
BY *(signature)*: _____
NAME *(printed)*: _____
TITLE: _____
DATE: _____

**STANDARD FORM OF AGREEMENT
BETWEEN OWNER AND CONTRACTOR**

**SECTION 00 52 13
STANDARD FORM OF AGREEMENT
BETWEEN OWNER AND CONTRACTOR
ON THE BASIS OF STIPULATED PRICE**

This Agreement dated _____ is by and between **Hall County** and **CONTRACTOR NAME** (“Contractor”).

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

This Contract for _____ (hereinafter “Services” or “Project”) is made and between Hall County, Georgia, Board of Commissioners, (hereinafter “County”) located at 2875 Browns Bridge Rd, Gainesville, Georgia 30504, and _____, located at _____ (hereinafter “Contractor”). Contractor is an entity that is legally registered and qualified and holding any such licenses and certifications as may be required to render Services to do business in the State of Georgia. County and Contractor are known individually as a “Party” and collectively as the “Parties”.

Nothing contained in this Contract shall be construed to convert the Contractor or any of its employees, agents, subcontractors, or sub-subcontractors into a partner, employee, or agent of the County, nor shall either Party to this Contract have any authority to bind the other in any respect.

WHEREAS the Contractor represents that it complies with the State of Georgia requirements for corporations and has signified a willingness to provide Services to the County and the County has relied on such representation; and,

WHEREAS the Parties mutually desire to enter into this Contract to document the provision of Services by the Contractor to the County in exchange for payment as compensation; and,

WHEREAS this contract will become legally binding upon signature by both Parties; and,

WHEREAS any attached documents, plans, exhibits, attachments, or references are all incorporated herein by reference, and

NOW, THEREFORE and in consideration of the mutual promises, terms, conditions, covenants, and agreements made as expressed and contained herein, or attached, incorporated, and made a part hereof, and other good and valuable consideration expressed by a valid offer and acceptance, the receipt and sufficiency of which the Parties hereby acknowledge, the Parties hereto agree as follows:

Owner and Contractor hereby agree as follows:

ARTICLE 1—WORK

1.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: **Hall County-Spout Springs Water Reclamation Facility, Expansion to 1.6 MGD**

1.02 The Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

The project shall include furnishing all materials, labor, equipment, and any appurtenances as necessary for completion of the work described within the plans and specifications.

ARTICLE 1A – NOTICES

To the extent that either Party to this Contract is required to provide notice(s) to the other Party in compliance herewith, then the Party shall direct notice(s) to the following persons:

COUNTY PROJECT MANAGER COUNTY ISSUING OFFICER

William King, PE

Assistant County Engineer

**Hall County Community Development
and Infrastructure**

2875 Browns Bridge Rd

Gainesville, GA 30504

wking@hallcounty.org

Ph: (770) 531-6800 ext. 6799

Cell: (770) 329-0863

Cheryl Wright

Buyer

Hall County Purchasing Division

2875 Browns Bridge Rd

Gainesville, GA 30504

cwright@hallcounty.org

Ph: (770) 535-8263

CONTRACTOR'S CONTACT INFORMATION

Name: _____

Title: _____

Company Name: _____

Physical Address: _____

City, State, ZIP: _____

Email: _____

Phone: _____

REMIT TO ADDRESS (if different): _____

ARTICLE 2—ENGINEER

2.01 The Owner has retained **CIVIL ENGINEERING CONSULTANTS, INC.** ("Engineer") to act as Owner's representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.

2.02 The part of the Project that pertains to the Work has been designed by Engineer, and that same entity prepared the design.

ARTICLE 3—CONTRACT TIMES

3.01 *Time is of the Essence*

A. All time limits for Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

3.02 *Contract Times:*

A. Commences on Notice to Proceed.

3.03 *Contract Times: Days*

A. The Work will be substantially completed within **510 consecutive calendar days** from the date when the Contract Time commences to run as provided in paragraph 4.01 of the General Conditions or 30 days after delivery of all materials and major equipment. Work will be finally completed within 60 consecutive calendar days after substantial completion.

3.04 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 3.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. *Substantial Completion:* Contractor shall pay Owner Five Hundred Dollars \$500 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.
2. *Completion of Remaining Work:* After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$500 for each day that expires after such time until the Work is completed and ready for final payment.
3. Liquidated damages for failing to timely attain Substantial Completion, and final completion are not additive, and will not be imposed concurrently.

B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

ARTICLE 4—CONTRACT PRICE

4.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts that follow, subject to adjustment under the Contract:

- A. Lump Sum Base Bid Amount including Allowances **\$: (Enter Total Amount)**
- B. For all Unit Price Work, an amount equal to the sum of the extended prices (established for each separately identified item of Unit Price Work by multiplying the unit price times the actual quantity of that item).

The extended prices for Unit Price Work set forth as of the Effective Date of the Contract are based on estimated quantities. As provided in Paragraph 13.03 of the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by Engineer.

<u>Item</u>	<u>Description</u>	<u>Unit</u>	<u>Approx. Qty.</u>	<u>Unit Price</u>	<u>Total Price</u>
1.	DIP Pipe	Ton	1	\$ _____	\$ _____
2.	DIP Fittings	Ton	1	\$ _____	\$ _____
3.	Stone Stabilization	Tons	10	\$ _____	\$ _____
4.	Silt Fence Type Sd-1	LF	500	\$ _____	\$ _____
5.	Silt Fence Type Sd-1 Removal	LF	500	\$ _____	\$ _____
6.	Construction Exits	EA	1	\$ _____	\$ _____
7.	Permanent Grassing	AC	1	\$ _____	\$ _____
8.	Riprap	SY	500	\$ _____	\$ _____
9.	Erosion Control Monitoring	LS	1	\$ _____	\$ _____
10.	Concrete Wash Out	LS	1	\$ _____	\$ _____

C. Total of Unit Price Work (subject to final Unit Price adjustment) is \$ _____.

D. According to paragraph 13.02 of the General Conditions, all allowances are included in the abovementioned Lump Sum price.

1. Contractor's costs for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum and not in the allowances.
2. The Contractor shall cause work covered by these allowances to be performed for such amounts and by such persons as the Owner/Engineer may direct, but he will not be required to employ persons against whom he makes a reasonable objection. If the cost, when determined and approved by the Owner/Engineer, exceeds, or falls below the allowance, the Contract Sum shall be adjusted accordingly through a Change Order. The contractor is not entitled to overhead, profit, or mark-up on unutilized allowance funds. The amount of the Change Order shall reflect the difference between actual costs and the allowances.

ARTICLE 5—PAYMENT PROCEDURES

5.01 Submittal and Processing of Payments

- A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

5.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on the basis of Contractor's Applications for Payment on or about the 1st day of each month during performance of the Work as provided in Paragraph 5.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.
1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.
 - a. **95%** of the value of the Work completed (with the balance being retainage)
; and
 - b. **100%** of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to **98%** of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less **such amounts as Engineer shall determine as** the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

5.03 *Final Payment*

Upon final completion and acceptance of the Work, Owner shall pay the remainder of the Contract Price in accordance with Paragraph 15.06 of the General Conditions.

ARTICLE 6—CONTRACT DOCUMENTS

6.01 *Contents*

- A. The Contract Documents consist of all of the following:
1. This Agreement.
 2. Bonds:
 - a. Performance bond (together with power of attorney).
 - b. Payment bond (together with power of attorney).
 3. General Conditions.
 4. Supplementary Conditions.
 5. Specifications (not attached but incorporated by reference) consisting of [#] sections with each sheet bearing the following general title: HALL COUNTY-SPOUT SPRINGS WATER RECLAMATION FACILITY EXPANSION TO 1.6 MGD.

6. Drawings (not attached but incorporated by reference) consisting of [#] sheets with each sheet bearing the following general title: HALL COUNTY-SPOUT SPRINGS WATER RECLAMATION FACILITY EXPANSION TO 1.6 MGD.
 7. Addenda: Addendum No. # dated _____.
 8. Appendices to this Agreement (enumerated as follows): Appendix A, Appendix B, Appendix C.
 9. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directives.
 - c. Change Orders.
 - d. Field Orders.
- B. The Contract Documents listed in Paragraph 6.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 6.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 7—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

7.01 Contractor's Representations

- A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:
1. Contractor has examined and carefully studied the Contract Documents, including Addenda.
 2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
 4. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.

5. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
6. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
7. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
8. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
9. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

7.02 Contractor's Certifications

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 7.02:
 1. "Corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the Proposal process or in the Contract execution.
 2. "Fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the Proposal process or the execution of the Contract to the detriment of Owner, (b) to establish Proposal or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.
 3. "Collusive practice" means a scheme or arrangement between two or more Proposers, with or without the knowledge of Owner, a purpose of which is to establish Proposal prices at artificial, non-competitive levels.
 4. "Coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the Proposal process or affect the execution of the Contract.

ARTICLE 11 – NO DEFENSE OR INDEMNIFICATION BY COUNTY

The Parties agree that the County shall not be responsible for defending or indemnifying any Contractor from any claim brought by any third party against the Contractor.

ARTICLE 12 – ASSIGNMENT AND DELEGATION BY CONTRACTOR

The Contractor shall not assign or delegate this Contract, or any performance required by it, in whole or in part, without the prior expressed written consent of the County.

ARTICLE 13 – USE OF THIRD PARTIES (SUBCONTRACTORS)

This Contract is for the benefit of the Parties hereto only and is not intended to benefit any third party or give rise to any duty or causes of action for any third party. All restrictions, obligations, and responsibilities of the Contractor under the Contract shall also apply to third parties such as subcontractors, if allowed in writing by the County. Any Contract with a subcontractor must also preserve the rights of the County.

ARTICLE 14 – ENTIRE CONTRACT

This Contract, as executed and approved, shall constitute the entire agreement between the Parties and supersedes all other prior and contemporaneous statements, agreements, and understandings between the Parties. No written or oral statements, agreements, or understandings that are not set out, referenced, or specifically incorporated in this Contract shall in any way be binding or of effect between the Parties.

ARTICLE 15 – SEVERABILITY

If any paragraph, sub-paragraph, sentence, clause, phrase, or portion of this Contract is declared invalid or unconstitutional by any Court of competent jurisdiction or if the provisions of any part of this Contract as applied to any particular situation or set of circumstances shall be declared invalid or unconstitutional, such invalidity shall not be construed to affect the remaining portions of this Contract not so held to be invalid or the application of this Contract to other circumstances not so held to be invalid.

ARTICLE 16 – RECORDS

- A. Public Records Request. The Georgia Open Records Act, as provided in O.C.G.A. § 50-18-70 et seq, requires procurement records and all other records received by or prepared or maintained on behalf of the County shall be made open to public inspection unless otherwise provided by law.
- B. Record Retention and Access. The Contractor shall maintain books, records, and documents in accordance with generally accepted accounting principles and procedures and which sufficiently and properly document and calculate all charges billed to the County throughout the term of the Contract for a period of at least five (5) years following the date of final payment or completion of any required audit, whichever is later. Records to be maintained include both financial records and service records.

ARTICLE 17 – ADDITIONAL TERMS

The County shall not be bound by any terms and conditions included in any Contractor's sales-orders, literature, packaging, invoice, catalog, brochure, technical data sheet, on-line representation, warranties or service level agreement, or other document which attempts to impose any condition in variance with or in addition to the terms and conditions contained herein.

ARTICLE 18– WAIVER

The failure of any Party hereto to seek a remedy for any alleged breach of this Contract shall not constitute a waiver of any claim, cause of action, or remedy allowed by Georgia law for breach thereof.

ARTICLE 19 – CONTRACTOR AND COUNTY RIGHTS AND OBLIGATIONS

- A. The County has the right at any time to require the Contractor to put an immediate stop to any procedure, or the use of any equipment, chemical, material, personnel, etc. considered by the County to be hazardous or toxic to persons, buildings, or surfaces. The Contractor will utilize acceptable substitutes approved by the County as quickly as possible. In the event of such replacement, Contractor shall (i) notify County of any resulting replacement, (ii) introduce the individual serving as the replacement to County, and/or (iii) provide County with a résumé and any other information regarding the individual that may be reasonably requested by County.
- B. The County has the right to require the Contractor to reassign or remove any employee or subcontractor's employee from the premises temporarily or permanently when, in the County's sole opinion, the employee is not suitable. The County's decision shall be final, and Contractor will remove the employee immediately and replace with a person of at least equivalent training, experience, and requisite qualifications as quickly as possible, subject to the County's approval.
- C. Contractor agrees to obtain prior written approval from the County for the use of subcontractors to provide the Services described in Scope of Work prior to subcontractor's performance of work.

ARTICLE 20– INSURANCE REQUIREMENTS

The Contractor must procure and maintain insurance policies at the Contractor's own expense and must furnish the County with a certificate of insurance (COI) providing evidence of proof of coverage at least in the amounts indicated in this subsection. The COI must list "Hall County, Georgia" as the certificate holder and as an additional insured under the commercial general, automobile, and umbrella liability policies as follows: "County of Hall, its Board of Commissioners, officers, employees, servants, and agents, 2875 Browns Bridge Rd, Gainesville, GA, 30504". The policy must protect the Contractor and the County (as an additional insured) from any claims for bodily injury, property damage, or personal injury covered by the indemnification obligations set forth herein throughout the duration of the Contract. The Contractor must maintain the following insurance coverage during the term of the Contract, in at least the minimum amounts set forth below, to cover all loss and liability for damages or destruction of property caused by or arising from any and all services carried on and any and all work performed by the Contractor pursuant to this Contract:

Workers Compensation Insurance: Required for all contracts.

- \$500,000 Bodily Injury by Accident – Each Accident
- \$500,000 Bodily Injury by Disease – Each Disease
- \$500,000 Bodily Injury by Disease – Each Employee

Additional Provisions: Waiver of Subrogation. The insurer agrees to waive all rights of subrogation against Hall County Board of Commissioners (BOC), its elected or appointed officers, officials, agents, authorized volunteers, and employees for losses paid under the terms of this policy which arise from work performed by the Named Insured for Hall County BOC. This provision applies regardless of whether or not Hall County BOC has received a waiver of subrogation from the insurer.

General Liability Insurance: Required for all contracts.

- \$2,000,000 General Aggregate
- \$2,000,000 Products & Completed Operations Aggregate

- \$1,000,000 Each Occurrence
- \$1,000,000 Personal & Advertising Injury
- \$500,000 Damages to Premises/Fire/Legal
- \$5,000 Medical Payments

Commercial Auto Liability Insurance: Required for all contracts, except for goods and/or services that are remote in nature and/or are delivered by a professional delivery service.

- \$1,000,000 Combined Single Limit Or \$500,000 per Person/\$1,000,000 per Occurrence
- \$100,000 Property Damage
- \$1,000 for Medical Payments (no fault coverage)

Additional Provisions:

- Uninsured motorist's coverage should be equal to the per occurrence limit except for contracts with other governmental entities.
- Coverage shall be included for any owned, leased, hired, or non-owned autos.
- For any contracts involving the transportation of hazardous materials, limited pollution endorsement ISO form CA9948 or its equivalent shall be on the policy.

Umbrella Liability Insurance: Required for all contracts.
\$1,000,000 per Occurrence

Additional Provisions: Required for all contracts.

- Underlying coverage shall be General Liability, Automobile Liability, and Employers Liability (Workers Compensation).
- Minimum limit of \$5,000,000 per occurrence for all contracts over \$1,000,000 or involving any special risks or high hazard activities.
- Minimum limit of \$5,000,000 for automobile coverage for any transportation contracts involving seniors, special education, transit services, students, or youths.
- Concurrent policy dates with primary liability policies except for workers compensation.

Pollution Liability. Required for all road construction projects, work near wastewater, solid waste lines, or any work that involves handling, transporting, disposing, or working with hazardous materials, pollutants, water reclamation facilities, waste management, or other potentially toxic chemicals.

- \$1,000,000 per Occurrence
- \$1,000,000 Aggregate

Additional Provisions:

- Minimum limit of \$5,000,000 per occurrence for all contracts over \$50,000,000 or involving any special risks or high hazard activities

Professional Liability Insurance (Errors & Omissions): Required for all professional service contracts. This shall include any consultants, medical, legal, technical, insurance agents, or other professions that require proper licenses.

- \$1,000,000 Each Claim/Wrongful Act
- \$2,000,000 General Aggregate

- If written on a claim's made policy, the policy must be maintained for at least two (2) years after the completion of the work and/or contract.

ARTICLE 21– PERFORMANCE AND PAYMENT BONDS

(Required for construction, renovation, and repair projects)

The Contractor must furnish to the County both a performance and payment bond, both equal to one hundred percent (100%) of the Contract's total award dollar amount. The County will only issue a Notice to Proceed after the bonds are received. Only surety companies licensed to do business in the State of Georgia are acceptable. The Contractor is required to provide new bonds at the issuance of each renewal option term(s) or extension(s) that follow.

The Contractor must provide all required bonding instruments to the County prior to the commencement of any work. The County will consider any work done prior to the receipt of bonding instruments as null and void and thus not eligible for compensation.

ARTICLE 22 – RETAINAGE (Required for construction, renovation, and repair projects)

The County will retain and withhold funds from compensation in compliance with Georgia law. The County shall hold five percent (5%) retainage, in accordance to Article 5.02. Progress Payments; Retainage, throughout the entire project and will release said retainage at the point of completion and final acceptance by the County.

ARTICLE 23 – VENUE AND GOVERNING LAW

The Parties agree that this Contract shall be interpreted, construed, and enforced in accordance with the laws of the State of Georgia. Should either party bring a legal suit to enforce the terms of this Contract, including suit in equity, the Parties agree and consent to file any such suit in the Superior Court of Hall County, Georgia.

ARTICLE 24– NOTICE OF INTENT TO LITIGATE

Contractor hereby agrees not to file any civil action of disputes or claims relating to the Contract except after first giving thirty (30) days written notice to the County of the claim and the intent to initiate a civil action.

ARTICLE 25 – GEORGIA SECURITY AND IMMIGRATION COMPLIANCE ACT (E-Verify)

- A. By signing this Contract, the Contractor certifies that prior to and throughout the performance of all applicable work under this Contract it will remain in full compliance with all federal and state immigration laws including, but not limited to, 8 U.S.C. § 1324a and the Georgia Security and Immigration Compliance Act (O.C.G.A. §13-10-90 et seq.), as amended by the Illegal Immigration Reform and Enforcement Act of 2011 regarding the verification of employment eligibility of employees under the Immigration Reform and Control Act of 1986. Contractor will ensure that only persons who are citizens or nationals of the United States or non-citizens authorized under federal immigration laws are employed to perform services under this Contract or any subcontract or sub-subcontract hereunder.
- B. Contractor further certifies its compliance with the aforementioned federal and state immigration laws set forth by signing a sworn affidavit, the Georgia Security and Immigration Compliance Act Affidavit (herein known as Exhibit E – E-Verify Affidavit), notarized by an Official Notary Public and

incorporated herein by reference, and obtaining the same affidavit(s) from any subcontractor providing services pursuant to this Contract.

ARTICLE 26 – ORDER OF PRECEDENCE

In the event of any inconsistency, ambiguity, or conflict among the specific provisions of the Contract and the Contractor's response, the order of precedence shall be as follows:

1. Any amendments to the Contract, including all exhibits thereto.
2. The Contract itself, including all exhibits thereto.
3. Attachments appended to the Contract.
4. All other Contract attachments appended to the Contract.

ARTICLE 27 – CONTRACT EXHIBITS AND ATTACHMENTS

The Parties mutually acknowledge that all exhibits and attachments listed below made a part of this Contract, as though expressly written in the solicitation documents and the Bidder's response, are herein incorporated into this Contract by reference.

ARTICLE 28 – SALES TAX EXEMPTION STATUS

The County is exempt from Federal Excise Taxes and from Georgia State and Local Sales and Use Taxes on the Services. The Contractor may request a copy of the County's Georgia Sales and Use Tax Exemption Certificate.

ARTICLE 29 – HOLD HARMLESS AGREEMENT

The successful respondent hereby agrees to indemnify, hold free and harmless Hall County Government, County Commissioners, its agents, servants, employees, officers, directors, elected officials, or any other person(s) against any loss or expense to the maximum extent allowable by law. This includes attorney fees because of any liability imposed by law upon the County, except in cases of the County's sole negligence, sustained by any person(s) on account of bodily injury or property damage arising out of or in the consequence of this Contract.

ARTICLE 30 – NOT A JOINT VENTURE

The County shall not be bound by any terms and conditions included in any Contractor packaging, invoice, catalog, brochure, technical data sheet, on-line representation, warranties or service level agreement, or other document which attempts to impose any condition in variance with or in the addition to the terms and conditions contained herein.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____, (which is the Effective Date of the Contract).

OWNER:

CONTRACTOR:

(typed or printed name of organization)

(typed or printed name of organization)

By:

(individual's signature)

By:

(individual's signature)

**HALL COUNTY – SPOUT SPRINGS WRF
EXPANSION TO 1.6 MGD**

07/17/2024

Date: _____
(date signed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Address for giving notices:

Hall County, Georgia-Attn: Bill King
2875 Browns Bridge road
Gainesville, GA 30504

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address: _____

Phone: _____

Email: _____

Date: _____
(date signed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

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

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Address for giving notices:

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address: _____

Phone: _____

Email: _____

License No.: _____
(where applicable)

State: _____

SECTION 00 55 00
NOTICE TO PROCEED

OWNER: HALL COUNTY, GEORGIA

ENGINEER: CIVIL ENGINEERING CONSULTANTS, INC.

CONTRACTOR: _____

PROJECT: SPOUT SPRINGS WATER RECLAMATION FACILITY,
EXPANSION TO 1.6 MGD

EFFECTIVE DATE
OF CONTRACT: _____

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

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

In accordance with the Agreement:

The number of days to achieve Substantial Completion is 510 **days** from the date stated above for the commencement of the Contract Times, resulting in a date for Substantial Completion of **DATE**.

Owner: HALL COUNTY, GEORGIA

By (signature): _____

Name (printed): _____

Title: _____

Date Issued: _____

ACCEPTANCE OF NOTICE: Receipt of the above NOTICE TO PROCEED is hereby acknowledged by

Contractor: _____

By (signature): _____

Name (printed): _____

Title: _____

Date Issued: _____

Bond No. _____

**SECTION 00 61 14
PERFORMANCE BOND**

KNOW ALL PERSONS BY THESE PRESENTS: that

(Name of Contractor)

(Address of Contractor)

A Corporation hereafter called (Corporation, Partnership or Individual) PRINCIPAL and

(Name of Surety)

hereinafter called SURETY, are held, and firmly bound unto Hall County located at 2875 Brown Bridge Road, Gainesville, Ga 30504 herein after called OWNER in the total aggregate penal sum of _____ (\$_____) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the PRINCIPAL entered into a certain Contract with the OWNER, dated the ____ day of _____, 20__, a copy of which is hereto attached and made a part hereof for the construction of the **HALL COUNTY – SPOUT SPRINGS WATER RECLAMATION FACILITY, EXPANSION TO 1.6 MGD.**

NOW, THEREFORE, if the PRINCIPAL shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of said Contract during the original term thereof, and any extensions thereof which may be granted by the OWNER, with or without notice to the SURETY and during the one year guaranty period and if the PRINCIPAL shall satisfy all claims and demands incurred under such Contract, and shall fully indemnify and save harmless the OWNER from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the OWNER all outlay and expense which the OWNER may incur in making good any default, then this obligation shall be void, otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said SURETY, for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to WORK to be performed there under or the SPECIFICATIONS accompanying same shall in any way affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the WORK or to the SPECIFICATIONS.

07/17/2024

Bond No. _____

**SECTION 00 61 15
PAYMENT BOND**

KNOW ALL PERSONS BY THESE PRESENTS: that

(Name of Contractor)

(Address of Contractor)

A Corporation hereinafter called (Corporation, Partnership or Individual) PRINCIPAL and

(Name of Surety)

hereinafter called SURETY, are held and firmly bound unto the Hall County located at 2875 Brown Bridge Road, Gainesville, Ga 30504 herein after called OWNER in the total aggregate penal sum of _____ (\$_____) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the PRINCIPAL entered into a certain Contract with the OWNER, dated the ____ day of _____, 20__, a copy of which is hereto attached and made a part hereof for the construction of the **HALL COUNTY – SPOUT SPRINGS WATER RECLAMATION FACILITY, EXPANSION TO 1.6 MGD.**

NOW, THEREFORE, if the PRINCIPAL shall promptly make payment to all persons, firms, and corporations furnishing materials for or performing all labor in the prosecution of the WORK provided for in such Contract, and any authorized extensions or modification thereof, including all amounts due for materials, lubricants, oil, gasoline, coal and coke, repairs on machinery, equipment and tools, consumed or used in connection with the construction of such WORK, and for all labor cost incurred in such WORK including that by a SUBCONTRACTOR, and to any mechanic or materialman lienholder whether it acquires its lien by operation of State or Federal law; then this obligation shall be void, otherwise to remain in full force and effect.

PROVIDED, that beneficiaries or claimants hereunder shall be limited to the SUBCONTRACTORS, and persons, firms, and corporations having a direct contract with the PRINCIPAL or its SUBCONTRACTORS.

PROVIDED, FURTHER, that no suit or action shall be commenced hereunder by any claimant: (a) Unless claimant, other than one having a direct contract with the PRINCIPAL, shall have given written notice to any two of the following: The PRINCIPAL, the OWNER, or the SURETY above named within ninety (90) days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the PRINCIPAL, OWNER, or SURETY, at any place where an office is regularly maintained for the transaction of business or served in any manner in which legal process may be served in the state in which the aforesaid project is located, save that such service need not be made by a public officer. (b) After the expiration of one (1) year following the date of which PRINCIPAL ceased work on said CONTRACT, is being understood, however, that if any limitation embodied in the BOND is prohibited by any law controlling the construction hereof, such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

PROVIDED, FURTHER, that it is expressly agreed that this BOND shall be deemed amended automatically and immediately, without formal and separate amendments hereto, upon amendment to the Contract no increasing the contract price more than 20 percent, so as to bind the PRINCIPAL and the SURETY to the full and faithful performance of the Contract as so amended. The term "Amendment", wherever used in this BOND and whether referring to this BOND, the contract or the loan Documents shall include any alteration, addition, extension, or modification of any character whatsoever.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

**HALL COUNTY – SPOUT SPRINGS WRF
EXPANSION TO 1.6 MGD**

07/17/2024

WITNESS WHEREOF, this instrument is executed in Three (3) counterparts, each of which shall be deemed an original.

Signed and Sealed this _____ day of _____, 20__.

Contractor as Principal

Surety

(Full formal name and address of Contractor)

(Full formal name and address of Surety) (corporate seal)

By:

By:

(Signature)

(Signature)(Attach Power of Attorney)

Name:

Name:

(Printed or typed)

(Printed or typed)

Title:

Title:

Attest:

Attest:

(Signature)

(Signature)

Name:

Name:

(Printed or typed)

(Printed or typed)

Title:

Title:

NOTE: Date of BOND must not be prior to date of Contract. If CONTRACTOR is partnership, all partners should execute BOND.

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 of Georgia.

**SECTION 00 62 15
CERTIFICATE OF OWNER'S ATTORNEY**

I, the undersigned, _____, the duly authorized and acting legal representative of the _____, (the "City") do hereby certify as follows:

I have examined the attached Contract Documents and the manner of execution thereof by the City, and I am of the opinion that each of the aforesaid agreements are adequate and have been duly executed by the proper parties on behalf of the City; that said representative(s) has full power and authority to execute said agreements on behalf of the City, and that the foregoing agreements constitute valid and legally binding obligations upon the City in accordance with terms, conditions, and provisions thereof.

By: _____

Date: _____

SECTION 00 63 63
CHANGE ORDER FORM

OWNER: _____

ENGINEER: CIVIL ENGINEERING CONSULTANTS, INC.

CONTRACTOR: _____

PROJECT: HALL COUNTY – SPOUT SPRINGS WATER
RECLAMATION FACILITY, EXPANSION TO 1.6 MGD

ORIGINAL AGREEMENT DATE: _____

ORIGINAL CONTRACT AMOUNT: _____

CHANGE ORDER DATE: _____

_____ is hereby directed to comply with the following additions and deductions to the above referenced Contract Plans and Specifications.

1.	<u>Additions / Deductions:</u>	Brief Description	
	Itemized Detail		\$ _____
	Itemized Detail		\$ _____
	Itemized Detail		\$ _____
	Subtotal Additions / Deductions:		\$ _____
2.	<u>Additions / Deductions:</u>	Brief Description	
	Itemized Detail		\$ _____
	Itemized Detail		\$ _____
	Itemized Detail		\$ _____
	Subtotal Additions / Deductions:		\$ _____
	TOTAL CHANGE ORDER NO. ____		\$ _____

The **Contract Amount** shall be **increased / decreased** by \$_____, from \$_____ to \$_____. The **completion date** is **changed / unchanged**.

This Document will become a supplement to the Contract Documents and all provisions will apply hereto.

Requested By: OWNER
HALL COUNTY, GA

EMPLOYEE NAME:
EMPLOYEE POSITION:

Date: _____

Recommended By: ENGINEER
CIVIL ENGINEERING CONSULTANTS, INC.

Andrew E. Lovejoy, P.E.
President

Date: _____

Accepted By: CONTRACTOR
CONTRACTOR COMPANY NAME

Contractor Contact Name
Title

Date: _____

SECTION 00 65 20
FINAL LIEN WAIVER

TO: HALL COUNTY, GEORGIA

FROM: _____(Contractor)

Re: Agreement between the Hall County, Georgia and _____
(Contractor) dated _____, _____ for construction of the Spout Spring Water Reclamation
Facility, Expansion to 1.6 MGD project.

I hereby certify that all suppliers of materials, equipment and services, subcontractors, mechanics and laborers employed by _____ (contractor) or any of its subcontractors in Hall County, Georgia have been paid and satisfied in full as of _____, that there are no outstanding obligations or claims of any kind for the payment of which Hall County, Georgia on the above-named project might be liable, or subject to, in any lawful proceeding at law or in equity.

The undersigned is authorized by contractor to execute this document on contractor's behalf and has personal knowledge of the facts herein stated.

By: Authorized Officer or Agent

Date

Title of Authorized Officer or Agent

Printed Name of Authorized Officer or Agent

Subscribed and sworn before me on this

_____ day of _____, _____

Notary Public

My Commission Expires: _____

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ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 Defined Terms

- A. Wherever used in the Bid Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. Addenda—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bid Requirements or the proposed Contract Documents.
 2. Agreement—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. Application for Payment—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. Bid—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. Bidder—An individual or entity that submits a Bid to Owner.
 6. Bid Documents—The Bid Requirements, the proposed Contract Documents, and all Addenda.
 7. Bid Requirements—The Advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. Change Order—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. Change Proposal—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. Claim
 - a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.
 - b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.
 - c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.
 - d. A demand for money or services by a third party is not a Claim.

11. **Constituent of Concern**—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. **Contract**—The entire and integrated written contract between Owner and Contractor concerning the Work.
13. **Contract Documents**—Those items so designated in the Agreement, and which together comprise the Contract.
14. **Contract Price**—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.
15. **Contract Times**—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. **Contractor**—The individual or entity with which Owner has contracted for performance of the Work.
17. **Cost of the Work**—See Paragraph 13.01 for definition.
18. **Drawings**—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. **Effective Date of the Contract**—The date, indicated in the Agreement, on which the Contract becomes effective.
20. **Electronic Document**—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.
21. **Electronic Means**—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.
22. **Engineer**—The individual or entity named as such in the Agreement.
23. **Field Order**—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
24. **Hazardous Environmental Condition**—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.
 - a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.
 - b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.

- c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.
- 25. Laws and Regulations; Laws or Regulations—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
- 26. Liens—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
- 27. Milestone—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.
- 28. Notice of Award—The written notice by Owner to a Bidder of Owner’s acceptance of the Bid.
- 29. Notice to Proceed—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
- 30. Owner—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
- 31. Progress Schedule—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor’s plan to accomplish the Work within the Contract Times.
- 32. Project—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
- 33. Resident Project Representative—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.
- 34. Samples—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
- 35. Schedule of Submittals—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals.
- 36. Schedule of Values—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.
- 37. Shop Drawings—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.
- 38. Site—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.
- 39. Specifications—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

40. Subcontractor—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
41. Submittal—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
42. Substantial Completion—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion of such Work.
43. Successful Bidder—The Bidder to which the Owner makes an award of contract.
44. Supplementary Conditions—The part of the Contract that amends or supplements these General Conditions.
45. Supplier—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
46. Technical Data
 - a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.
 - b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.
 - c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.

- 47. **Underground Facilities**—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.
- 48. **Unit Price Work**—Work to be paid for on the basis of unit prices.
- 49. **Work**—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.
- 50. **Work Change Directive**—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bid Requirements or Contract Documents, have the indicated meaning.
- B. **Intent of Certain Terms or Adjectives:** The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. **Day:** The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. **Defective:** The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - 1. does not conform to the Contract Documents.
 - 2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - 3. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).

E. Furnish, Install, Perform, Provide

1. The word “furnish,” when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
2. The word “install,” when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.
4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

F. Contract Price or Contract Times: References to a change in “Contract Price or Contract Times” or “Contract Times or Contract Price” or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term “or both” is not expressed.

G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.01 Delivery of Performance and Payment Bonds; Evidence of Insurance

- A. Performance and Payment Bonds: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).
- B. Evidence of Contractor’s Insurance: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.
- C. Evidence of Owner’s Insurance: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 Copies of Documents

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 Before Starting Construction

- A. Preliminary Schedules: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:
1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract.
 2. a preliminary Schedule of Submittals; and
 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 Preconstruction Conference; Designation of Authorized Representatives

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 Acceptance of Schedules

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.
1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.
 4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 Electronic Transmittals

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.
- B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.

- C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 Intent

- A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.
- F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.
- G. Nothing in the Contract Documents creates:
 - 1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or
 - 2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

3.02 Reference Standards

- A. Standards Specifications, Codes, Laws and Regulations
 - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 - 2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 Reporting and Resolving Discrepancies

A. Reporting Discrepancies

1. Contractor's Verification of Figures and Field Measurements: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.
2. Contractor's Review of Contract Documents: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. Resolving Discrepancies

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 Requirements of the Contract Documents

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs) or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 Reuse of Documents

- A. Contractor and its Subcontractors and Suppliers shall not:
1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 Commencement of Contract Times; Notice to Proceed

- A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.02 Starting the Work

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work may be done at the Site prior to such date.

4.03 Reference Points

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 Progress Schedule

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 Delays in Contractor's Progress

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes.
 2. Abnormal weather conditions.
 3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and
 4. Acts of war or terrorism.
- D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:
 1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
 2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.
 3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.
- E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:
 1. The circumstances that form the basis for the requested adjustment.
 2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work.
 3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work.

4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and
5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.

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

- F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.
- G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

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

5.01 Availability of Lands

- A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 Use of Site and Other Areas

- A. Limitation on Use of Site and Other Areas
 1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.
- B. Removal of Debris During Performance of the Work: During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations.
- C. Cleaning: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. Loading of Structures: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 Subsurface and Physical Conditions

- A. Reports and Drawings: The Supplementary Conditions identify:
 1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data.
 2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and
 3. Technical Data contained in such reports and drawings.
- B. Underground Facilities: Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.
- C. Reliance by Contractor on Technical Data: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.

- D. Limitations of Other Data and Documents: Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto.
 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings.
 3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or
 4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 Differing Subsurface or Physical Conditions

- A. Notice by Contractor: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate.
 2. is of such a nature as to require a change in the Drawings or Specifications.
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents.
- then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.
- B. Engineer's Review: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. Owner's Statement to Contractor Regarding Site Condition: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

- D. Early Resumption of Work: If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- E. Possible Price and Times Adjustments
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work, subject, however, to the following:
 - a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A.
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,
 - c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.
 2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise.
 - b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bid Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice required by Paragraph 5.04.A.
 3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
 4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.
- F. Underground Facilities; Hazardous Environmental Conditions: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 Underground Facilities

- A. Contractor's Responsibilities: Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following is included in the Contract Price, and Contractor shall have full responsibility for:
1. reviewing and checking all information and data regarding existing Underground Facilities at the Site.
 2. complying with applicable state and local utility damage prevention Laws and Regulations.
 3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction.
 4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 5. the safety and protection of all existing Underground Facilities at the Site and repairing any damage thereto resulting from the Work.
- B. Notice by Contractor: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.
- C. Engineer's Review: Engineer will:
1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings or was not shown or indicated with reasonable accuracy.
 2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary, issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question.
 3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and
 4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. Owner's Statement to Contractor Regarding Underground Facility: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. Early Resumption of Work: If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

F. Possible Price and Times Adjustments

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work, subject, however, to the following:
 - a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03.
 - b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and
 - c. Contractor gave the notice required in Paragraph 5.05.B.
2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.
4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 Hazardous Environmental Conditions at Site

A. Reports and Drawings: The Supplementary Conditions identify:

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
3. Technical Data contained in such reports and drawings.

B. Reliance by Contractor on Technical Data Authorized: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto.
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition and impose a set-off against payments to account for the associated costs.
- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.
- H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 Performance, Payment, and Other Bonds

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.
- B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.
- C. All bonds must be in the form included in the Bid Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or Regulations, and must be issued and signed by a surety named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.

- E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.
- F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.
- G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.
- H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 Insurance—General Provisions

- A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Alternative forms of insurance coverage, including but not limited to self-insurance and "Occupational Accident and Excess Employer's Indemnity Policies," are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.
- D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.
- E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.
- F. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

- G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.
- H. Contractor shall require:
 - 1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and
 - 2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.
- I. If either party does not purchase or maintain the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.
- K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price will be adjusted accordingly.
- L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.
- M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.
- N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.03 Contractor's Insurance

- A. Required Insurance: Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.
- B. General Provisions: The policies of insurance required by this Paragraph 6.03 as supplemented must:
 - 1. include at least the specific coverages required.
 - 2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater.

3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract.
 4. apply with respect to the performance of the Work, whether such performance is by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable; and
 5. include all necessary endorsements to support the stated requirements.
- C. Additional Insureds: The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:
1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions.
 2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds.
 3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);
 4. not seek contribution from insurance maintained by the additional insured; and
 5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 Builder's Risk and Other Property Insurance

- A. Builder's Risk: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.
- B. Property Insurance for Facilities of Owner Where Work Will Occur: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.
- C. Property Insurance for Substantially Complete Facilities: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.
- D. Partial Occupancy or Use by Owner: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.

- E. Insurance of Other Property; Additional Insurance: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 Property Losses; Subrogation

- A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.
1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.
 2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.
1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.
- C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.
- D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

6.06 Receipt and Application of Property Insurance Proceeds

- A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.
- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 Contractor's Means and Methods of Construction

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

7.02 Supervision and Superintendence

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 Labor; Working Hours

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall maintain good discipline and order at the Site.
- B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.

- C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 Services, Materials, and Equipment

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.05 "Or Equals"

- A. Contractor's Request; Governing Criteria: Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that the proposed item:
 - 1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics.
 - 2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole.
 - 3) has a proven record of performance and availability of responsive service; and
 - 4) is not objectionable to Owner.

- b. Contractor certifies that if the proposed item is approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. Contractor's Expense: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. Engineer's Evaluation and Determination: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.
- D. Effect of Engineer's Determination: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding and may not be reversed through an appeal under any provision of the Contract.
- E. Treatment as a Substitution Request: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 Substitutes

- A. Contractor's Request; Governing Criteria: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.
 - 1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.
 - 2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
 - 3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:
 - a. will certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design.
 - 2) be similar in substance to the item specified; and
 - 3) be suited to the same use as the item specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times.
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

- 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from the item specified; and
 - 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. Engineer's Evaluation and Determination: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. Special Guarantee: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. Reimbursement of Engineer's Cost: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- E. Contractor's Expense: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. Effect of Engineer's Determination: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 Concerning Subcontractors and Suppliers

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.
- B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.

- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bid process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.
- E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.
- F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.
- J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.
- K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.
- L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.
- M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 Patent Fees and Royalties

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If an invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights will be disclosed in the Contract Documents.

- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.09 Permits

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.10 Taxes

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.11 Laws and Regulations

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.

- C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 Record Documents

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.13 Safety and Protection

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.
- B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.
- C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work.
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.

- F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
- G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.
- H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).
- J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 Hazard Communication Programs

- A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as material safety data sheets) or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 Emergencies

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused by an emergency or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 Submittals

- A. Shop Drawing and Sample Requirements
 - 1. Before submitting a Shop Drawing or Sample, Contractor shall:
 - a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.
 - b. determine and verify:
 - 1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal.
 - 2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

- 3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
 - c. confirm that the Submittal is complete with respect to all related data included in the Submittal.
 2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.
 3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.
- B. Submittal Procedures for Shop Drawings and Samples: Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.
1. Shop Drawings
 - a. Contractor shall submit the number of copies required in the Specifications.
 - b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.
 2. Samples
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.
 3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. Engineer's Review of Shop Drawings and Samples
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.
 3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.
 5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.
 6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
 7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.
 8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.
- D. Resubmittal Procedures for Shop Drawings and Samples
1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.
 2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.
 3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.
- E. Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs
1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:
 - a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.
 - b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.
 - c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.
 - d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance and resubmit an acceptable document.

2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03, 2.04, and 2.05.

F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 Contractor's General Warranty and Guarantee

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.
- B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:
 1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective: and
 2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.
- C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:
 1. Observations by Engineer.
 2. Recommendation by Engineer or payment by Owner of any progress or final payment.
 3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner.
 4. Use or occupancy of the Work or any part thereof by Owner.
 5. Any review and approval of a Shop Drawing or Sample submittal.
 6. The issuance of a notice of acceptability by Engineer.
 7. The end of the correction period established in Paragraph 15.08.
 8. Any inspection, test, or approval by others; or
 9. Any correction of defective Work by Owner.
- E. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 Indemnification

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 Delegation of Professional Design Services

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

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

ARTICLE 8—OTHER WORK AT THE SITE

8.01 Other Work

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.
- D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.
- F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 Coordination

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
 1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors.

2. An itemization of the specific matters to be covered by such authority and responsibility; and
 3. The extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 Legal Relationships

- A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.
- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.
1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.
 2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.
- C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER’S RESPONSIBILITIES

9.01 Communications to Contractor

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 Replacement of Engineer

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer’s status under the Contract Documents will be that of the former Engineer.

9.03 Furnish Data

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 Pay When Due

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 Lands and Easements; Reports, Tests, and Drawings

- A. Owner’s duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner’s duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner’s identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 Insurance

- A. Owner’s responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 Change Orders

- A. Owner’s responsibilities with respect to Change Orders are set forth in Article 11.

9.08 Inspections, Tests, and Approvals

- A. Owner’s responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 Limitations on Owner’s Responsibilities

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor’s means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor’s failure to perform the Work in accordance with the Contract Documents.

9.10 Undisclosed Hazardous Environmental Condition

- A. Owner’s responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 Evidence of Financial Arrangements

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).

9.12 Safety Programs

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 Owner's Representative

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 Visits to Site

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 Resident Project Representative

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.
- B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 Engineer's Authority

- A. Engineer has the authority to reject Work in accordance with Article 14.

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

10.05 Determinations for Unit Price Work

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.06 Decisions on Requirements of Contract Documents and Acceptability of Work

- A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.07 Limitations on Engineer's Authority and Responsibilities

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 Compliance with Safety Program

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 Amending and Supplementing the Contract

- A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
- B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.
- C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 Change Orders

- A. Owner and Contractor shall execute appropriate Change Orders covering:
 - 1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive.
 - 2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off.
 - 3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and
 - 4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 Work Change Directives

- A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.
- B. If Owner has issued a Work Change Directive and:
 - 1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.

2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 Field Orders

- A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.
- B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 Owner-Authorized Changes in the Work

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.
- B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price, or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.
- C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 Unauthorized Changes in the Work

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 Change of Contract Price

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
 1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03).
 2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or
 3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work

- (determined as provided in Paragraph 13.01) plus a contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).
- C. Contractor's Fee: When applicable, the Contractor's fee for overhead and profit will be determined as follows:
1. A mutually acceptable fixed fee; or
 2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent.
 - b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent.
 - c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
 - d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C.
 - e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
 - f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

11.08 Change of Contract Times

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.
- B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 Change Proposal

- A. Purpose and Content: Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.
- B. Change Proposal Procedures
1. Submittal: Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.
 2. Supporting Data: The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.
 - a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.
 - b. Change Proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.
 3. Engineer's Initial Review: Engineer will advise Owner regarding the Change Proposal and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.
 4. Engineer's Full Review and Action on the Change Proposal: Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.
 5. Binding Decision: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- C. Resolution of Certain Change Proposals: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

- D. Post-Completion: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 Notification to Surety

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12—CLAIMS

12.01 Claims

- A. Claims Process: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:
1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals.
 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents.
 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and
 4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.
- B. Submittal of Claim: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. Review and Resolution: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.
- D. Mediation
1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.
 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.
 3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

- E. Partial Approval: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. Denial of Claim: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. Final and Binding Results: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 Cost of the Work

- A. Purposes for Determination of Cost of the Work: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
 - 1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
 - 2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. Costs Included: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:
 - 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.
5. Other costs consisting of the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - 1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.
 - c. Construction Equipment Rental
 - 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.
 - 2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.
 - 3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts

thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.

- d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.
 - g. The cost of utilities, fuel, and sanitary facilities at the Site.
 - h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
 - i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.
- C. Costs Excluded: The term Cost of the Work does not include any of the following items:
- 1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
 - 2. The cost of purchasing, renting, or furnishing small tools and hand tools.
 - 3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
 - 4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
 - 5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
 - 6. Expenses incurred in preparing and advancing Claims.
 - 7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. Contractor's Fee

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

- E. Documentation and Audit: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

13.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. Cash Allowances: Contractor agrees that:
1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.
- C. Owner's Contingency Allowance: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.
- E. Adjustments in Unit Price
 - 1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:
 - a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
 - b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.
 - 2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.
 - 3. Adjusted unit prices will apply to all units of that item.

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

14.01 Access to Work

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.02 Tests, Inspections, and Approvals

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except those costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or

approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner.
 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work.
 3. by manufacturers of equipment furnished under the Contract Documents.
 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 Defective Work

- A. Contractor's Obligation: It is Contractor's obligation to assure that the Work is not defective.
- B. Engineer's Authority: Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. Notice of Defects: Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. Correction, or Removal and Replacement: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. Preservation of Warranties: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. Costs and Damages: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 Acceptance of Defective Work

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 Uncovering Work

- A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.
- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 Owner May Stop the Work

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 Owner May Correct Defective Work

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses, and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15—PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 Progress Payments

- A. Basis for Progress Payments: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. Applications for Payments
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.
 - 2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
 - 3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. Review of Applications

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information, and belief:
 - a. the Work has progressed to the point indicated.
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work.
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto.
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work.
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement.
 - b. the Contract Price has been reduced by Change Orders.
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07 or has accepted defective Work pursuant to Paragraph 14.04.
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or
 - e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. Payment Becomes Due

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. Reductions in Payment by Owner

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement.
 - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site.
 - c. Contractor has failed to provide and maintain required bonds or insurance.
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible.
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities.
 - f. The Work is defective, requiring correction or replacement.
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07 or has accepted defective Work pursuant to Paragraph 14.04.
 - h. The Contract Price has been reduced by Change Orders.
 - i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause.
 - j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work.

- k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or
 - l. Other items entitle Owner to a set-off against the amount recommended.
2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.
3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

15.02 Contractor's Warranty of Title

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 Substantial Completion

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 Partial Use or Occupancy

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.
 - 2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
 - 4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 Final Inspection

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 Final Payment

- A. Application for Payment
 - 1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.

2. The final Application for Payment must be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents.
 - b. consent of the surety, if any, to final payment.
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects or will so pass upon final payment.
 - d. a list of all duly pending Change Proposals and Claims; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.
- B. Engineer's Review of Final Application and Recommendation of Payment: If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.
- C. Notice of Acceptability: In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.
- D. Completion of Work: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.
- E. Final Payment Becomes Due: Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 Waiver of Claims

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

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

- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim or appealed under the provisions of Article 17.

15.08 Correction Period

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such adjacent areas.
 - 2. correct such defective Work.
 - 3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.
- B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.
- C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.
- D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so, provided in the Specifications.
- E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 Owner May Suspend Work

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 Owner May Terminate for Cause

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents.
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any

rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 Owner May Terminate for Convenience

- A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work.
 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost bid.
- B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 Contractor May Stop Work or Terminate

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 Methods and Procedures

- A. Disputes Subject to Final Resolution: The following disputed matters are subject to final resolution under the provisions of this article:
1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and

2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.
- B. Final Resolution of Disputes: For any dispute subject to resolution under this article, Owner or Contractor may:
 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions.
 2. agree with the other party to submit the dispute to another dispute resolution process; or
 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 Giving Notice

- A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:
 1. in person, by a commercial courier service or otherwise, to the recipient's place of business.
 2. by registered or certified mail, postage prepaid, to the recipient's place of business; or
 3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 Computation of Times

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 Cumulative Remedies

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 Limitation of Damages

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 No Waiver

- A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.06 Survival of Obligations

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will

survive final payment, completion, and acceptance of the Work or termination of the Contract or of the services of Contractor.

18.07 Controlling Law

- A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 Assignment of Contract

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract.

18.09 Successors and Assigns

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

18.10 Headings

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

END OF SECTION

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**SECTION 00 73 00
SUPPLEMENTARY CONDITIONS**

PART 1 GENERAL

1.1 SUPPLEMENTARY CONDITIONS

- A. The provisions of the Supplementary Conditions as described herein change, amend, or supplement the General Conditions and shall supersede any conflicting provisions of this CONTRACT. All provisions of the General Conditions which are not changed, amended, or supplemented, remain in full force.

1.2 INSURANCE

- A. The CONTRACTOR shall purchase and maintain such insurance as will protect it from claims set forth below which may arise out of, or result from, the CONTRACTOR's execution of the WORK, whether such execution be by the CONTRACTOR, any SUBCONTRACTOR, or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:
1. Claims under workmen's compensation, disability benefit and other similar employee benefit acts.
 2. Claims for damages because of bodily injury, occupational sickness or disease, or death of employees.
 3. Claims for damages because of bodily injury, sickness or disease, or death of any person other than employees.
 4. Claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the CONTRACTOR, or (2) by any other person; and
 5. Claims for damages because of injury to or destruction of tangible property, including loss of use resulting there from.
- B. Evidence of Contractor's Insurance: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner copies of the policies (including all endorsements, and identification of applicable self-insured retentions and deductibles) of insurance required to be provided by Contractor in this Contract. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

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

1.3 CONFLICTS

- A. The General Conditions of the Contract shall govern in the event of any conflict with any other provisions of the Contract Documents unless notice to the contrary shall have been issued by the Owner. In the event of conflict, the Supplementary General Conditions control over the General Conditions and the Contract controls over the Supplementary and General Conditions. The Engineer has no authority to amend the General Conditions, orally or in writing, either expressly or by implication.
- B. The following principles shall govern the settlement of disputes which may arise over conflicts in the Contract Documents: (a) as between figures given on drawings and the scaled measurements, the figures shall govern; (b) as between large-scale drawings and small-scale drawings, the larger scale shall govern; (c) as between drawings and specifications, the requirements of the specifications shall govern; and (d) as between the contract and the specifications, the requirements of the contract shall govern. Conflicts noted shall be reported to the Design Professional.

1.4 ACCEPTANCE AND FINAL PAYMENT

- A. When the work provided for under this CONTRACT shall have been completed by the Contractor, and all parts thereof have been approved by the ENGINEER according to the CONTRACT, the ENGINEER shall, within ten (10) days unless otherwise provided, make final inspection and advise the Contractor as to preparing a final estimate, showing the value of work as soon as the necessary measurements and computations can be made, all prior certificates or estimates upon which payments have been being made approximated only, and subject to correction in the final payment. The amount of the final estimates, less any sums that may have been deducted or retained under the provisions of this CONTRACT, will be paid to the Contractor within sixty (60) days after approval by the Engineer, provided that the Contractor has properly maintained and operated the PROJECT as specified under these Specifications, and provided, that it has furnished to the Owner a sworn affidavit in form satisfactory to Owner's attorney to the effect that all bills are paid and no suits are pending in connection with the work done or labor and material furnished under this CONTRACT.

1.5 SUBSURFACE AND PHYSICAL CONDITIONS

- A. If a Geotechnical Report is included in the project, it will be listed as an Appendix.
- B. All excavation is considered unclassified excavation.

END OF SECTION

**SECTION 00 73 16
STANDARD INSURANCE REQUIREMENTS**

Prior to the Commencement of Work, the Contractor shall provide a Certificate of Insurance Indicating the Following Coverages and Liability Limits.

The following coverage must apply:

1. General Liability Insurance (CGL):

Commercial general liability on an occurrence coverage form. The limits of liability shall not be less than:

\$1,000,000 each occurrence (combined single limit for bodily injury and property damage).

\$1,000,000 for personal and advertising injury liability.

\$2,000,000 general aggregate.

\$2,000,000 aggregate on products and completed operations.

Liability policy shall name the Owner and all parties required by contract as additional insured using the additional insured endorsements **CG 2010 7 04 & CG 2037 7 04** or equivalent endorsements. These endorsements should be attached to the certificate of insurance. The additional insured coverage afforded will apply on a “**primary and noncontributory**” basis.

2. Automobile Liability Insurance:

\$1,000,000 Combined single limit each accident for bodily injury and property damage.

Include coverage on all owned, hired, and non-owned automobiles.

3. Umbrella/Excess Liability insurance:

A minimum of \$2,000,000 each occurrence in excess of the liability insurance is required.

Additionally, the subcontractor shall maintain the coverage during the period of construction, and for two years following owner’s acceptance of the project.

4. Workers Compensation (Statutory) and Employer’s Liability:

\$1,000,000 each accident for bodily injury by accident.

\$1,000,000 each employee for bodily injury by disease.

\$1,000,000 policy limit for bodily injury by disease.

5. Hall County (and any applicable Authority) should be shown as an additional insured on General Liability, Auto Liability and Umbrella Liability policies.

6. The cancellation should provide 10 days’ notice for nonpayment and 30 days’ notice of cancellation.

**HALL COUNTY – SPOUT SPRINGS WATER RECLAMATION FACILITY
EXPANSION TO 1.6 MGD**

7. Certificate Holder should read:

**Hall County, Georgia
2875 Brown Bridge Road
Gainesville, GA 30504**

Insurance Company should be licensed to do business by the Georgia Department of Insurance.

8. Certificates of Insurance, and any subsequent renewals, must reference specific proposal/contract by project name and project/proposal number.
9. All insurance coverages required to be provided by the Contractor will be primary over any insurance program carried by the COUNTY.
10. Contractor shall incorporate a copy of the insurance requirements as herein provided in each and every subcontract with each and every Subcontractor in any tier and shall require each and every Subcontractor of any tier to comply with all such requirements. Contractor agrees that if for any reason Subcontractor fails to procure and maintain insurance as required, all such required Insurance shall be procured and maintained by Contractor at Contractor's expense.
11. No Contractor or Subcontractor shall commence any work of any kind under this Contract until all insurance requirements contained in this Contract have been complied with.
12. The Contractor shall agree to waive all rights of subrogation against the COUNTY, its officers, officials, employees, and volunteers from losses arising from work performed by the contractor for the COUNTY.

END OF SECTION

**HALL COUNTY – SPOUT SPRINGS WRF
EXPANSION TO 1.6 MGD**

07/17/2024



CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)
01/01/2022

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 ABC Agency, Inc. One Agent Drive Atlanta, GA 20000	CONTACT Agency Contact	
	NAME: PHONE: (A/C, No. Ext): E-MAIL: ADDRESS:	FAX (A/C, No):
INSURED XYZ Company, Inc. One Contractor Street Atlanta, GA 30000	INSURER(S) AFFORDING COVERAGE	
	INSURER A: Insurance Carrier A	
	INSURER B: Insurance Carrier B	
	INSURER C: Insurance Carrier C	
	INSURER D: Insurance Carrier D	
	INSURER E: Insurance Carrier E	
INSURER F:		

COVERAGES

CERTIFICATE NUMBER:

REVISION NUMBER:

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

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
A	<input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS-MADE <input checked="" type="checkbox"/> OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: <input checked="" type="checkbox"/> POLICY <input checked="" type="checkbox"/> PRU-JECT OTHER:	Y	Y	XXX123456	Date	Date	EACH OCCURRENCE \$ 1,000,000 DAMAGE TO RENTED PREMISES (Ea occurrence) \$ 100,000 MED EXP (Any one person) \$ 5,000 PERSONAL & ADV INJURY \$ 1,000,000 GENERAL AGGREGATE \$ 2,000,000 PRODUCTS - COMP/OP AGG \$ 2,000,000 \$
B	AUTOMOBILE LIABILITY <input checked="" type="checkbox"/> ANY AUTO <input checked="" type="checkbox"/> OWNED AUTOS ONLY <input type="checkbox"/> SCHEDULED AUTOS <input checked="" type="checkbox"/> HIRED AUTOS ONLY <input checked="" type="checkbox"/> NON-OWNED AUTOS ONLY <input type="checkbox"/> OTHER:	Y	Y	XXX123456	Date	Date	COMBINED SINGLE LIMIT (Ea accident) \$ 1,000,000 BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE (Per accident) \$ \$
C	<input checked="" type="checkbox"/> UMBRELLA LIAB <input checked="" type="checkbox"/> OCCUR <input type="checkbox"/> EXCESS LIAB <input type="checkbox"/> CLAIMS-MADE DED RETENTION \$	Y	Y	XXX123456	Date	Date	EACH OCCURRENCE \$ 2,000,000 AGGREGATE \$ 2,000,000 \$
D	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	Y / N N	Y N / A	XXX123456	Date	Date	<input checked="" type="checkbox"/> PER STATUTE <input type="checkbox"/> OTH-ER E.L. EACH ACCIDENT \$ 1,000,000 E.L. DISEASE - EA EMPLOYEE \$ 1,000,000 E.L. DISEASE - POLICY LIMIT \$ 1,000,000
E					Date	Date	

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

Project Name and Address
 (Owner) and all parties required by contract are included as additional insured with regards to General Liability per CG2010(10/01) & CG2037 (10/01) or equivalent, Automobile Liability and Umbrella Liability. Coverage is Primary and non-contributory over any insurance held by the additional insureds. A Waiver of Subrogation, per CG2404 (05/09) or equivalent, in favor of the additional insureds and a (30)day notice of cancellation, except 10 days for non-payment of premium applies on all policies.

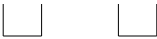
**HALL COUNTY – SPOUT SPRINGS WRF
EXPANSION TO 1.6 MGD**

07/17/2024

CERTIFICATE HOLDER	CANCELLATION
Hall County	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 Signature of Agents Authorized Representative

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POLICY
NUMBER:

COMMERCIAL GENERAL
LIABILITY CG 20 10 10 01

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

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

This endorsement modifies insurance provided under the

following: COMMERCIAL GENERAL LIABILITY

COVERAGE PART

SCHEDULE

Name of Person or Organization:

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

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

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

2. Exclusions

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

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



**HALL COUNTY – SPOUT SPRINGS WRF
EXPANSION TO 1.6 MGD**

07/17/2024

POLICY
NUMBER:

**COMMERCIAL GENERAL
LIABILITY CG 20 37 10 01**

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

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

This endorsement modifies insurance provided under the

following: COMMERCIAL GENERAL LIABILITY

COVERAGE PART

SCHEDULE

Name of Person or Organization:

Location And Description of Completed Operations:

Additional Premium:

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

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

**HALL COUNTY – SPOUT SPRINGS WRF
EXPANSION TO 1.6 MGD**

07/17/2024

**CG 20 37 10
01**

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2000

**Page 1 of
1**



POLICY
NUMBER:

COMMERCIAL GENERAL
LIABILITY CG 24 04 05 09

WAIVER OF TRANSFER OF RIGHTS OF RECOVERY AGAINST OTHERS TO US

This endorsement modifies insurance

provided under the following:

COMMERCIAL GENERAL LIABILITY

COVERAGE PART

PRODUCTS/COMPLETED OPERATIONS LIABILITY COVERAGE PART

SCHEDULE

Name of Person or Organization:

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

The following is added to
Paragraph 8. **Transfer Of Rights
Of Recovery Against Others To
Us** of Section IV - **Conditions:**

We waive any right of recovery we
may have against the person or
organization shown in the
Schedule above because of
payments we make for injury or
damage arising out of your
ongoing operations or "your work"
done under a contract with that
person or organization and
included in the "products•
completed operations hazard".
This waiver applies only to the

**HALL COUNTY – SPOUT SPRINGS WRF
EXPANSION TO 1.6 MGD**

07/17/2024

person or organization shown in
the Schedule above.

**SECTION 00 73 46
WAGE RATE DETERMINATION**

WAGE RATE DETERMINATION FOR HEAVY CONSTRUCTION HALL COUNTY, GEORGIA

"General Decision Number: GA20240289 01/05/2024

Superseded General Decision Number: GA20230289

STATE: GEORGIA

Construction Type: Heavy

County: Hall County in Georgia.

HEAVY CONSTRUCTION PROJECTS

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658.

Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022 or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	Executive Order 14026 generally applies to the contract. The contractor must pay all covered workers at least \$17.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2024.
If the contract was awarded on or between January 1, 2015, and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	Executive Order 13658 generally applies to the contract. The contractor must pay all covered workers at least \$12.90 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2024.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <https://www.dol.gov/agencies/whd/government-contracts>.

**HALL COUNTY – SPOUT SPRINGS WRF
EXPANSION TO 1.6 MGD**

07/17/2024

Modification Number Publication Date
0 01/05/2024

ELEC0613-003 09/01/2023

	Rates	Fringes
ELECTRICIAN.....	\$ 34.50	32%

SUGA2017-004 04/15/2021

	Rates	Fringes
CARPENTER.....	\$ 21.64	3.90
CEMENT MASON/CONCRETE FINISHER...	\$ 19.02	3.29
LABORER: Common or General.....	\$ 13.98 **	1.38
LABORER: Pipelayer.....	\$ 17.11 **	3.23
OPERATOR: Backhoe/Excavator/Track hoe.....	\$ 24.17	4.70
OPERATOR: Bulldozer.....	\$ 16.29 **	0.00
OPERATOR: Crane.....	\$ 25.45	0.00
OPERATOR: Loader.....	\$ 17.86	0.65
OPERATOR: Roller.....	\$ 11.89 **	0.00

WELDERS - Receive rate prescribed for craft performing
operation to which welding is incidental.

** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$17.20) or 13658 (\$12.90). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any

solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing

this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

<https://sam.gov/wage-determination/GA20220064/1>

**SECTION 01 11 00
SUMMARY OF WORK**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Work to be done under this Contract shall include the furnishing of all materials, equipment, labor and means of construction necessary for the construction of the Hall County Spout Springs Water Reclamation Facility, Expansion to 1.6 MGD and all other work as shown on the Contract Drawings and/or as specified herein including. Substantial completion in 510 consecutive calendar days after the Notice to Proceed is issued. The SBR, UV disinfection system and filter system equipment has been pre-selected for this project. Refer to the Appendix A and B for vendor scope of supply.
- B. Work shall include clean-up and dress-up and all repair work necessary to restore pavement, lawns, and finished areas as closely as possible to their original condition following installation of the work.
- C. All work pertaining to any requirements contained herein shall be included in the overall proposal submitted unless such cost is designated as a separate pay item in the Bid Schedule.
- D. Contractor shall be responsible for obtaining and paying for all necessary local and state licenses, permits and taxes.
- E. The Contractor will be required to deliver all equipment, pipe, valves, and other materials to the location of installation. Care shall be exercised in handling all materials and equipment, and the Contractor will be held responsible for all breakage or damage to same.

1.2 WORK AND MATERIALS BY THE OWNER

- A. The Owner will furnish all water for construction operations and for testing.
- B. The Contractor shall make his own arrangements to convey the water from the Owner's tap to points of construction.
- C. The Owner shall provide personnel to operate all necessary valves in existing system and will oversee all necessary taps and connections to existing lines made by the Contractor's personnel.

1.3 OR APPROVED EQUIVALENT CLAUSE

- A. Whenever a material or article required is specified or shown on the Contract Drawings by using the name of the proprietary product or of a particular manufacturer or vendor, any material or article which will meet design criteria and is equal in function and durability, as determined by the Engineer, will be considered.

1.4 COMPLIANCE OF WORK WITH SPECIFICATIONS

- A. The Contractor will be supplied with three sets of Drawings and Specifications. Of these sets, one complete set shall always be available on the job site.
- B. Should any portion of the Drawings and/or Specifications be obscure or in dispute, it shall be referred to the Engineer and he shall decide as to the true meaning and intent. He shall have the right to correct errors and omissions at any time when those corrections are necessary for the proper fulfillment of the Drawings and Specifications.
- C. The Contractor shall furnish the Engineer with every reasonable facility for ascertaining whether or not the work performed, and materials used are in accord with the requirements and intent of the Specifications and Drawings. The Contractor shall give the work the constant attention necessary to facilitate the progress thereof and shall cooperate with the Engineer and with other contractors in every way possible.
- D. The Contractor shall employ only competent and skilled personnel on the work. At all times when the work is in progress, the Contractor shall have a competent Superintendent or Foreman present with authority to receive orders, execute the work and to promptly supply materials, tools, plant equipment and labor as may be required. Should the Engineer so demand, the Contractor shall immediately remove any Superintendent, Foreman or worker whom the Engineer considers incompetent, undesirable, or both.
- E. The Project Engineer shall be authorized to inspect all work done and all materials furnished, including the preparation, fabrication and manufacture of the materials to be used. The Project Engineer shall be authorized to alter or waive the requirements of the Specifications. He may reject materials and suspend the work.
- F. No work shall be done, nor materials used without suitable supervision and/or inspection by the Engineer or his representative. Failure to reject defective work and/or materials shall not in any way preclude later rejection when that defect is discovered or obligate the Owner to final acceptance.
- G. Inspection of the work shall not relieve the Contractor of his obligation to fulfill his contract. Defective work shall be made good even if such work and/or materials have been previously inspected by the Engineer or his representative and accepted or included in an estimate for payment. All rejected work and/or materials shall immediately be removed and replaced with materials and work in accord with the Specifications and Drawings. If the Contractor fails to remove the defective work and/or materials within ten days after having been ordered to do so, the Owner shall have the right and authority to stop the Contractor and suspend the work at once and to supply personnel and material to remove and replace that defective work and/or materials at the expense of the Contractor.

1.5 CONFLICTING REQUIREMENTS

- A. In case of conflict between the requirements in the Technical Specifications, that requirement which is in compliance with all the applicable codes, and which is, in the opinion of the Engineer, more advantageous to the Owner, shall govern. This shall apply to all requirements indicated by the Technical Specifications of the Contract Documents.

1.6 EROSION CONTROL MONITORING

- A. The contractor shall comply with the requirements of the State of Georgia General NPDES Permit for Storm Water Discharges from Construction Activities, General Permit No. GAR 100000. The cost of the work from the Notice of Intent to the Notice of Termination and all other activities related to the Erosion and Sedimentation Control Program shall be included in the Lump Sum Proposal Item for Erosion Control Monitoring in the Proposal Schedule.

END OF SECTION

**SECTION 01 21 00
ALLOWANCES**

PART 1 GENERAL

1.1 SCOPE

- A. The General Contractor shall include with the bid price the following allowance items and amounts for this Contract.
- B. The Contractor's handling costs on the site, labor, installation costs, overhead, profit and other expenses contemplated for the original allowance shall be included in the contract price and not in the allowance. The Contractor shall cause work covered by these allowances to be performed for such amounts and by such persons as the Owner/Engineer may direct, but he will not be required to employ persons against whom he makes a reasonable objection. If the cost, when determined and approved by the Owner/Engineer, exceeds, or falls below the allowance, the Contract Sum shall be adjusted accordingly through a Change Order. The contractor is not entitled to overhead, profit, or mark-up on unutilized allowance funds.

1.2 SCHEDULE OF ALLOWANCE ITEMS (PART 3 IN BID FORM)

- A. Unforeseen Utility Conflicts (Bid Item 1):
 - 1. The General Contractor shall include in the bid price the following amount for correction of unforeseen utility conflicts and utility relocations as determined by the Owner and Engineer.
 - 2. **Total Allowance Item 1 = \$50,000.00**
- B. Owner Contingency (Bid Item 2):
 - 1. Owner Contingency is the lump sum amount shall be used for payment for additional Work performed at the discretion and direction of the Owner and the Engineer which is not included in the other Bid Items on the Bid Form.
 - 2. **Total Allowance Item 2 = \$300,000.00**
- C. Landscape Allowance (Bid Item3):
 - 1. Landscape Allowance: is the lump sum amount shall be used for payment for the landscaping work performed at the discretion and direction of the Owner and the Engineer which is not included in the other Bid Items on the Bid Form. A cost proposal for each item of additional work shall be prepared by the Contractor in accordance with the General Conditions for the Engineer's review as required by the General Conditions and other Sections of the Specifications. The total amount of the allowance funds paid to the Contractor shall be the total amount agreed to and ordered performed, which shall not necessarily be the total amount shown in the Bid Schedule.
 - 2. **Total Allowance Item 3 = \$ 40,000.00**

D. Pista Grit Chamber Inspection (Bid Item 4):

1. General Contractor shall include in the bid price the following amount for Smith & Loveless to inspect the internal components of the grit chamber including the gear drive assembly, suction pipe, baffle and paddle mixer to determine condition and provide letter of recommendation for repairs.
2. Contractor responsible to dewater grit chamber and clean as part of the Base Bid.
3. **Total Allowance Item 4 = \$15,000**

E. Electrical Service Allowance (Bid Item 5):

1. The Contractor will include in their proposal to provide three phase power to the site.
2. **Total Allowance Item 5 = \$100,000**

F. Spare Parts Allowance (Bid Item 6):

1. This is the lump sum amount to be used for payment for the Spare Parts provided at the discretion and direction of the Owner and the Engineer which is not included in the other Bid Items on the Bid Form. A cost proposal for each item of additional work shall be prepared by the Contractor in accordance with the General Conditions for the Engineer's review as required by the General Conditions and other Sections of the Specifications. The total amount of the allowance funds paid to the Contractor shall be the total amount agreed to and ordered performed, which shall not necessarily be the total amount shown in the Bid Schedule.
2. **Total Allowance Item 6 = \$ 20,000**

G. Metal Canopy System (Bid Item 7):

1. This is a lump sum amount to be used for payment for the materials, labor, design and installation of the metal canopy system over the existing and proposed filters. This allowance is separate from the demolition cost to remove the existing canopy and the cost to prepare the site for installation of the proposed canopy system. This allowance item also includes the cost of preparation of shop drawing submittals. Design parameters are presented in the Drawings.
2. The payment also includes materials , labor , design and installation of the metal canopy system over the proposed post equalization basin. This allowance item also includes the cost of preparation of shop drawing submittals. Design parameters are presented in the Drawings.
3. A cost proposal for this item of work shall be prepared by the Contractor in accordance with the General Conditions for the Engineer's review as required by the General Conditions and other Sections of the Specifications. The total amount of the allowance funds paid to the Contractor shall be the total amount agreed to and ordered performed, which shall not necessarily be the total amount shown in the Bid Schedule.
4. **Total Allowance Item 7= \$ 400,000**

H. Plant Reuse System Upgrade (Bid Item 8):

1. This is the lump sum amount to be used for payment for labor, and materials required for a new manifold piping, replacement of solenoid valves, pressure switches, miscellaneous valves and gauges associated with the pressure tanks to be relocated to the new electrical building. Adjusting the pre-charge pressure of each tank is part of this allowance. Yard piping from existing pressure tank location to the new electrical building, demo/removal and re-installation of existing tanks and testing of the system modifications is not included in this allowance. This allowance will be used at the discretion and direction of the Owner and the Engineer which is not included in the other Bid Items on the Bid Form. A cost proposal for additional work shall be prepared by the Contractor in accordance with the General Conditions for the Engineer's review as required by the General Conditions and other Sections of the Specifications. The total amount of the allowance funds paid to the Contractor shall be the total amount agreed to and ordered performed, which shall not necessarily be the total amount shown in the Bid Schedule.
2. **Total Allowance Item 8 = \$ 75,000**

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

**SECTION 01 22 00
MEASUREMENT AND PAYMENT**

PART 1 GENERAL

1.1 SCOPE

- A. The Bid Schedule lists each item of the Project for which payment will be made. No payment will be made for any items other than those listed in the Bid Schedule.
- B. Required items of work and incidentals necessary for the satisfactory completion of the work which are not specifically listed in the Bid Schedule, and which are not specified in this Section to be measured or to be included in one of the items listed in the Bid Schedule, shall be considered as incidental to the work. All costs thereof, including Contractor's overhead costs and profit, shall be considered as included in the lump sum or unit prices bid for the various Bid items. The Contractor shall prepare the Bid accordingly.
- C. Work includes furnishing all labor, equipment, tools, and materials, which are not furnished by the Owner and performing all operations required to complete the work satisfactorily, in place, as specified and as indicated on the Drawings.

1.2 DESCRIPTIONS

- A. Measurement of an item of work will be by the unit indicated in the Bid Schedule.
- B. Final payment quantities shall be determined from the record drawings. The record drawing lengths, dimensions, quantities, etc., shall be determined by a measurement by the Engineer for any Unit Price Bid items after the completion of all required work. The precision of final payment quantities shall match the precision shown for that item in the Bid Schedule.
- C. Payment will include all necessary and incidental related work not specified to be included in any other item of work listed in the Bid Schedule.
- D. Unless otherwise stated in individual Sections of the Specifications or in the Bid Schedule, no separate payment will be made for any item of work, materials, parts, equipment, supplies, or related items required to perform and complete the work. The costs for all such items required shall be included in the price bid for item of which it is a part.
- E. Payment will be made by extending unit prices multiplied by quantities provided and then summing the extended prices to reflect actual work. Such price and payment shall constitute full compensation to the Contractor for furnishing all labor, equipment, tools and materials not furnished by the Owner and for performing all operations required to provide to the Owner the entire Project, complete in place, as specified and as indicated on the Contract Drawings.

1.3 HALL COUNTY – SPOUT SPRINGS WRF EXPANSION TO 1.6 MGD

Part 1-Base Bid

- A. Bid Item No. 1: General Construction of the Spouts Springs WRF Expansion to 1.6 MGD per Contract Documents including all work shown on the Drawings and as specified, exclusive of those items listed below in Part 2 and Part 3 of the Bid.
- B. Bid Item No. 1 is a lump sum price bid including furnishing all materials, labor, and equipment to construct the WRF expansion to 1.6 MGD. The work includes but is not limited to modifications to the Influent Sewer, Headworks Structure, SBR's, Post Equalization Basin, Tertiary Filters, UV Disinfection, SBR Blowers and Equipment Pad, Aerobic Digester, Aerobic Digester Blowers, WAS Pumping, Plant Drain Pump Station, Plant Reuse Water System Modifications, Generator and ATS, Electrical Building, Control Building Modifications, including all electrical, instrumentation, mechanical, site work, piping, plumbing, paint, earthwork, and any appurtenances as necessary for completion of the work included in the Contract Documents.
- C. Aqua Aerobics is the selected Process Instrumentation and Control Supplier for this project.
- D. All costs for permitting to be included in Bid Item No. 1, as part of the Base Bid.
- E. The major mechanical equipment listed below is pre-selected by the Owner. The Contractor shall provide all necessary coordination with the equipment suppliers as shown in the Contract Documents. The pre-selected equipment suppliers are listed below, and a copy of the equipment manufacturer's scope of supplies and the Contractor's responsibilities are included in the Appendix A and Appendix B. Contractor shall provide all labor, equipment and materials not provided in the scope of supply in Appendix A and Appendix B and install all the work shown on the Contract Drawings and as necessary for a complete installation.
 - 1. SBR – Aqua Aerobics
 - 2. Tertiary Filter – Aqua Aerobics
 - 3. UV Disinfection – Trojan
- F. Erosion and Sediment Control and Monitoring
 - 1. Erosion and sediment control including monitoring costs to be included in Part 1, Bid item 1. No separate payment shall be made for temporary and/or permanent erosion and sedimentation controls. All other temporary and/or permanent erosion and sedimentation control costs shall be included in the price bid for the item to which it pertains. When ordered by the Engineer, additional work or increases in the quantities of certain classes of work over those called out on the Drawings may be required. Quantities for payment shall be based upon actual quantity constructed and authorized by the Engineer.
 - 2. No payment will be made for any portion of the Project for which temporary erosion and sedimentation controls are not properly maintained.

G. Permanent Grassing:

1. No separate payment will be made for temporary grassing. Include costs in Part 1, Bid Item 1.
2. All costs for permanent grassing, including seed bed preparation, topsoil, seeding, fertilizing, mulching as well as temporary measures, shall be included in the Lump Sum Price for Part 1 Bid Item 1.

Part 2 - Allowance Costs

A. Bid Item 1- Allowance for correction of unforeseen utility conflicts.

1. Unforeseen Utility Conflicts: This is the lump sum amount that shall be used for payment for additional Work performed as a result of unforeseen utility conflicts which is not included in the other Bid Items on the Bid Form. The Contingency or portion thereof shall not be paid to the Contractor except for additional work ordered in writing by the Engineer. A cost proposal for each item of additional work shall be prepared by the Contractor in accordance with the General Conditions for the Engineer's review as required by the General Conditions and other Sections of the Specifications. The total amount of Contingency funds paid to the Contractor shall be the total amount agreed to and ordered performed, which shall not necessarily be the total amount shown in the Bid Schedule.

B. Bid Item 2- Owners Contingency

1. Owner Contingency: is the lump sum amount that shall be used for payment for additional Work performed at the discretion and direction of the Owner and the Engineer which is not included in the other Bid Items on the Bid Form. The Contingency or portion thereof shall not be paid to the Contractor except for additional work ordered in writing by the Engineer. A cost proposal for each item of additional work shall be prepared by the Contractor in accordance with the General Conditions for the Engineer's review as required by the General Conditions and other Sections of the Specifications. The total amount of Contingency funds paid to the Contractor shall be the total amount agreed to and ordered performed, which shall not necessarily be the total amount shown in the Bid Schedule.

C. Bid Item 3- Landscape Allowance

1. Landscape Allowance is the lump sum amount that shall be used for payment for the landscaping work performed at the discretion and direction of the Owner and the Engineer which is not included in the other Bid Items on the Bid Form. A cost proposal for each item of additional work shall be prepared by the Contractor in accordance with the General Conditions for the Engineer's review as required by the General Conditions and other Sections of the Specifications. The total amount of the allowance funds paid to the Contractor shall be the total amount agreed to and ordered performed, which shall not necessarily be the total amount shown in the Bid Schedule.

D. Bid Item 4- Pista Grit Equipment Inspection

1. Equipment Inspection Allowance is a lump sum amount that shall be used for payment for the inspection of the paddle mixer, gearbox of the existing grit chamber. A cost proposal for this item of work shall be prepared by the Contractor in accordance with the General Conditions for the Engineer's review as required by the General Conditions and other Sections of the Specifications. The total amount of the allowance funds paid to the Contractor shall be the total amount agreed to and ordered performed, which shall not necessarily be the total amount shown in the Bid Schedule.
- E. Bid Item 5 – Electrical Service Allowance:
1. The Contractor will include \$100,000 in their proposal to provide three phase power to the site.
- F. Bid Item 6 – Spare Parts Allowance:
1. This is the lump sum amount that shall be used for payment for the Spare Parts provided at the discretion and direction of the Owner and the Engineer which is not included in the other Bid Items on the Bid Form. A cost proposal for each item of additional work shall be prepared by the Contractor in accordance with the General Conditions for the Engineer's review as required by the General Conditions and other Sections of the Specifications. The total amount of the allowance funds paid to the Contractor shall be the total amount agreed to and ordered performed, which shall not necessarily be the total amount shown in the Bid Schedule.
- G. Bid Item 7 – Metal Canopy Allowance:
1. Contractor to include in his bid the amount of \$400,000. This is the lump sum amount that shall be used for payment for the metal canopy system to be installed over the existing filters and proposed filters.
 2. Included in this allowance amount is the installation of a separate canopy system over the proposed post equalization basin.
 3. A cost proposal for this item of work shall be prepared by the Contractor in accordance with the General Conditions for the Engineer's review as required by the General Conditions and other Sections of the Specifications. The total amount of the allowance funds paid to the Contractor shall be the total amount agreed to and ordered performed, which shall not necessarily be the total amount shown in the Bid Schedule.
- H. Bid Item 8- Plant Reuse System Upgrade Allowance:
1. This is the lump sum amount of \$75,000 to be used for payment for replacement of solenoid valves, pressure switches, miscellaneous valves and gauges associated with the pressure tanks and piping relocated to the new electrical building. This work is in addition to moving the tanks. This allowance will be used at the discretion and direction of the Owner and the Engineer which is not included in the other Bid Items on the Bid Form. A cost proposal for additional work shall be prepared by the Contractor in accordance with the General Conditions for the Engineer's review as required by the General Conditions and other Sections of the Specifications. The total amount of the

allowance funds paid to the Contractor shall be the total amount agreed to and ordered performed, which shall not necessarily be the total amount shown in the Bid Schedule.

Part 3- Unit Price Bids

A. Bid Item 1- DIP Pipe:

1. This is the unit price per ton for the installation of ductile iron pipe directed by the Engineer. This price includes labor, equipment and pipe bedding.

B. Bid Item 2- DIP Fittings:

1. This is the unit price per ton for the installation of ductile iron pipe fittings directed by the Engineer. This price includes labor, equipment and pipe bedding.

C. Bid Item 3 - Stone Stabilization:

1. This is the unit price per ton for the installation of stone stabilization where directed by the Engineer, in addition to that amount required as bedding or sand cushion to stabilize poor soil shown on the Drawings. The extent of stabilization stone shall be determined by the Engineer at the time when the stone is placed. Measurement will be on a volume basis and a unit stone weight of 100 pounds per cubic foot shall be used to calculate weight. The unit price includes all costs for the materials and labor for work in accordance with Contract Documents.

D. Bid Item 4- Silt Fence Type S:

1. This is the unit price per foot for the installation of Type S silt fence. This work is at the direction of the Engineer is for silt fence not included in the Base Bid Amount.

E. Bid Item 5- Silt Fence Type S Removal :

1. This is the unit price per foot for the removal of Type S silt fence. This work is at the direction of the Engineer is for silt fence not included in the Base Bid Amount.

F. Bid Item 6 - Construction Exits:

1. This is the unit price for each installation. This work is to be performed at the direction of the Engineer. All costs for construction exit, including installation, maintenance, repair, and removal shall be included in the Unit Price for this Bid Item.

G. Bid Item 7- Permanent Grassing:

1. Payment shall be made only for additional temporary and permanent grassing not included in the Base Bid. All costs for grassing, including seed bed preparation, topsoil, seeding, fertilizing, mulching as well as temporary measures.

H. Bid Item 8- Rip Rap:

1. This is a unit price for additional rip rap not included in the Base Bid Amount.

I. Bid Item 9 - Erosion Control Monitoring:

1. This is the lump sum unit price for the regulatory required site monitoring for the entire life of the project. All costs are included in the Unit Price for this Bid Item.

J. Bid Item 10 – Concrete Washout Area:

1. This is the unit price for each installation. This work at the direction of the Engineer. All costs for concrete washout area, including installation, maintenance, repair, and removal shall be included in the Unit Price for this Bid Item.

1.4 WATER LINE OR FORCE MAIN TESTING

- A. No separate payment will be made for pressure testing of piping and/or disinfection (for water lines) and shall be included in the Base Bid.

1.5 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

- A. Payment will not be made for following:

1. Loading, hauling, and disposing of rejected material.
2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Material and equipment not properly stored.
6. Defective Work not accepted by Owner.
7. Material remaining on hand after completion of work.

1.6 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

- A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings or preliminary operation and maintenance manuals are acceptable to Engineer.
- B. Final Payment: Will be made only for products incorporated in work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

1.7 CLEARING AND GRUBBING

- A. No separate payment shall be made for clearing and grubbing. Include cost in Base Bid amount.

1.8 EARTHWORK

A. Earth Excavation:

1. NO separate payment will be made for earth excavation. The cost of such work and all costs incidentals thereto shall be included in the price bid for the item to which the work pertains.
2. NO separate payment will be made for providing sheeting, bracing, shoring and timbering.

B. Rock Excavation: NO separate payment will be made for any rock excavation required for the construction of this project.

C. Foundation Excavation:

1. Costs for additional undercutting, foundation preparation, removal and disposal of unsuitable material, and replacement with crushed stone where shown on the Drawings or specified, shall be included in the Unit Price for Item 3 of the Bid.
2. No separate payment will be made for concrete backfill of trenches beneath structures. The cost of this work and all costs incidentals thereto shall be included in Lump Sum price for the Base Bid.
3. Additional costs of corrective work, made necessary by unauthorized excavation of earth or rock, shall be borne by the Contractor.

D. Dewatering: NO separate payment will be made for dewatering required to accomplish the work.

E. Backfilling: NO separate payment will be made for backfilling or excavation, hauling and placement of borrow material. The cost of all such work and all costs incidentals thereto shall be included in the Lump Sum price for the Base Bid.

1.9 TRENCH EXCAVATION AND BACKFILL

A. No separate or additional payment shall be made for any special or unique method, means, techniques or equipment necessary for the Contractor's compliance with these Specifications, regulatory requirements, permits, laws or regulations which govern this Project.

B. Trench Excavation: No separate payment shall be made for trench excavation. All costs shall be included in the Unit Price for this Bid Item.

C. Sheeting, Bracing and Shoring: No separate payment will be made for providing sheeting, bracing, shoring and timbering.

D. Trench Rock Excavation: NO SEPARATE PAYMENT WILL BE MADE FOR TRENCH ROCK EXCAVATION.

E. Dewatering Excavations: All costs of equipment, labor and materials required for dewatering shall be included in the Base Bid Amount. No separate payment will be made.

MEASUREMENT AND PAYMENT

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1.10 PAVEMENT REPLACEMENT

- A. Payment for pavement replacement, due to construction activities and not paid for under specific bid item, shall be included in the Base Bid Amount.

1.11 MAINTENANCE OF TRAFFIC

- A. No separate payment shall be made for maintenance of traffic required for construction. All costs shall be included in the Base Bid Amount.

1.12 BY-PASS PUMPING AND TEMPORARY PIPING SYSTEMS

- A. NO separate payment shall be made for temporary bypass pumping equipment and/or temporary piping systems (process, plant water, potable or chemical). All costs for labor, materials, equipment and operations of bypass pumping and temporary piping systems to be included in the Base Bid Amount.

END OF SECTION

**SECTION 01 23 00
ALTERNATES**

PART 1 GENERAL

1.1 SCOPE

- A. The following items are to be included as Alternate Work under the Contract, and a price for each shall be entered in the Bid Form (Section 00 41 43) in the spaces provided for Bid Alternates.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

- A. This Section specifies administrative and procedural requirements for Alternates.
- B. Definition: An alternate is an amount proposed by Bidders and stated on the Bid Form for certain construction activities defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in Contract Documents.
- C. Coordination: Coordinate related work and modify or adjust adjacent work as necessary to ensure that the Work performed by each accepted Alternate is complete and fully integrated into the Project.
- D. Include as part of each Alternate, miscellaneous devices, accessory object, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.
- E. The Bidder shall quote all-inclusive deductive or added costs for proposed Bid Alternates to the Project scope listed on the Bid Form. The Bidder shall provide a quote for all proposed Bid Alternates. Quoted Bid Alternates shall include the costs for all work, including Contractor's direct and indirect costs and fees, proposed to be added or deleted from the scope of the Project and all work, including all costs and fees, required to fully execute the proposed substitute Project scope.
- F. Owner reserves the right to accept or reject any Bid Alternate. The Owner may, at its option, exercise alternate(s) no later than project award. Any alternate will be incorporated into the to the Work to be performed under the Contract Documents, any of them, or any combination of them, at the Alternate pricing as listed on the Bid Form – Section 00 41 43.
- G. Acceptance or non-acceptance of any Bid Alternates by the Owner shall have no effect on the Contract Period, Date of Substantial Completion, or Date of Final Completion.

PART 2 SCHEDULE OF ALTERNATIVES

2.1 SCOPE OF BID ALTERNATIVES

- A. The Bidder shall be responsible for determining from the Bid and Contract Documents the full scope of the proposed Bid Alternates briefly described below including the stipulated elements and any and all required associated work.

2.2 ADD /DEDUCT BID ALTERNATES

- A. Alternate- 43 25 00 Submersible Wastewater Pumps
- B. Alternate- 46 21 12 Vac Truck Receiving Station
- C. Alternate- 43 24 00 Centrifugal Chopper Pumps
- D. Alternate- 43 26 00 Vertical Mult-Stage Water Pumps

PART 3 EXECUTION (Not Used)

END OF SECTION

**SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.1 PRE-CONSTRUCTION CONFERENCE

- A. The Engineer shall schedule the pre-construction conference prior to the issuance of the Notice to Proceed.
- B. Representatives of the following parties are to attend the meeting:
 - 1. Owner.
 - 2. Engineer.
 - 3. Contractor and superintendent.
 - 4. Major subcontractors.
 - 5. Representatives of governmental or regulatory agencies when appropriate.
- C. The agenda for the pre-construction conference shall consist of the following as a minimum:
 - 1. Distribute and discuss a list of major subcontractors and a tentative construction schedule.
 - 2. Critical work sequencing.
 - 3. Designation of responsible personnel and emergency telephone numbers.
 - 4. Processing of field decisions and change orders.
 - 5. Adequacy of distribution of Contract Documents.
 - 6. Schedule and submittal of shop drawings, product data and samples.
 - 7. Pay request format, submittal cutoff date, pay date and retainage.

1.2 COORDINATION WITH PROJECT ENGINEER

- A. During the work under this Contract, the Contractor shall be responsible for keeping the Project Engineer informed of his work schedule and of his requirements concerning staking and inspection as herein specified.
- B. If any work subject to inspection or testing by the Project Engineer is installed without notification in time for such testing or inspection to be done, that work shall be subject to removal and replacement by the Contractor at no additional cost to the Owner.
- C. The Contractor shall not put workers on the job or perform any work on any portion of the project without prior knowledge of the Project Engineer that such work is to be done, the place of work, and the scheduled starting time. A minimum 24-hour notification to the Project Engineer is required.

1.3 PROGRESS MEETINGS

- A. Contractor shall schedule and hold periodic progress meetings at least every month just prior to submittal of the monthly partial payment request and at other times as requested by Engineer or required by progress of the work. Contractor, Engineer, and all Subcontractors active on the site shall be represented at each meeting. Contractor may at his discretion request attendance by representatives of his suppliers, manufacturers, and other Subcontractors.
- B. Contractor shall preside at the meetings and provide for keeping and distribution of the minutes. The purpose of the meetings will be to review the progress of the work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop.
- C. The Contractor shall provide a list of all subcontractors to the Engineer, for information only, at the Pre-Construction Conference. If the Contractor makes any additions or changes to this list, the Contractor shall resubmit the amended list to the Engineer and Owner immediately.

1.4 CONSTRUCTION SCHEDULE

- A. The Contractor shall submit to the Engineer an Estimated Construction Progress Schedule in accordance with Section 01 32 13.
- B. The Schedule shall show the anticipated dates of commencement and completion of each of the various types of work required under the Contract Documents and the anticipated amount of each monthly payment that will become due the Contractor in accordance with the Progress Schedule.
- C. The construction costs employed in making up these Schedules will be used only for determining the basis of partial payments and will not be considered as fixing a basis of additions to or deductions from the Contract price.

1.5 PROJECT LAYOUT

- A. The Engineer will furnish the Contractor with a list of coordinates for the various project structures, as well as benchmark locations and elevations. The Contractor shall be responsible for verifying these elevations and locations and for laying out the Work. The cost of this survey shall be the responsibility of the Contractor.
- B. At request, the Engineer will provide digital files to the Contractor.

1.6 SAFETY REQUIREMENTS

- A. All construction work on public rights-of-way shall be done in accordance with the rules and regulations of the agency having control. All safety equipment and markings shall be furnished by the Contractor.

- B. Work done on such rights-of-way shall be done only with the written consent of and in strict accordance with the Specifications of the right-of-way Owner.
- C. It shall be the responsibility of the Contractor to notify the right-of-way Owner's field engineer before doing any work within the right-of-way.
- D. All construction work shall be performed in accordance with established construction safety standards, and the Contractor shall be responsible for the safety of his employees and the public. All applicable local, state, and Federal regulations, including the Department of Labor, Occupational Safety and Health Administration, (OSHA), 29 CFR Part 1926, Subpart P, latest edition shall be adhered to by the Contractor.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

**SECTION 01 31 13
PROJECT COORDINATION**

PART 1 PART 1 GENERAL

1.1 SUMMARY

- A. Contractor shall be solely responsible for coordination of all the work. Contractor shall supervise, direct, and cooperate fully with all subcontractors, manufacturers, fabricators, suppliers, distributors, installers, testing agencies and all others whose services, materials or equipment are required to ensure completion of the work within the contract time and in accordance with the Contract Documents.
- B. Contractor shall cooperate with and coordinate their work with the work of any other contractors, subcontractors, utility service companies, and the Owner's employees performing additional work related to the project at the site.
- C. Contractor shall not be responsible for damage done by contractors not under their jurisdiction and will not be liable for any such loss or damage unless it is through the negligence of the Contractor.
- D. Contractor shall also coordinate their work with the work of others to assure compliance with schedules.
- E. Contractor shall attend and participate in all project coordination or progress meetings and report on the progress of all work and compliance with schedules.

END OF SECTION

**SECTION 01 32 13
CONSTRUCTION SCHEDULES**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Promptly after award of the contract, the Contractor shall prepare and submit to the Engineer estimated construction progress schedules for the Work, with sub-schedules of related activities, which are essential to its progress.
- B. Submit revised progress schedules periodically.

1.2 RELATED WORK

- A. Section 01 33 00 – Submittals.
- B. Section 01 30 00 – Administrative Requirements

1.3 FORM OF SCHEDULES

- A. Prepare schedules in the form of a horizontal bar chart.
- B. Provide separate horizontal bar for each trade or operation.
- C. Horizontal time scale: Identify the first workday of each week.
- D. Scale and spacing: To allow space for notations and future revisions.
- E. Minimum sheet size: 11” by 17”.
- F. Format of listings: The chronological order of the start of each item of work.
- G. Identification of listings: By major specification section numbers.

1.4 CONTENT OF SCHEDULES

- A. Construction Progress Schedule:
 - 1. Show the complete sequence of construction by activity.
 - 2. Show the dates for the beginning, and completion of, each major element of construction.
 - 3. Show projected percentage of completion for each item, as of the first day of each month.

- B. Submittals Schedule for Shop Drawings, Product data and samples. Show:
 - 1. The dates for Contactor's submittals.
 - 2. The dates approved submittals will be required from the Engineer.
 - 3. Products Delivery Schedule Dates.
 - 4. Provide sub-schedules to define critical portions of prime schedules.

1.5 PROGRESS REVISIONS

- A. Indicate progress of each activity to date of submission.
 - 1. Show changes occurring since previous submission of schedules:
 - 2. Major changes in scope.
 - 3. Activities modified since previous submission.
 - 4. Revised projections of progress and completion.
 - 5. Other identifiable changes.
- B. Provide a narrative report as needed to define:
 - 1. Problem areas, anticipated delays, and the impact on the schedule.
 - 2. Corrective action recommended, and its effect.

1.6 SUBMISSIONS

- A. Submit initial schedules within 15 days after award of Contract.
- B. The Engineer will review schedules and return review copy within 15 days after receipt.
- C. If required, resubmit within 7 days after return of review copy.
- D. Submit revised progress schedules at construction meetings or with each application for payment.

1.7 DISTRIBUTION

- A. Distribute copies of the reviewed schedules to:
 - 1. Job site file.
 - 2. Subcontractors.
 - 3. Other concerned parties.
- B. Instruct recipients to report promptly to the Contractor, in writing, any problems anticipated by the projections shown in the schedules.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

**SECTION 01 32 33
CONSTRUCTION PHOTOGRAPHS**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall employ a competent, professional photographer to provide aerial photographs of the construction site.

1.2 PHOTOGRAPHY REQUIRED

- A. Three (3) prints of two (2) views of overall aerial photographs of the site for each of the following progress stages:
 - 1. 50 percent, 75 percent, and 100 percent completion.
- B. Provide six (6) prints of selected aerial photographs enlarged for framing from the set of aerial photos taken.
- C. Additional prints:
 - 1. Photographer shall agree to furnish additional prints to Owner and the Engineer at commercial rates applicable at time of purchase.
- D. Costs of Photography: The Contractor shall include all costs for specified photography and printing in the Base Bid Price. Parties requiring additional photography or prints will pay photographer directly.

PART 2 PRODUCTS

2.1 PRINTS

- A. Type of Print:
 - 1. Paper: Single weight, full color print paper.
 - 2. Finish: Smooth surface, matte finish.
 - 3. Size: 8-in. x 10-in for preliminary aerial photos; 16-in x 20-in for selected aerial photos.
- B. Identify each print on back, listing:
 - 1. Name of project
 - 2. Description and orientation of view
 - 3. Date and time of exposure
 - 4. Name and address of photographer
 - 5. Photographer's numbered identification

- C. Aerial Photographs: Each aerial photograph shall be scaled to picture the plant site within no less than 80 percent of the print total area. Each selected enlarged aerial print shall be provided mounted within a black metal frame, non-glare glass front, behind a minimum 2-in wide, two-tone, double beveled mat.

PART 3 EXECUTION

3.1 TECHNIQUE

- A. Factual Presentation.
- B. Correct exposure and focus.
- C. High resolution and sharpness
- D. Maximum depth of field
- E. Minimum distortion

3.2 VIEWS REQUIRED

- A. Photograph from locations to adequately illustrate condition of construction and state of progress.
- B. Consult with the Engineer at each period of photography for instructions concerning views required.

3.3 DELIVERY OF PRINTS

- A. Deliver prints to the Engineer to accompany the corresponding percent complete pay request.
- B. Distribution of construction prints as soon as processed.

END OF SECTION

**SECTION 01 33 00
SUBMITTAL PROCEDURES**

PART 1 GENERAL

1.1 SCOPE

- A. The work under this Section includes submittal to the Engineer of shop drawings, product data and samples required by the various Sections of these Specifications.
- B. Within 45 days after Notice to Proceed is issued, the Contractor shall submit one (1) electronic copy in PDF format of all anticipated shop drawings and/or manufacturers' descriptions sheets for all materials and/or equipment for the approval of the Engineer.
- C. The submittals process for this project will be electronic.
- D. Definitions: Submittals are categorized as follows:
 - 1. Shop Drawings:
 - a. Shop drawings shall include technical data, drawings, diagrams, procedures and methodology, performance curves, schedules, templates, patterns, test reports, calculations, instructions and training, measurements, and similar information as applicable to the specific item for which the shop drawing is prepared.
 - b. Drawings shall be presented in a clear and thorough manner. Details shall be identified by reference to sheet and detail, Specification Section, schedule, or room numbers shown on the Contract Drawings.
 - c. Minimum assembly drawings sheet size shall be 11 x 17 inches.
 - d. Minimum detail sheet size shall be 8 1/2 x 11 inches.
 - e. Scale: As required.
 - 2. Product Data:
 - a. Product data includes standard printed information on materials, products, and systems, not specially prepared for this Project, other than the designation of selections from among available choices printed therein.
 - b. Collect required data into one submittal for each unit of work or system and mark each copy to show which choices and options are applicable to the Project. Include manufacturer's standard printed recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements that have been checked and special

coordination requirements.

3. Samples:

- a. Samples include both fabricated and un fabricated physical examples of materials, products, and units of work, both as complete units and as smaller portions of units of work, either for limited visual inspection or, where indicated, for more detailed testing and analysis.
- b. Provide a full set of optional samples where the Engineer's selection is required. Include information with each sample to show generic description, source or product name and manufacturer, limitations, and compliance with standards.

4. Miscellaneous submittals:

- a. Related directly to the work (non-administrative) include warranties, maintenance agreements, workmanship bonds, Project photographs, survey data and reports, physical work records, statements of applicability, quality testing and certifying reports, copies of industry standards, record drawings, field measurement data, operating and maintenance materials, overrun stock, security/protection/safety keys and similar information, devices and materials applicable to the work.

1.2 SPECIFIC CATEGORY REQUIREMENTS

A. General: Except as otherwise indicated in the individual work sections, comply with the general requirements specified herein for each indicated category of submittal. Submittals shall contain:

1. The date of submittal and the dates of any previous submittals.
2. The Project title.
3. The submittal number as indicated as follows:
 - a. Submittal Identification and Packaging: Shop drawing submittals to the Engineer shall be numbered beginning with 1, with the applicable Specification Section in parenthesis after the submittal number. Should any submittal be returned for resubmittal, that resubmittal shall be numbered 1.1 and so on.
 - b. The Contractor shall identify as an activity in the schedule, all major equipment submittals as well as those involving complex reviews and long lead deliveries. Submittal schedule information shall be updated monthly with the Contractor's updated Project schedule.
4. Field dimensions clearly identified as such.
5. Wiring and control diagrams.

6. Support calculations and other supporting information to describe the structure, machine, system, and its intended use.
7. Relation to adjacent or critical features of the work or materials.
8. Applicable standards, such as ASTM or Federal specification numbers.
9. Notification to the Engineer in writing of any deviations to the requirements of the Contract Documents. The notification of deviation shall be clearly marked by the Contractor in the body of the submittal and stated in text in the Contractor's remarks on the transmittal document of the submittal. Indicate the reasons for the deviations and the benefits to the Project.
10. Identification of revisions on re-submittals.
11. An 8 x 3 -inch blank space for Contractor and Engineer stamps.
12. A stamp, initialed or signed, certifying the Contractor's review of the submittal and indicating the submittal's status relative to the requirements of the Contract Documents.

1.3 ROUTING OF SUBMITTALS

- A. Submittals and routine correspondence shall be routed as follows:
 1. Supplier to Contractor (through representative if applicable)
 2. Contractor to Engineer
 3. Engineer to Contractor and Owner
 4. Contractor to Supplier

1.4 SUBMITTAL LOG

- A. A submittal log shall be maintained by the Engineer and the Contractor as the complete listing of submittals.

PART 2 PRODUCTS

2.1 SHOP DRAWINGS

- A. Unless otherwise specifically directed by the Engineer, make all shop drawings accurately to scale and large enough and in sufficient detail to show all pertinent features of the submitted item and its method of connection to the work.
- B. Affix the following Certification, signed by the Contractor, to each submittal:

"By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and pertinent data and I have checked and coordinated each item with other applicable approved drawings and all Contract requirements."

2.2 MANUFACTURER’S LITERATURE

- A. Where the content of submitted literature from manufacturers includes data not pertinent to this submittal, clearly indicate which portion of the contents is being submitted for the Engineer's review.

2.3 SAMPLES

- A. Samples shall illustrate the material, workmanship, and established standards by which completed work is judged.
- B. Unless otherwise specifically directed by the Engineer, all samples shall be made of and derived from the proposed product to be furnished.
- C. Submit the number of samples that are desired by the Contractor to be returned plus one sample, which will be retained by the Engineer on site. Samples shall be reviewed and comments, if any, returned to the Contractor electronically with the status of the submittal indicated.

2.4 COLORS

- A. Unless the precise color and pattern is specifically described in the Contract Documents, wherever a choice of color or pattern is available in a specified product, submit accurate color charts and pattern charts to the Engineer for review and selection.
- B. Submit the number of color and pattern charts that are desired by the Contractor to be returned plus three charts to be retained by the Engineer.
- C. Unless all available colors and patterns have identical costs and identical wearing capabilities, and are identically suited to the installation, completely describe the relative costs and capabilities of each.

2.5 CONSTRUCTION METHOD

- A. When specified or directed by the Engineer, submit proposed construction methods for those specific portions of the Work for review and approval.
- B. Include detailed written descriptions of the proposed construction.
- C. If required by the Specifications, submit working drawings to supplement the written description.
- D. The Engineer’s review and approval of construction methods will be in accordance with approval process described herein.
- E. Such approval shall not relieve the Contractor from his responsibility with regard to fulfillment of the terms of the Contract.
- F. All risks associated with the proposed construction method shall remain with the Contractor.

- G. After review and approval, if the Contractor believes that modifications are necessary, submit a description of the required modifications in detail.
- H. Include reasons why the modifications are necessary.
- I. Do not use the modifications prior to review and approval by the Engineer.

2.6 MANUFACTURER'S INSTALLATION RECOMMENDATIONS

- A. Provide written, detailed, step by step preparation and installation instructions for the materials and products.

2.7 OPERATION AND MAINTENANCE MANUALS

- A. Comply with Section 01 78 23.

PART 3 EXECUTION

3.1 CONTRACTOR'S COORDINATION OF SUBMITTALS

- A. Prior to submittal for the Engineer's review, the Contractor shall use all means necessary to fully coordinate all material and products, including the following procedures:
- B. Determine and verify all field dimensions and conditions, catalog numbers and similar data.
- C. Coordinate as required with all trades and all public agencies involved.
- D. Submit a written statement of review and certification of compliance with the requirements of all applicable technical Specifications as well as the requirements of this Section.
- E. Clearly indicate in a letter or memorandum on the manufacturer's or fabricator's letterhead, all deviations from the Contract Documents. Clearly mark the deviation in the body of the submittal and state the deviation on the transmittal form of the submittal. Describe the benefits and reasons for the deviation.

END OF SECTION

**SECTION 01 35 23
SAFETY IN WASTEWATER WORKS**

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. The Contractor is responsible for conducting all work in a safe manner and shall take reasonable precautions to ensure the safety and protection of workers, property, and the general public.
- B. All Construction work shall be conducted in accordance with the latest applicable requirements of the Occupational Safety and Health Act, as well as any other local or state safety codes and regulations.
- C. The Contractor shall designate a trained and qualified employee who is to be responsible for ensuring that the work is performed safely and in conformance with all applicable regulations. The name and resume of the designated safety supervisor shall be submitted to the Engineer prior to commencing any construction work.
- D. The Contractor shall determine for himself the safety hazards involved in executing the work and the precautions necessary to conduct the work safely. If the Contractor is unsure as to any special hazards which may be unique to the various processes and facilities at the treatment plant, it shall be his responsibility to contact the Engineer and request such information in writing prior to beginning the work.
- E. The Contractor shall bear all risks associated with performing the work and shall indemnify the Owner and Engineer.

END OF SECTION

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**SECTION 01 40 00
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section includes general requirements for quality control by the General Contractor.
- B. This section also contains new work and materials quality requirements.

1.2 RELATED WORK

- A. Submittals Section 01 33 00.

1.3 PROTECTION OF PROPERTY

- A. Existing Facilities
 - 1. Protect existing surfaces and facilities from damage resulting from the work unless the surfaces or facilities are being modified as part of this Contract.
 - 2. Protect existing paving, landscaping, and utilities from damage by mobile and stationary equipment, including vehicles delivering materials to the site.
 - 3. Protect adjacent structures from damage. Provide the following whenever required by law or necessary for safety:
 - a. Shoring
 - b. Bracing
 - c. Underpinning
 - d. Other measures necessary to those portions of adjacent structures that may be affected by the work.
- B. Utilities
 - 1. Known utilities are shown on Drawings using best available information.
 - 2. The locations of these utilities are not guaranteed, nor is there any guarantee that other utilities are not present.
 - 3. Protect utilities from damage and cause no interruption of service.
 - 4. Establish and maintain direct contact with Owner of each utility that may be affected by work and proceed with work that may affect a utility only with the cooperation and approval of the Owner of the utility.
 - 5. Before commencing construction, verify the location of utilities in vicinity of work.

C. Detection of Movement and Damage

1. Conduct a pre-construction inspection of existing facilities and structures in vicinity of work.
 - a. Document inspection by photographs, video recordings, sketches, and narratives assembled into an inspection report.
 - b. Submit three (3) copies of the inspection report to the Engineer for approval.
 - c. Upon approval, the Engineer will sign and date the report and return one copy to the Contractor, indicating agreement that the report represents an accurate description of existing conditions.
2. Establish a system of reference points on or about structures that may be affected by excavation performed as part of work.
 - a. Survey the applicable reference points at least weekly whenever there is excavation in the vicinity.
3. Submit to the Engineer a copy of each movement detection survey within 24 hours after the survey is made.

D. Damage Repair

1. Repair damage to surfaces or facilities that are to remain in place as soon as possible after discovery.
2. Use repairs shall result in conditions equal or greater in strength than the original conditions.
3. Make repaired surfaces identical in color and texture to adjacent existing materials. Where materials cannot be matched, refinish surrounding area to give a uniform appearance acceptable to Engineer.
4. Replace shrubs, cultivated vegetation, and trees damaged by the work and not shown to be removed in kind.
 - a. Replace trees larger than 3 inches diameter, measured at a height of 3 feet above the ground swell, with trees of 3 inches in diameter.
 - b. Replace other vegetation with the same species and size as that damaged, unless otherwise approved by the Engineer.

1.4 SAFETY AND FIRE PROTECTION

- A. Comply with Federal, State, and local safety and fire codes.**
1. Where there are conflicting requirements, the more stringent shall apply.

B. Fire Protection

1. The storage of flammable material on site shall be kept to a minimum. Such material that is on-site shall be properly handled and stored.
 - a. Store gasoline and other flammable liquids in Underwriters Laboratories listed safety containers in conformance with the National Board of Fire Underwriters recommendations.
 - b. Do not store flammable liquids in buildings.
2. Except as otherwise provided, do not permit fires to be built or open salamanders to be used in work.
3. Comply with published standards of the National Fire Protection Association as they pertain to general construction practices such as cutting and welding.
4. Provide a sufficient number of approved, non-freeze, portable fire extinguishers distributed throughout the project.

1.5 MANUFACTURED GENERAL REQUIREMENTS

A. Manufactured and Fabricated Products

1. Design, fabricate and assemble in accordance with the best engineering and shop practices.
2. Manufacture like parts to be interchangeable, with standard sizes and gauges.
3. Two or more items of the same kind shall be identical and by the same manufacturer.
4. Provide products which are suitable for the service conditions in which they are installed.
5. Adhere to equipment capacities, sizes, and dimensions shown or specified unless variations are specifically approved by the Engineer.
6. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.6 APPROVAL OF MATERIALS

A. Incorporate only new materials and equipment into the Work.

1. The Engineer shall inspect and approve all materials and equipment incorporated into the Work.
2. Do not deliver material to the site or incorporate it into the Work without prior approval of Engineer.
3. Provide all facilities and labor for handling and inspecting materials and equipment for the project.

- 4. Submit samples, if directed by the Engineer, for testing to demonstrate that they conform to the specifications.
- B. Provide, store, pack, and ship samples as directed by the Engineer or per manufacturer recommendations. This shall be at the Contractor's sole expense.
- C. Submit data and samples sufficiently early to permit their review and approval.
 - a. Approval is required before the items are incorporated into the Work.
 - b. Failure to submit samples or data in a timely manner shall not be an acceptable basis of claim for additional costs or time.
- D. Provide samples of workmanship or finish as directed by the Engineer. Samples may be used to:
 - a. Demonstrate the proficiency of workers or
 - b. Facilitate the choice among several textures, types, finishes, and surfaces.
- E. Use materials and equipment in the work that corresponds to approved samples or other data.

1.7 MANUFACTURER'S INSTALLATION INSTRUCTIONS

- A. Provide manufacturer's written installation instructions to all parties involved.
 - a. Maintain one set of complete instructions at the job site during installation and
- B. Handle, install, connect, clean, condition, and adjust products in strict accordance with the manufacturer's instructions and the Contract Documents. Perform all work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.8 DEFECTIVE WORK

- A. All materials furnished and work done by the Contractor at any time during the progress of the work shall be subject to the inspection of the Engineer, who shall have full power to accept or reject any part thereof.
- B. The Contractor shall remedy any defective or unsatisfactory work or material at no additional cost to the Owner. In the event the Contractor fails to initiate corrections after written notice, the Engineer shall have full right to have same done and to bill the Contractor for cost thereof.

1.9 COMPETENT LABOR

- A. The Contractor shall employ only competent and skilled personnel on the work. Either the on-site project manager or the field superintendent, as listed in the Contractor's statement of qualifications, must be on site full time for the duration of the project. The on-site project manager or the field superintendent shall have the authority to receive orders and execute the Work. Should there be a change from the listed on-site project manager and/or field superintendent, the Contractor is to submit resume of proposed personnel to Engineer for approval.

1.10 TESTING AND INSPECTION

- A. Equipment testing will be performed in accordance with Section 01 79 00 – Facility Testing and Start-up of these specifications. Payment for testing not specifically stated to be paid for by the Owner is to be included in the construction costs bid for the item to be tested.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

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**SECTION 01 45 23
TESTING LABORATORY SERVICES**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Testing laboratory inspection, sampling and testing is required for:
 - 1. Soils Compaction
 - 2. Concrete
 - 3. Earthwork
 - 4. Asphalt paving
- B. Related Requirements in other parts of the project.
- C. Inspection and testing required by laws, ordinances, rules, regulations, orders, or approvals of public authorities: conditions of the contract.

1.2 TESTING LABORATORY AND PAYMENTS

- A. Owner has preselected the testing laboratory service company. The costs for the testing shall be paid for by the Owner and is not part of this contract. The testing laboratory for this project is GeoSystems Engineering, Inc. Roswell, Georgia 30076.

1.3 QUALIFICATIONS OF LABORATORY

- A. Meet "Recommended Requirements for Independent Laboratory Qualification", published by American Council of Independent Laboratories.
- B. Meet basic requirements of ASTM E 329, "Standards of Recommended Practice for Inspection and Testing Agencies for concrete and steel as used in construction."
- C. Authorized to operate in the State in which the Project is located.

1.4 LABORATORY DUTIES

- A. Promptly submit written report of each test and inspection: One copy each to the Engineer, Owner, Contractor, and one copy to Record Documents file. Each report shall include:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Testing laboratory name, address, and telephone number.
 - 4. Name and signature of laboratory inspector.
 - 5. Date and time of sampling or inspection.

6. Record of temperature and weather conditions.
 7. Date of test.
 8. Identification of product and specification section.
 9. Location of sample or test in the project.
 10. Type of inspection or test.
 11. Results of tests and compliance with contract documents.
 12. Interpretation of test as required by the Engineer or the Owner.
- B. Provide reports summarizing all testing performed. Each report shall tabulate all testing data and should have a section that highlights any inconsistencies with any material supplied or work performed on the job during that period. Each report shall be submitted to the Engineer promptly.

1.5 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

- A. Laboratory is not authorized to:
1. Release, revoke, alter or enlarge on requirements of Contract Documents.
 2. Approve or accept any portion of the work.
 3. Perform any duties of the contractor.

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with laboratory personnel; provide access to work site.
- B. Secure adequate quantities of representational samples of materials proposed to be used and which require testing.
- C. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other materials mixes which require control by the testing laboratory.
- D. Furnish copies of products test reports as required.
- E. Furnish incidental labor and facilities:
1. To provide access to work to be tested.
 2. To obtain and handle samples at the project site or at the source of the product to be tested.
 3. To facilitate inspections and tests.
 4. For storage and curing of test samples.

- F. Contact the testing laboratory when testing or samples are required by the testing laboratory. Contractor shall provide 24-hour advance notice to allow for laboratory assignment of personnel and scheduling of tests.
 - 1. When tests or inspections cannot be performed after such notice, reimburse Owner for laboratory personnel and travel expenses incurred due to Contractor's negligence.
- G. Where the test results indicate a failure to meet the specified requirements, the Contractor shall pay all costs for re- testing with no reimbursement from the Owner.

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**SECTION 01 45 33
SPECIAL INSPECTION SERVICES**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Special testing is required by Building Code to verify the materials are properly constructed. Examples include, but not limited to:
 - 1. Reinforcement prior to concrete installation
 - 2. Field welding
 - 3. Inspection of masonry wall
 - 4. Fire suppression systems
 - 5. Plumbing
- B. Related Requirements in other parts of the project.
- C. Owner, Owners Representative or County will provide these services.

1.2 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with special inspections personnel; provide access to work site.
- B. Contractor shall provide 24-hour advance notice to allow for special inspections.
- C. Where the inspection results indicate a failure to meet the specified requirements, the Contractor shall pay all costs for the inspection with no reimbursement from the Owner.

END OF SECTION

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**SECTION 01 45 34
DELIVERY STORAGE AND HANDLING**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Provide, transport, handle, store and protect material and equipment used on this project as specified herein.

1.2 TRANSPORTATION AND HANDLING

- A. Arrange product deliveries in accordance with the approved construction schedule. Coordinate to avoid conflict with work and conditions at the project site.
 - 1. Deliver products in undamaged condition and in the manufacturer's original containers or packaging with identifying labels intact and legible.
 - 2. Materials and equipment delivered to the site shall be crated, boxed, or otherwise completely enclosed and protected during shipment, handling, and storage.
 - 3. Boxes crates and other protection shall be labeled.
 - 4. Inspect shipments immediately upon delivery.
 - a. Ensure compliance with requirements of Contract Documents and approved submittals.
 - b. Ensure that products are properly protected and undamaged.
- B. Handle products and packaging using methods designed to prevent damage.
- C. Equipment and materials damaged during delivery shall be replaced by the Contractor at no expense to the Owner.

1.3 PROTECTION DURING STORAGE

- A. Provide covered, weather-protected structures to store products and equipment. Examples of suitable enclosures include buildings or trailers which have a concrete or wooden floor, a roof, and fully closed walls on all sides.
 - 1. Provide a clean, dry, non-corrosive environment for all mechanical equipment, valves, architectural items, electrical and instrumentation equipment, and special equipment.
 - a. Protect mechanical and electrical equipment from contamination by dust, dirt, water, atmosphere moisture, chemicals, insects, animals, vandals, or other sources of damage.
 - b. Store equipment in strict accordance with the manufacturer's instructions. Include heating and moisture control when required. Maintain temperature and humidity within the ranges recommended in manufacturers' instructions. Lubricate equipment during storage if recommended.

2. Replace corroded, damaged, or deteriorated equipment and parts before project acceptance.
 3. Do not include improperly stored equipment and materials in payment estimates.
 4. Ensure that all seals and labels remain intact and legible during storage.
 5. Store fabricated products above the ground or floor and on blocking or skids.
 - a. Prevent soiling or staining.
 - b. Cover products which are subject to deterioration with impervious sheet coverings.
 - c. Provide adequate ventilation to avoid condensation.
 6. Provide heated storage for materials subject to damage by freezing or low temperatures.
 7. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
 - a. Store cement, sand, and lime under roof and off the ground.
 - b. Keep material completely dry at all times.
- B. Handle and store all material and equipment in a manner to prevent warping, twisting, bending, breaking, cracking chipping, spalling, rusting, staining, and any injury, theft, dampness, corrosion, or damage of any kind whatsoever.
1. Store structural steel, miscellaneous steel and reinforcing steel off the ground and away from water or otherwise prevent accumulations of dirt or grease and corrosion.
 2. Store steel beams with the webs vertical.
- C. Remove all material which, in the sole opinion of Engineer, is damaged from the project site. The Contractor shall receive no compensation for either the damaged material or its removal.
- D. Arrange stored items in a manner to provide easy access for inspection.
1. Make periodic inspections of stored products.
 2. Ensure that products are maintained under specified conditions, and free from damage or deterioration.
- E. Protect installed products from damage due to traffic, fallen objects, incidental contact by equipment or other materials during placement, and any other subsequent construction operations. Remove protection prior to testing.
- F. Correct storage and handling issues that do not conform to these specifications within seven days after receiving written notice to do so.
1. If the Contractor fails to act within the specified length of time, the Owner and/or Engineer may correct all deficiencies identified in the written notice and deduct the costs associated with these corrections from Contractor's payments.

2. The Owners costs shall include labor, equipment usage, administration, clerical, engineering, and any other costs associated with making the necessary corrections.

1.4 EQUIPMENT DELIVERY, STORAGE, AND HANDLING ON SITE

- A. Do not deliver equipment to the project site more than one month prior to installation without written authorization from Engineer.
- B. Store instruments and equipment with moving parts such as gears, electric motors, etc. in a temperature and humidity-controlled building approved by the Engineer until such time as the equipment is to be installed.
 1. Store such equipment fully lubricated with oil, grease, etc. unless otherwise instructed by the manufacturer.
 2. Rotate the moving parts of all equipment in storage at least once weekly to ensure proper lubrication and to avoid metal-to-metal “welding”.
 - a. When equipment is installed, start the equipment at a minimum of half load on a weekly basis.
 - b. Operate equipment for a sufficient length of time to ensure that the equipment does not deteriorate from lack of use.
 - c. Change lubricants when installation is complete and as frequently as required thereafter during the period between installation and acceptance.
 - d. Mechanical equipment to be used in the work, if stored for longer than ninety (90) days, shall have the bearings cleaned, flushed, and lubricated prior to testing and startup.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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**SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS**

PART 1 GENERAL

1.1 SCOPE

- A. This Section includes requirements for the installation, maintenance and removal of temporary utilities, controls, facilities, and construction aids during construction.

1.2 SANITARY FACILITIES

- A. The Contractor must provide portable toilet facilities during construction activities. The Contractor shall pay all costs for sanitary facilities. Owner's facilities will not be available for Contractor's use.

1.3 PARKING AND WORK AREAS

- A. The Contractor must park equipment, construction, and private vehicles, in a safe manner off all travel lanes.
- B. Are on the plant site can be utilized for materials storage. Any additional areas needed must be provided off-site by the Contractor at its sole expense.

1.4 EROSION CONTROL

- A. The Contractor shall comply with the requirements of the State of Georgia General NPDES Permit for Storm Water Discharges from Construction Activities, General Permit No. GAR100002. The cost of the work from the Notice of Intent to the Notice of Termination and all other activities related to the Erosion and Sedimentation Control Program shall be included in the overall cost of the project. No separate payment will be made for this work.
- B. All erosion and sedimentation control measures and Best Management Practices (BMPs) must be in conformance to the State of Georgia Erosion and Sedimentation Control Act of 1975, as currently amended. All erosion and sedimentation control measures must be installed in accordance with the Manual for Erosion and Sedimentation Control in Georgia, as currently amended.
- C. At a minimum the General Permit includes having BMP plan on site, initial inspection for BMP record keeping, rain measurement, repairs, etc.
- D. Contractor is responsible for all sampling to comply with the General Permit.
- E. All Erosion and Sedimentation control measures must be installed prior to initiation of construction activity.

1.5 TEMPORARY UTILITIES

- A. Potable Water: Potable water will be available from the Owner for drinking from a cooler, etc. Contractor shall pay for all costs to transfer water from source to point of use.
- B. Telephone: Telephone service is not available from the Owner. Contractor shall pay all costs to establish a separate telephone service.
- C. Internet: Contractor must maintain an e-mail account over the duration of the Contract.
- D. Temporary light and power
 - 1. Contractor may use existing 110-volt outlets for operation of hand tools, where such outlets are available and functional; however, the existence of an outlet does not guarantee that it is functional, and the Owner will not be responsible for repairing non-functioning outlets.
 - 2. Contractor shall provide all additional temporary light and power necessary to complete the work, including 220-volt service for welding. Make necessary arrangements with the local electric company for temporary electric service and pay all expenses in connection therewith.
 - 3. Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. For connection of power tools and equipment, provide outlets equipped with ground-fault circuit interrupters, reset button and pilot light.
 - 4. Provide grounded extension cords. Use “hard-service” cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if more than one length is required.
 - 5. Provide general service incandescent lamps as required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.
- E. Temporary heat
 - 1. Provide all heat as may be necessary for proper execution and protection of the work.
- F. Non-potable water
 - 1. Owner will allow the Contractor to withdraw non-potable water for structure water tightness testing and process start-up.

1.6 DUST CONTROL

- A. The Contractor shall always provide dust control, including holidays and weekends, as required to abate dust nuisance on and about the site which is a result of construction activities. Dust control shall be by means of sprinklered water or by other approved methods, except that chemicals, oil, or similar palliatives shall not be used.
- B. Quantities and equipment for dust control shall be sufficient to effectively prevent dust nuisance on and about the jobsite; and when weather conditions warrant, sprinklering equipment shall be always on hand for immediate availability.
- C. The Engineer shall have authority to order dust control work whenever conditions warrant, and there shall be no additional cost to the Owner, therefore. Dust control shall be effectively maintained whether the Engineer orders such work.
- D. Complaints from the public related to construction shall be reported to the Engineer and shall be acted on immediately.
- E. Where earthwork operations are in progress, keep exposed earth surfaces dampened continuously. Also, keep dirt accessways and roads dampened continuously.
- F. If portions of the site are temporarily inactive or abandoned for whatever reason, provide dust control and abatement continuously during such periods of inactivity.
- G. Where dust resulting from construction activities has collected on public sidewalks and streets, hose down such sidewalks and streets to abate flying dust particles. Clean all sidewalks and streets from accumulated dirt and dust.

1.7 MUD CONTROL

- A. The Contractor shall take measures to prevent tracking of mud onto public streets, drives, and sidewalks.
- B. All egress from the site shall be maintained in a dry condition, and any mud tracked onto streets, sidewalks, or drives shall be immediately removed, and the affected area shall be cleaned. The Engineer may order such work at any time the conditions warrant.
- C. Where trucks will leave a muddy site and enter paved road surfaces, the Contractor shall maintain a suitable truck wheel-washing facility and crew. All trucks, or other vehicles leaving the site, shall be cleaned of mud and dirt, including mud and dirt clinging to exterior body surfaces of vehicles.
- D. All trucks coming to the jobsite or leaving the jobsite with materials or loose debris shall be loaded in a manner that will prevent dropping of materials or debris on streets. Spillage resulting from hauling operations along or across any public traveled way shall be removed immediately.

1.8 TEMPORARY VENTILATION

- A. Provide temporary ventilation of construction area. Exhaust air to outdoor discharge. Locate exhaust air discharge to an elevation sufficient to prevent personnel contact with the exhaust air.

1.9 BYPASS PUMPING

- A. The Contractor is required to furnish all materials, labor, equipment, power, maintenance, etc. to implement a temporary pumping system for the purpose of diverting the existing sewer flow where required. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall employ the services of Godwin Pumps, Rain for Rent, or approved equal. The vendor shall provide at least 5 references of projects of a similar size and complexity as this project performed by his firm within the past 3 years. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
- B. Equipment: All pumps used shall be fully automatic self-priming units that do not require the use of foot valves or vacuum pumps in the priming system. The pumps shall be diesel powered unless approved otherwise by the Engineer. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows.
 - 1. The Contractor shall provide the necessary stop/start controls for each pump.
 - 2. The Contractor shall include one standby pump of each size utilized to be maintained on site.
 - 3. Back-up pumps shall be on-line, isolated from the primary system by a valve.
 - 4. Discharge Piping: In order to prevent accidental spillage of flows all discharge systems shall be temporarily constructed of rigid pipe with positive, restrained joints. Under no circumstances will glued PVC pipe be allowed. Discharge hose will only be allowed in short sections and by specific permission from the Engineer.
- C. Design Requirements:
 - 1. Bypass pumping systems shall have sufficient capacity to pump a peak flow as required for the system being bypassed. Bypass shall be capable of passing a solid 3" diameter sphere. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle peak flow and temporary discharge piping to ensure that the total flow of the main can be safely diverted around the section to be repaired. Bypass pumping systems operating for more than 24 hours will require overnight monitoring by the contractor or a wireless monitoring system; Alarm Agent by RACO or equal.

2. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each size pump utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure.
3. Bypass pumping system shall be capable of bypassing the flow around the work area and of releasing any amount of flow up to full available flow into the work area as necessary for satisfactory performance of work.
4. The Contractor shall make all arrangements for bypass pumping during the time when the main is shut down for any reason. System must overcome any existing system pressure on discharge.

D. Performance Requirements:

1. It is essential to the operation of the existing sewerage system that there be no interruption in the flow of sewage throughout the duration of the project. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and backup units as required), conduits, all necessary power and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with his work, carry it past his work and return it to the existing sewer downstream of his work.
2. The Contractor shall provide all necessary means to safely convey the sewage past the work area. The Contractor will not be permitted to stop or impede the main flows under any circumstances.
3. The Contractor shall maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, that will not cause damage to sewers and that will protect public and private property from damage and flooding.
4. The Contractor shall protect water resources, wetlands and other natural resources.

E. Field Quality Control and Maintenance:

1. Test: The Contractor shall test the system for 4 hours during peak flows before dismantling existing pump system.
2. Inspection: Contractor shall inspect bypass pumping system every two hours to ensure that the system is working correctly.
3. Maintenance Service: The Contractor shall insure that the temporary pumping system is maintained 24/7 when operating.

4. Extra Materials:
 - a. Spare parts for pumps and piping shall be kept on site as required.
 - b. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

1.10 FENCING

- A. Maintain existing fencing during construction until completion of the work. Erect temporary fencing to maintain security around the job site or where permanent fencing must be removed to allow for construction.

1.11 CUTTING AND PATCHING OF PAVEMENT

- A. Contractor is responsible for all cutting and patching pavement during construction. Always maintain passable plant roads. Install temporary pavement patches as required to match the adjacent material.

END OF SECTION

**SECTION 01 52 13
FIELD OFFICE**

PART 1 GENERAL

1.1 TEMPORARY OFFICES FOR CONTRACTOR

- A. Temporary offices shall be established on the job site and adequately furnished, and maintained in a clean, orderly condition by the Contractor. The Contractor or his authorized representative shall be present in the field office at all times while work is in progress. Instructions received there from the Engineer shall be considered as delivered to the Contractor.
- B. The office shall be provided with janitor service, restroom, heating and air conditioning equipment, electrical wiring, outlets, and fixtures suitable to light tables and desks adequately.
- C. At this office, maintain complete field file of shop drawings, Contract Documents and Record Drawing mark-ups.

1.2 FIRE EXTINGUISHERS

- A. Provide portable UL-Rated Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide portable UL-Rated Class ABC dry chemical extinguishers or a combination of NFPA recommended Classes for the exposure. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PREPARATION

- A. Fill and grade site for temporary structures to provide surface drainage.

3.2 INSTALLATION

- A. Construct temporary field office on proper foundations and provide connections for utility services.
- B. Secure portable or mobile buildings when used.
- C. Provide steps and landings at entrance doors.
- D. Mount thermometer at convenient outside location, not in direct sunlight.
- E. Potable water and sewer service connections are the responsibility of the Contractor.

3.3 MAINTENANCE

- A. Provide periodic maintenance and cleaning for temporary structures, furnishings, equipment, and services.

3.4 REMOVAL

- A. Remove temporary field offices, contents and services at a time when they are no longer needed.
- B. Remove foundations and debris; grade the site to required elevations and clean the area.

END OF SECTION

**SECTION 01 65 00
MATERIALS AND EQUIPMENT**

PART 1 GENERAL

1.1 SCOPE

- A. These requirements apply, in general, to all equipment and piping. They supplement the detailed equipment specifications, but in case of conflict, the detailed equipment specifications shall govern.

1.2 COORDINATION

- A. The Contractor shall resume full responsibility for the coordination of the installation of all equipment, materials and products furnished under these Contract Documents. The Contractor shall be completely responsible for verification that all structures, piping and equipment components furnished by him and/or his Subcontractors and Suppliers are compatible. The Contractor shall start up each equipment system and shall make all necessary adjustments to place each system in proper operating condition.

1.3 ADAPTATION AND LOCATION OF EQUIPMENT

- A. Equipment shall be readily adaptable for installation and operation in the structures to be constructed under these Contracts. No responsibility for alteration of a planned structure to accommodate other types of equipment will be assumed by the Owner. Equipment, which requires alteration of the structures, will be considered only if the Contractor assumes all responsibility for making and coordinating all necessary alterations. All such alterations shall be made at the Contractor's expense.
- B. The Contractor shall install the work in such manner that the equipment, piping, vents, conduit, panels, ductwork, etc., be as neatly installed and out-of-the-way as physically possible. All equipment, piping, ductwork, conduit, etc., shall be installed to provide needed maintenance and passage space.

1.4 PATENT ROYALTIES

- A. All royalties and fees for patents covering materials, articles, apparatus, devices, or equipment shall be included in prices bid by the Contractor.

1.5 WORKMANSHIP AND MATERIALS

- A. All equipment shall be designed, fabricated, and assembled in accordance with the best modern engineering and shop practice. Individual parts shall be manufactured to standard sizes and gauges so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall be new and shall not have been in service at any time prior to delivery, except as required by tests. All bolts, nuts, fastening, pipe and fittings shall be manufactured in conformance with the United States system of measurement.

- B. Materials shall be suitable for service conditions. Iron castings shall be tough, close grained, gray iron free from blowholes, flaws, or excessive shrinkage and shall conform to ASTM A48, Class 30 minimum. Plugging of defective castings shall not be permitted. Castings shall be annealed to remove internal stresses prior to machining and shall have the mark number and heat number cast on them.
- C. Except where otherwise specified, structural and miscellaneous fabricated steel used in items of equipment shall conform to the Standards of the American Institute of Steel Construction. All structural members shall be considered as subject to shock or vibratory loads.
- D. All replaceable or expendable elements such as filters, screens, drive belts, fuses, indicator lamps, etc., shall be easily accessible and replaceable without need of dismantling equipment or piping. All such items shall be of a standard type that is readily available from multiple suppliers.
- E. Threaded openings for drains or vents in pump volutes, compressor or fan scrolls, air receivers, and heat exchangers which are plugged during normal operation shall be provided with stainless steel plugs.

1.6 LUBRICATION AND LUBRICATION FITTINGS

- A. Equipment shall be adequately lubricated by systems, which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during start-up or shutdown and shall not waste.
- B. Lubricants of the type recommended by the equipment manufacturer shall be provided in sufficient quality by the Contractor to fill all lubricant reservoirs and to replace all lubricants consumed during testing, start-up, and initial operation. The Contractor shall provide sufficient quantities of lubricants to lubricate all equipment for one year of normal service before final acceptance of the equipment will be made by the Owner.
- C. Where special run-in oil or storage lubricants are used, they shall be flushed out and replaced with the required service lubricant by the Contractor.
- D. Tag each piece of equipment with cloth tag showing proper type lubricant, period between lubrication, date of lubrication, and worker's initials. Have space for ten lubrication notations.
- E. Except for rotating shaft couplings, all lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards. Fittings shall be accessible from safe, permanent platforms or portable high-pressure grease gun. Connection from a remote fitting to the point of use shall be with minimum 3/16-inch stainless steel tubing, securely mounted parallel to equipment and protected where exposed.

1.7 DRIVE UNITS

- A. Except when specified otherwise in the detailed equipment specifications, 87 percent of the nameplate horsepower rating of each drive motor shall be at least equal to the theoretical brake horsepower required to drive the equipment under full load, including all losses in speed reducers and power transmission.
- B. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor.
- C. Drive units shall be designed for 24-hour continuous service and shall be constructed so that oil leakage around shafts is precluded.

1.8 GEAR MOTORS

- A. Gear Motors shall be rated AGMA Class II and shall bear an AGMA nameplate.

1.9 GEAR REDUCERS

- A. Each gear reducer shall be totally enclosed, oil-lubricated, with antifriction bearings throughout. Worm gear reducers shall have a service factor of at least 1.25. Shaft-mounted gear reducers shall be rated AGMA Class II. Other helical, spiral bevel, and combination bevel-helical gear reducers shall have a service factor of at least 1.40. Each gear reducer shall bear an AGMA nameplate, or the manufacturer shall certify that the gear reducer is designated and rated in accordance with AGMA standards.

1.10 CHAIN DRIVES

- A. Chain drives shall utilize roller chain having an ultimate strength of not less than 10 times the maximum working loads.

1.11 V-BELT DRIVES

- A. Each V-belt drive shall include a sliding base or other suitable tension adjustment. Fixed ratio V-belt drives shall have a service factor of at least 1.5 based on motor nameplate horsepower.

1.12 COUPLINGS

- A. Couplings between motors drives or between drives and the driven equipment shall have a service factor of not less than 1.25 based on motor nameplate horsepower. Couplings between drives and the driven equipment shall have a service factor not less than that of the drive based on motor nameplate horsepower. All couplings rotating at speeds less than 900 rpm shall be of all steel construction. In general, couplings shall be of the tapered grid steel spring type or the crowned gear type.

1.13 OVERTORQUE PROTECTION

- A. All low speed, high torque drives for equipment such as mechanical screens, conveyors, and clarifier and thickener mechanisms shall be protected against excessive torque by means of a suitable over torque protection device. Acceptable devices shall include torque switches, shear pins, shear keys and full-release torque couplings. Torque limiting couplings using sliding surfaces or friction to limit torque shall not be used.

1.14 SAFETY GUARDS

- A. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 gauge or heavier galvanized or aluminum-clad sheet steel or ½-inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal. All necessary supports accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water. All safety guards shall comply with OSHA General Industry Standards, Part 1910, Subpart O, Machinery and Machine Guarding. Provide tachometer access on shaft ends. The safety guards shall be painted yellow in accordance with Section 09 91 00, Painting.

1.15 ANCHOR BOLTS

- A. Equipment suppliers shall furnish suitable anchor bolts for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Two nuts and two washers shall be provided with sufficient threads to permit a nut and washer to be installed on the concrete side of the concrete form or supporting template, but in no case shall bolts be threaded less than 2 (two) inches. Anchor bolts used in anchoring rotating or vibrating equipment shall be provided with suitable lock washers.
- B. Unless otherwise shown or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit a minimum of one (1) inch of grout beneath the baseplate and to provide adequate anchorage into structural concrete. Individual, embedded anchor bolts for heavy equipment shall be centered in a steel pipe sleeve having an inside diameter approximately two (2) times the bolt diameter and an embedded length approximately eight (8) times the bolt diameter.
- C. Bolts specified to be bent shall be bent cold. Bend radius shall not be less than twice the bolt diameter. Unless otherwise shown or specified, anchor bolts shall be embedded in concrete a minimum distance of fifteen (15) times the bolt diameter. Unless otherwise shown or specified, all anchor bolts shall be at least ½ inch diameter.
- D. All embedded anchor bolts or anchor bolt materials shall be ASTM A 193, Grade B8, ASTM A276, Type 304, or IFI-104, Grade 304 stainless steel threaded per ANSI B1.1. Nuts shall be heavy hex nuts, ANSI B18.2, semi-finished pattern, and shall be ASTM A194, Grade 8 or IFI-104, Grade 304 stainless steel. Flat washers shall be 18-8 stainless steel and shall conform to ANSI B27.2

- E. Expansion anchors shall be used to anchor equipment to existing concrete. Expansion anchors shall be stainless steel, Type 304 and shall be of the wedge type for use in bottomless holes. Expansion anchors shall conform to the applicable requirements of Federal Specification FF-S-325. Installation methods shall be in conformance with the manufacturer's recommendations for maximum pullout and shear strength, but in no case shall the depth of the hole be less than eight (8) bolt diameters or three (3) inches, whichever is greater. The minimum distance between the center of any expansion anchor and an edge or exterior corner of concrete shall not be less than five (5) times the diameter of the hole in which it is installed. The minimum distance between adjacent anchors shall not be less than ten (10) times the diameter of the hole in which it is installed.

1.16 EQUIPMENT BASES

- A. Equipment shall be installed on a raised reinforced concrete base. The base shall be a minimum of four (4) inches in height and shall extend beyond the equipment baseplate approximately two (2) inches on all sides.
- B. The electrical contractor shall be instructed concerning electrical conduit locations prior to pouring the concrete base.
- C. Unless otherwise specified, a cast iron or welded steel baseplate shall be provided for each pump, compressor, and any other item of equipment which is to be installed on a concrete base. Each unit and its drive assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components and adequate grout holes. Baseplates for pumps shall have a raised lip all around and a threaded drain connection. Baseplates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with epoxy or non-shrink grout as specified in the grouting section.
- D. On direct-coupled equipment, motor and driven equipment shall be doweled to a common base with a minimum of two (2) dowels each.

1.17 ALIGNMENT OF MOTORS AND EQUIPMENT

- A. After machine base grouting, all machines mounted on baseplates or soleplates shall be laser aligned. All equipment with a motor horsepower less than or equal to 5 is exempt.
- B. Machines supported on integral feet or support pads shall be leveled, grouted and aligned in the following order: driven machine; intermediate bearings or machines; and driver. All machines shall be aligned without any connections to piping, electrical and instrumentation systems.
- C. Upon completion of all field connections, alignment shall be rechecked to demonstrate no change. If change has occurred, the Contractor shall eliminate any external forces affecting machine alignment and repeat the alignment process. All machine alignment parameters shall be rechecked after the equipment has been brought to operating temperature by operation at specified conditions.

- D. Where required by other sections in the Contract Documents, factory authorized installation technicians representing the equipment manufacturer shall witness final alignment work. All alignment work shall be independently checked using the shaft and coupling spool method described in the “Shaft Alignment Handbook 2nd Edition”.
- E. After completion of all alignment work and acceptance in writing, by factory installation technicians, all machines shall be doweled in place using tapered stainless steel dowels.
- F. Alignment work shall be performed by journeyman millwrights skilled in this type of work under the supervision of a technician trained in the use of the laser alignment by the manufacturer of the alignment equipment. The use of laborers, carpenters or apprentices for this work will not be acceptable.
- G. All final results of the alignment work shall be subject to inspection and verification by the Engineer.
- H. Equipment shall be installed in such a way that no strain is transmitted to the equipment by piping systems or adjacent equipment.

1.18 GROUTING

- A. A special epoxy, non-shrink grout shall be used in the placement of all pumps, motor, and equipment baseplates or bedplates, column baseplates, other miscellaneous baseplates, and other grouting applications as shown on the Drawings.

1.19 WELDING AND BRAZING

- A. All welds shall be sound and free from embedded scale and slag. All butt welds shall be continuous and where exposed to view shall be ground smooth. All continuous welds shall be gas and liquid tight. Welds in piping shall have full penetration and shall be smooth on the inside of the pipe. Intermittent welds shall have an effective length of at least two (2) inches and shall be spaced not more than six (6) inches apart.
- B. All welding of steel and aluminum, including materials, welding techniques, general safety practices, appearance and quality of welds, and methods of correcting defective work, shall conform to the latest requirements of AWS Specifications. Structural steel welding shall conform to the requirements of the AWS Structural Welding Code. The general recommendations and requirements of the AWS Structural Code shall also apply to welded aluminum structures. The welding process and welding operators must meet qualification tests and welding performance tests in accordance with the latest provisions of ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications. Welding process and qualification procedures for welding of pipe shall conform to the latest requirements of ANSI B31.1, Section 327, Welding, and Section 328, Brazing and Soldering. All welding qualification tests shall be witnessed by the Engineer, except as provided herein. All costs associated with the qualification or testing of welder and welding operators shall be borne by the Contractor.

- C. Actual welding procedures to be used in field assembly and installation of equipment furnished under this Contract shall be submitted to the Engineer for approval prior to beginning the work. Reports certifying that the welding procedures, welders and welding operators that the Contractor intends to use are qualified as specified above shall also be submitted to the Engineer prior to beginning the work. In case of welder qualifications for shop welding and for carbon steel field welding, welders presenting certified qualification papers validated within the preceding six (6) month period and acceptable to the Engineer will not be required to take the qualification tests. In case of field welding of stainless steel or aluminum, all welders shall be required to take the qualification tests regardless of past experience or availability of certified qualification papers.
- D. Field welding practices shall conform to OSHA construction standards, Part 1926, Subpart J, Welding and Cutting. Shop welding practices shall conform to OSHA General Industry Standards, Part 1910, Subpart Q, Welding, Cutting, and Brazing.
- E. Welding electrodes for structural steel shall conform to the standard recommendations of the AISC. Welding electrodes for stainless steel shall conform to applicable AWS Specifications and shall be as recommended by “Welded Austenitic Chromium-Nickel Stainless Steel, Techniques and Properties”. Published by the International Nickel Company, New York, New York. Welding electrodes for aluminum shall conform to applicable AWS Specifications.
- F. Each welder and welding operator must identify his/her welds with his/her assigned symbol.
- G. Welders performing unsatisfactory work shall be removed from the welding process.
- H. The Owner may inspect any weld by radiographic or other means. Welds not in accordance with the requirements specified herein shall be repaired or replaced at the Contractor’s expense. Excessive porosity, nonmetallic inclusions, lack of fusion, incomplete penetration, and cracking shall constitute grounds for rejection of welds.

1.20 ERECTION AND SETTING

- A. In erection and setting of all fabricated equipment, the Contractor shall exercise care to ensure that each item of equipment is adequately supported so as not to bend or distort under its own weight until adequate foundation support and anchorage are provided. Where lifting lugs, angles or clips are provided on equipment, they shall be used in erecting and setting equipment. Erection and setting of equipment and structural steel shall conform to the requirements of OSHA Construction Standards.
- B. During placement and prior to any grouting or connection of adjacent piping the equipment shall be leveled and aligned true to level, plumb, alignment, and grade with all parts bearing or fitting the structure or equipment accurately and securely. It shall not be permitted to cock out of alignment, redrill, reshape or force fit any fabricated items.

- C. The Contractor shall take all measurements necessary to properly fit his work in the field, and he shall be governed by and responsible for these measurements and the proper working out of all details. The Contractor shall be responsible for the correct fitting of all work in the field and the accurate placement of all anchor bolts installed by him.
- D. The Contractor shall bring all parts to be erected or assembled into close contact. Before assembly, all surfaces to be in contact with other shall be thoroughly cleaned. Drift pins may be used only for bringing members into position, never to enlarge or distort holes. Torching or burning of holes or cutting of fabricated items to correct misalignment or shop errors shall not be permitted. Enlargement of holes necessary to make field connections shall be done only with the Engineer's approval by reaming with twist drills and in a manner acceptable to him.
- E. All equipment shall be furnished with suitable eyebolt lifting lugs or lifting angles to facilitate handling.

1.21 VIBRATION TESTS

- A. Unless specified otherwise in the detailed equipment specifications, each pump, motor or similar item of stationary rotating equipment having a rated power in excess of 50 Hp or an operating speed in excess on 1,800 rpm shall be tested in the field for acceptable vibration levels. Vibration testing shall be performed by an experienced, factory-trained and authorized vibration analysis expert (not a sales representative) retained by the Contractor for this work. Each unit or pump system shall be tested separately without duplicate equipment running. All field-testing shall be done in the presence of the Engineer. The engineer shall be furnished with four (4) certified copies of vibration test data for each test performed.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

**SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS**

PART 1 GENERAL

1.1 GUARANTEE OF WORK

- A. All work shall be guaranteed against defects in workmanship and material for a period of one year after the date of acceptance by the Owner. Refer to the General Conditions for details.

1.2 PUNCH LIST

- A. The Engineer and Owner will perform a Punch List inspection after Substantial Completion.
- B. The punch list is the basis for establishing Final Completion for the Work. The schedule for completing and/or correcting punch list activities shall be no longer than 30 consecutive calendar days for intermediate milestones and 60 consecutive calendar days for final contract completion but shall be scheduled to conclude on or before the contract completion date and it shall be initiated immediately upon Substantial Completion. The overall Contract duration is based upon a 60-day period following the contractual date for Substantial Completion to establish the contractual date for Final Completion. Later delivery of Substantial Completion shall not revise the Final Acceptance date. Assessment of liquidated damages for late Substantial Completion shall not relieve assessment of liquidated damages for Final Acceptance should Final Acceptance be established beyond the contractual completion date.

1.3 PROJECT RECORD DRAWINGS

- A. Project Record Drawings shall be submitted to the Engineer prior to Final Acceptance for Payment is recommended.
- B. Legibly marked drawings to record actual construction including, but not limited to:
 - 1. Measured horizontal and vertical locations of underground utilities.
 - 2. Field changes of dimensions and details.
 - 3. Details not on original Contract Drawings.
 - 4. Changes made by Change Order.
 - 5. Location of Facilities.
 - 6. Location of Utilities.
 - 7. Use of different product or material.
 - 8. Other matters not originally specified or documented.

END OF SECTION

**EXECUTION AND CLOSEOUT REQUIREMENTS
SECTION 01 70 00**

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**SECTION 01 74 23
CLEAN-UP**

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers general cleaning which the Contractor shall be required to perform both during construction and before final acceptance of the project unless otherwise shown on the Drawings or specified elsewhere in these specifications.

1.2 GENERAL

- A. The Contractor shall clean the work site of all trash and foreign object debris on a daily basis.

1.3 HAZARD CONTROL

- A. The Contractor shall store volatile wastes in covered metal containers and remove from premises daily.
- B. The Contractor shall prevent accumulation of wastes which create hazardous conditions.
- C. Burning or burying rubbish and waste materials on the site shall not be allowed.
- D. Disposal of volatile wastes into sanitary or storm sewers is not permitted.

1.4 DISPOSAL OF SURPLUS MATERIALS

- A. Unless otherwise shown on the Drawings, specified, or directed, the Contractor shall dispose of all surplus excavated materials and materials and equipment from demolition, legally off the site, and shall provide his own suitable, off-site spoil area, or on a site designated by the Owner.
- B. The Owner shall have the opportunity to inspect any materials removed prior to disposal by the Contractor. If said materials are determined to be salvageable by the Owner, the Contractor shall transport, and unload said material to an area designated by the Owner.

1.5 FINAL CLEANING

The Contractor shall:

- A. Schedule cleaning operations so that dust and other contaminants resulting from the cleaning process will not fall on wet, newly painted surfaces.
- B. Vacuum clean interior building areas when ready to receive finish painting and continue vacuum cleaning on an as-needed basis until building is ready for substantial completion or occupancy.
- C. Employ experienced workmen or professional cleaners for final cleaning.

- D. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces and of concealed spaces.
- E. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces; polish surfaces so designated to shine finish.
- F. Repair, patch, and touch up marred surfaces to specified finish to match adjacent.
- G. Brom clean paved surfaces; rake clean other surfaces of grounds.
- H. Clean screens on air intake vents.
- I. Upon completion of the work, Contractor shall remove from the site all plant, material, tools, and equipment belonging to him, and leave the site with an appearance acceptable to the Engineer.
- J. The Contractor shall thoroughly clean all equipment and materials installed in this project.
- K. Restoration of Landscape Damage: Any landscape feature scared or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense. The Engineer will decide what method of restoration shall be used.
- L. Post-Construction Cleanup or Obliteration: The Contractor shall obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, or any other vestiges of construction.

END OF SECTION

**SECTION 01 78 23
OPERATING AND MAINTENANCE DATA**

PART 1 GENERAL

1.1 SCOPE

- A. The Contractor shall provide (1) electronic copy in a PDF format of a complete and comprehensive reference manual containing operating and maintenance data to enable operators and plant engineers to correctly operate, service, and maintain for each piece of equipment and accessories covered by these Specifications. The data contained in the manual shall explain and illustrate clearly and simply all principles and theory of operation, operating instruction, maintenance procedures, calibration procedures and safety precautions and procedures for the equipment involved. Safety precautions and procedures shall be stressed.

PART 2 PRODUCTS

2.1 SUBMITTAL

- A. The Contractor shall submit, for the Engineer's approval, one electronic copy in PDF format of the data reference manual with all specified material before the Work covered by these Contract Documents is 50 percent complete. Before the Work is 80 percent complete, the Contractor shall submit one electronic copy in PDF format of each manual, complete in detail as specified below. The Engineer will notify the Contractor, in writing, of any deficiencies in the manual and will return the manual for completion and/or correction. The Contractor shall submit one electronic copy in PDF format of any revised or additional data required to complete the manual or as required by the Engineer.
 - 1. Submittal shall include:
 - a. The date of submission and the dates of any previous submissions.
 - b. The Project Title: Hall County – Spout Springs Water Reclamation Facility, Expansion to 1.6 MGD
 - c. Numerical submittal numbers
 - d. The names of: Contractor, Supplier & Manufacturer
 - e. Identification of the product, with the Specification section number, permanent equipment tag numbers and applicable Drawing Number.
- B. At the time of the inspection for Project completion, the Engineer will notify the Contractor of any revisions, corrections or incomplete data required for the satisfactory completion of the Operating and Maintenance Manual. The Engineer will not recommend final acceptance of the Work until the Operating and Maintenance Manual is complete and satisfactory to the Engineer.

2.2 CONTENTS OF OPERATING AND MAINTENANCE MANUAL

- A. A complete, detailed listing of all equipment, components and accessories showing component name, manufacturer, model number and quantity information shall be furnished for each component as outlined below:
1. Equipment function, normal operating characteristics and limiting conditions for all equipment furnished.
 2. Detailed assembly, installation, alignment, adjustment and checking instructions for all equipment furnished.
 3. Detailed operating instructions for start-up, calibration, routine and normal operation, regulation and control, shutdown and emergency conditions for all equipment furnished.
 4. Detailed lubrication instructions and schedules for all equipment furnished including identification of lubricant (description, specification, and trade name of at least two (2) manufacturers), and diagrams illustrating lubrication points.
 5. Detailed guide to "troubleshooting" for all equipment furnished.
 6. Detailed parts lists identified by generic title, materials of construction and part number (actual manufacturer's number, not supplier's) list of recommended spare parts identified as specified above, and predicted life of parts subject to wear, and an exploded view of each equipment assembly for all equipment furnished.
 7. Detailed disassembly, overhaul and reassembly instructions for all equipment furnished.
 8. Electrical and instrumentation schematics for all equipment furnished, including motor control centers, control panels, instrument panels and analyzer panels.
 9. List of all special tools supplied and description of their use for all equipment furnished. Special tools include any tool not normally available in an industrial hardware or mill supply house.
 10. Detailed preventative maintenance procedures and schedules for all equipment furnished.
 11. Detailed list of settings for relays, pressure switches, temperature switches, level switches, thermostats, alarms, relief valve, rupture discs, etc.
 12. One (1) copy of all record shop drawings and engineer data for all equipment furnished.
 13. Performance and characteristic operating curves for all equipment furnished.
 14. List of names and addresses of nearest service centers for parts, overhaul and service.
 15. One (1) copy of any instructions and parts list attached to equipment when delivered.

16. Procedures for storing, handling, and disposing of any chemicals or products used with the equipment or system.
17. The supplier's operation and maintenance information will address the equipment furnished, with specific details on operation and maintenance practices. General data is not acceptable.

PART 3 EXECUTION

3.1 ASSEMBLY OF OPERATING AND MAINTENANCE MANUAL

- A. Each electronic copy of the manual shall be assembled each with title page and table of contents.
- B. All copies of shop drawings, figures and diagrams shall be reduced to either 8-1/2 x 11-inches, or to 11-inches in the vertical dimension and as near as practical to 17-inches in the horizontal dimensions. Text, figures, and drawings shall be clearly legible and suitable for dry process reproductions.
- C. No separate payment will be made for the Operating and Maintenance Manual and the cost of said manual shall be included in the Contract Price.

END OF SECTION

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**SECTION 01 79 00
FACILITY TESTING AND START-UP**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Perform a field-testing program for mechanical equipment, systems, processes, digital process control systems, and electrical facilities.

1.2 DEFINITIONS

- A. System – Integrated operating unit consisting of mechanical and electrical equipment, piping, valves, structures, controls, and instrumentation which operate together to perform a specific function.
- B. Process Materials – Liquid or chemicals which are conveyed or treated by systems.
- C. Prerequisites – Items of work or submittals required prior to beginning each test.

1.3 QUALITY ASSURANCE

- A. Submit Manufacturer Proper Installation Certificate prior to Preliminary Testing. The form is located at the end of this Section.
- B. Comply as follows:
 - 1. Preliminary Test
 - a. The purpose of this phase of tests is to demonstrate that all of the equipment and systems when energized will perform the functions required by the Contract Documents, the approved Contractor's Drawings, and the Operation and Maintenance Manuals for each item of equipment or system.
 - b. This phase of tests must demonstrate that the equipment or system has been installed, rotates when energized, sequences properly, and activates alarms, as required. Neither fluids nor process materials need to be utilized during this phase of testing.
 - c. The quality of workmanship and installation shall be examined for deficiencies which shall be logged in a punch list of items of work to be completed prior to the Prefinal Test. Specific tasks include (as applicable):
 - (1) Conduct adjustment, testing and calibration of all controls, switches, drives, and other instrumentation and control associated with the piece of equipment.
 - (2) Demonstrate that alignment and clearances are properly adjusted.

- (3) Demonstrate that the equipment can be started, operated in all local modes, and stopped locally as required.
 - (4) Verify proper operation of hard-wired interlocks.
 - d. Conduct additional testing required by the manufacturer to verify proper installation of the equipment.
 - e. When local codes or laws require approval and inspection of the work by other agencies or organizations before installation or operation, such approval shall be obtained. Submit one signed original and three copies of the approval to the Engineer.
 - f. In accordance with the Construction Schedule and with approval of the Engineer, schedule the Preliminary Tests a minimum of five (5) days before the Prefinal Tests are scheduled to begin.
 - g. Tests to be provided by the Contractor, and tests to be provided by an Independent Testing Company, shall be performed, and recorded prior to the Preliminary Tests in order to avoid delays of the scheduled testing procedures.
- 2. Prefinal Test
 - a. The purpose of this phase of tests is to demonstrate that all equipment and systems have been installed in accordance with the Contract Documents, Operations and Maintenance Manuals, and the Contractor's Drawings which have been approved; all integrated equipment and systems operate as complete units; all punch list items developed in the Preliminary Tests have been corrected and the results of this Test shall contribute toward a unanimous, satisfactory recommendation from the Owner Inspection, Operations, and Maintenance personnel that the system is ready for Start-up.
 - b. Specific tasks include (as applicable):
 - (1) Demonstrate proper operation of the equipment in Local mode under actual or simulated operating conditions for a set period of time.
 - (2) Simulate alarm conditions to demonstrate operation of hard-wired interlocks.
 - (3) Complete vibration testing (if required).
 - (4) Check equipment for:
 - Overheating
 - Excessive vibration
 - Excessive noise
 - Overcurrent
 - (5) Confirm operation of Emergency Stop / Lockout

- (6) Demonstrate proper operation of automatic controls, if supplied by the manufacturer.

3. Startup Tests

- a. The purpose of this phase of tests is to demonstrate that the unit process within a system operate together to perform the required functions for an extended period of time, under actual operating conditions, with process liquids and chemicals. In addition, this test will verify that all systems and elements of the Work are fully operational and ready to be turned over to the Owner.
- b. Deficiencies noted in the Prefinal Tests shall be corrected before starting the Startup Tests.

4. Record Forms

- a. Test data record forms shall be provided for each system and item of equipment tested. The form and format of the forms shall be submitted for approval. Completed test forms shall contain the following minimum identifications, data, and quality.
- b. Project identification.
- c. Test stage identification, Preliminary or Prefinal.
- d. Sequence number of the test, i.e., First Test, Second Test...Final Test.
- e. Date test began, and date when completed.
- f. Identification of testing facility, e.g., Contractor, Independent Testing Co., Manufacturer.
- g. All data shall be typewritten or neatly hand lettered, not long hand, and shall clear and bold to permit photocopying without loss of clarity.
- h. All test data record forms, or the Title Sheet of a multiple page test report shall bear the signature of the person conducting the tests or the chief person of a test team. Signatures shall be augmented by typewritten or digital facsimiles.

1.4 TEST EQUIPMENT

- A. All test instruments, gauges, meters, and auxiliary equipment shall be provided by the Contractor and the Independent Testing companies and, where required, by manufacturers field service personnel. All test equipment must have been tested and calibrated within 6 months of their use under this contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PREREQUISITE ACTIVITIES

- A. Unless specified otherwise, perform the following prerequisite items of work, prior to beginning Preliminary Tests:
 - 1. Verify that there is no visible corrosion or mechanical damage to the equipment.
 - 2. Verify that all mountings are secure and level, all piping attached, all belts and drives are installed and tensioned correctly, and all safety features are in place.
 - 3. Verify that all control and power circuits to the equipment are energized.
 - 4. Bump motors to verify correct rotation.
 - 5. Perform megger tests on all motors and electrical equipment.
 - 6. Verify operation of valves.
 - 7. Inspect valving and verify proper open or shut positions.
 - 8. Check all feed and drain lines.
 - 9. Deliver manufacturer's Certifications and Contractor Compliance Forms in accordance with Section 01 33 00.
 - 10. Verify that all equipment has been properly lubricated in accordance with manufacturer requirements.
 - 11. Other activities as specified in this Section.
- B. Unless specified otherwise, perform the following items of work prior to beginning Prefinal Tests:
 - 1. Correct punch list items from Preliminary Test.
- C. Unless specified otherwise, perform the following items of work prior to beginning the Start-up Tests:
 - 1. Correct punch list items from Prefinal Test.
 - 2. Verify that adequate chemicals and/or process liquids are in place for the respective equipment and systems.
 - 3. Verify that equipment, piping, tanks, sumps, or wet wells do not leak when filled with clear potable water.

4. Complete disinfection procedures as required for potable water systems.
5. Complete all training activities required for each system, facility, and equipment.
6. Complete all SCADA testing including demonstration of remote/auto programs for all systems and processes.

3.2 START-UP TESTING

- A. All equipment, piping, structures, and facilities associated with the systems identified above shall satisfactorily complete Prefinal testing and associated deficiencies shall be corrected before Start-up testing shall begin. All costs associated with start-up testing or re-testing shall be the responsibility of the Contractor.

3.3 ACCEPTANCE OF THE WORK AND SPECIFIC TESTS

- A. The Owner will accept each system and process after successful completion of each Startup Test and 30 days operational period is complete. Failures resulting from mechanical, electrical or process performance will be corrected at the Contractors expense and the 30-day operational period will be repeat until such time as the 30-day operational period has successfully been completed without failures.

END OF SECTION

MANUFACTURERS CERTIFICATE OF PROPER INSTALLATION

**PROJECT NAME: HALL COUNTY - SPOUT SPRINGS WATER RECLAMATION
FACILITY, EXPANSION TO 1.6 MGD**

THE UNDERSIGNED HEREBY ATTESTS THAT HE HAS EXAMINED THE EQUIPMENT
INSTALLATION AND THE INSTALLATION IS IN ACCORDANCE WITH THE
MANUFACTURERS RECOMMENDATIONS.

EQUIPMENT: _____
MANUFACTURER: _____
ADDRESS: _____

By: _____
(Type Name and Title)
_____/s/_____
(Signature) (Date)

CERTIFICATE MUST BE SIGNED BY A REPRESENTATIVE (START-UP TECH, FIELD SERVICE
REPRESENTATIVE, ETC.) OF THE EQUIPMENT MANUFACTURER. IN THE EVENT THE
MANUFACTURER IS NOT THE SUPPLIER, THEN A PRINCIPAL PERSON OF THE SUPPLIER
MUST ALSO SIGN THIS FORM.

SUPPLIER: _____
ADDRESS: _____

By: _____
(Type Name and Title)
_____/s/_____
(Signature) (Date)

**SECTION 01 79 01
MANUFACTURER’S FIELD SERVICES AND TRAINING**

PART 1. GENERAL

1.1. DESCRIPTION

- A. Provide the manufacturer’s services for installation supervision, inspection of equipment installation and training required by these Contract Documents.

1.2. SUBMITTALS

A. Training Plan

- 1. Submit within fourteen (14) days after training coordination meetings.

B. Training Materials

- 1. Submit written outlines for each training session.
- 2. Furnish complete training materials, including operation and maintenance data.

1.3. MANUFACTURER FIELD SERVICES

- A. Provide manufacturer’s trained representative to provide installation supervision as identified in specific Sections of these specifications.
- B. Provide manufacturer trained representative to inspect equipment installation, assist with equipment start-up and testing in accordance with Section 01 79 00.

1.4. TRAINING REQUIREMENTS

- A. Manufacturer’s qualified representative shall conduct training.
 - 1. Consider the time required to perform specified services in excess of that stated in the Specifications as incidental work.
- B. Schedule manufacturer’s onsite services to avoid conflicts with others working onsite.
- C. Ensure that all conditions necessary to allow successful testing are met before scheduling services.
- D. Days of service must be approved by Engineer to fulfill the specified minimum services.
- E. Unless specified otherwise, manufacturer’s onsite services shall include as a minimum:

EXPANSION TO 1.6 MGD

1. Installation assistance which includes observation, guidance, and instruction of the contractor's team during assembly, erection, and installation.
2. Equipment inspection, checking, and adjustment.
 - a. Make equipment function as warranted by manufacturer.
 - b. Manufacturer shall provide written approval of installation.
3. Correct assembly, installation, and operating problems.
 - a. Revisit the site as often as required.
 - b. Make acceptable to Engineer.
4. Train personnel in the proper operation and maintenance of equipment.

1.5. TRAINING SCHEDULE

- A. Begin all training after Prefinal Testing, Section 01 79 00, and complete the training no less than thirty (30) days prior to Startup Testing.
- B. List equipment and systems that require training and show:
 1. Estimated date to complete installation.
 2. Proposed training dates. Allow for multiple sessions as several shifts are involved.
- C. Adjust training schedule when deemed necessary by the Owner to ensure training of appropriate personnel.
 1. Provide full participation by manufacturers' representatives.
 2. Adjust schedule for interruptions in operability of equipment.

1.6. TRAINING PLAN

- A. Training Plan. Submit the following for each course:
 1. Title and objectives.
 2. Training schedule.
 3. Prerequisite training and experience of attendees.
- B. Recommended types of attendees (e.g., managers, engineers, operators, maintenance).
 1. Course description and outline of course content.
 2. Duration.

3. Location (e.g., training center of site).
4. Format (e.g., lecture, self-study, demonstration, hands-on).
5. Instruction materials and equipment requirements.

1.7. TRAINING PERSONNEL

A. Provide experienced and competent personnel to conduct the specified training.

1. Personnel shall be familiar with the operation and maintenance manuals submitted in accordance with Section 01 78 23.
2. Provide both classroom and onsite, hands-on training to plant personnel.
3. Address all aspects of operation and maintenance including systems, subsystems, and components.

B. Training Sessions

1. PowerPoint presentation training is required as part of each training session. The presentation shall depict equipment, controls, and operational techniques.
2. The presentation will be held in a classroom setting. Provide minimum of 30-minute presentation.
3. Provide two (2) digital copies of each presentation to the Owner. Provide “thumb drives” for each copy.
4. Following the presentation, hands-on equipment instruction is required.
5. All digital information to be compatible with Microsoft software.

PART 2. PRODUCTS (NOT USED)

PART 3. EXECUTION (NOT USED)

END OF SECTION

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**SECTION 02 01 00
MAINTENANCE OF PLANT OPERATIONS**

PART 1 GENERAL

1.1 DESCRIPTION

- A. The intent of this Specification is to have the Contractor schedule and perform the Work in a manner such that the Owner can keep the existing WRF treatment plant facilities in continuous dependable operation and meet all regulatory requirements. This Section also presents an outline for the start-up sequence of the new facilities. The Contractor shall adhere to the constraints listed in this Section.
- B. The Contractor shall:
 - 1. Perform all construction necessary to complete connections, tie-ins and shutdowns to existing facilities.
 - 2. Keep existing facilities in operation unless otherwise specifically permitted in these Specifications or approved by the Owner.
 - 3. Perform all construction activities so as to avoid interference with operations of the facility and the work of others.

1.2 GENERAL CONSTRAINTS

- A. Any temporary work, facilities, roads, walks, protection of existing structures, piping, blind flanges, valves, equipment, bypass pumping, line-stopping, temporary generators, temporary power, temporary equipment, etc. that may be required within the Contractor's work limits to maintain continuous and dependable plant operation shall be furnished by the Contractor at no extra cost to the Owner.
- B. Sediment control features and other similar requirements shall be in place prior to starting any shutdown work.
- C. If bypass pumping is necessary, the Contractor shall provide 100 percent back-up pump capacity available on-site.
- D. Contractor shall be responsible for any cleanup resulting from spills during the bypass or tie-in operations.
- E. The Contractor shall schedule the Work in such a manner so that the plant is maintained in continuous operation. All shutdowns shall be approved by the Owner. If, in the opinion of the Engineer, a shutdown is not required for the Contractor to perform the Work, the Contractor shall use alternate methods to accomplish the Work. All shutdowns shall be coordinated with and scheduled at times suitable to the Owner. Unless noted otherwise, the Contractor shall provide a minimum of 7 days' notice of any system or partial system shutdown.

- F. Shutdowns shall not begin until all required materials are on-hand and ready for installation and the written shutdown plan has been approved by the Owner. At a time approved by the Owner, the shutdown period will commence, and the Contractor shall proceed with the Work continuously, start to finish, until the Work is completed, and the system is tested and ready for operation. If the Contractor completes all required Work before the specified shutdown period has ended, the Owner may immediately place the existing system back in service.
- G. The Owner shall have the authority to order the Work to be performed during a scheduled shutdown stopped or prohibit Work which would, in his opinion, unreasonably result in stopping the necessary functions of the plant operations. The Owner reserves the right to cancel scheduled shutdowns if conditions warrant.
- H. All operations of existing equipment, valves and gates required for the Work shall be done by the Owner. Owner does not guarantee that valves, stop logs, gates, etc., are or will be 100 percent water or gas tight. Contractor shall provide, at no additional cost to the Owner, all temporary caps, plugs, dewatering, pumping and other measures required to perform the Work.
- I. Insofar as possible, all equipment shall be tested and in operating condition before the final tie-ins are made to connect new equipment to the existing facility.
- J. Owner will require continuous access to all plant operational areas. Gates, roads and pathways required for vehicle and personnel access shall be maintained such that they are serviceable. If construction activities require interruption of normal access to any area, the Contractor shall provide temporary means for the Owner access. Contractor shall coordinate access interruptions with the plant and provide at least 7 days' notice of such interruptions. If vehicle support is required in an area that is blocked by construction activity, the Contractor shall provide such access to the Owner upon request.

1.3 SUBMITTALS

- A. Submit information for each shutdown described herein and all others required to complete the Work. Submittal shall include detailed description of shutdown, shutdown time-line, detailed breakdown of work to be completed prior to and during shutdown, materials required and availability, proposed manpower, proposed method of protecting existing equipment, list of valves, gates and equipment that will require operation by the Owner and any other details to adequately describe the proposed shutdown.
- B. Submittals must be approved before shutdown can begin. Submit information at least 14 days prior to start of proposed shutdown.
- C. General Shutdown Requirements:
 - 1. Pre-Shutdown Meetings shall be held prior to any shutdown. The meetings shall be conducted at least one week prior to the schedule shutdown and the day before the shutdown.

2. Simultaneous shutdowns of more than one facility, except as specifically indicated or allowed by the Owner, will not be permitted.
3. Insofar as possible, all equipment to be incorporated into existing facilities shall be ready for installation before the existing facilities are shutdown.
4. If the work during the shutdown periods is not done satisfactorily, or as planned, or within the time required or approved by the Engineer, the Owner may order the Contractor to work a 24-hour, 7-day week work schedule with a full crew, or he may order the Contractor to place the facility back in service and reschedule the shutdown or, he may order the work required to place the facility back in service done with other forces. If the work is done by other forces, the Owner's costs will be deducted from the amounts due to the Contractor. In no case shall the Owner be required to make additional payment for overtime work or redoing the work caused by the Contractor's failure to complete the work in the allotted time.

END OF SECTION

**SECTION 02 06 13
GEOTECHNICAL REPORT**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Refer to Appendix C for geotechnical information. This information is provided to the Contractor for information only and is not considered part of the Contract Documents. The Contractor may perform separate investigations, at no cost to the Owner, to confirm or provide additional information.

END OF SECTION

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**SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES**

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 01 33 00 Submittals Procedures
- B. Section 03 20 00 Concrete Reinforcing
- C. Section 03 30 00 Cast-In-Place Concrete

1.2 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referenced in the text by the basic designation only. All publications shall be the latest edition.

- 1. American Concrete Institute (ACI):

- 117 – Standard Tolerances for Concrete Construction and Materials.
- 301 – Specifications for Structural Concrete for Buildings.
- 302.1 – Guide for Concrete Floor and Slab Construction.
- 318 – Building Code Requirements for Structural Concrete.
- 347 – Recommended Practice for Concrete Formwork.
- SP-4 – Formwork for Concrete.

1.3 SUBMITTALS

- A. All formwork shop drawings and related computations shall be furnished the Owner's Consultant for record purposes only. Shop drawings shall cover all formwork required. They shall show general arrangement of forms, sizes and grades of lumber, placement; construction and control joints and their method of forming; locations of inserts, tees, sleeves, and other related items. Drawings or descriptions of shoring and reshoring methods proposed for floor and roof slabs, spandrel beams, and other horizontal concrete members shall also be furnished.
- B. Provide product data on hydrophilic and PVC waterstops.

PART 2 PRODUCTS

2.1 CONCRETE FORMS

Formwork shall be designed for loads, lateral pressure and allowable stress in accordance with ACI 301, ACI 347, ACI SP-4. Design, engineering and construction of the formwork shall be responsibility of the Contractor.

- A. Forms shall be of plywood or of tongue and groove lumber and shall be of grade and type suitable to obtain the finish required as recommended in ACI 347 and ACI SP-4. Forms constructed of tongue-and-groove lumber shall be lined when used for exposed surfaces. Form lining, where used, shall be of tempered fiberboard of not less than 1/8-inch thickness. Metal forms, and other types of manufactured forms, shall not be used unless their use has been authorized by the Engineer. Form ties shall be of the cone nut threaded rod, or standard snap tie type, and designed so that when removed no metal will be left closer than 1 inch from the finished wall face. The cavities left in faces of concrete work by removal of form ties shall be pointed up with non-staining, non-shrink mortar. Form ties shall have a working strength of not less than 3,000 lbs. when fully assembled and shall be as approved by the Engineer.
- B. Permanent forms for elevated slabs shall be metal deck forms.
- C. Concrete form release shall be a non-residual, non-staining chemical type form release such as EZ Strip or Debond Form Locating, as manufactured by L & M Construction Chemicals, Inc., or approved equal.

2.2 FORM TIES

- A. Form ties shall be of factory-fabricated, adjustable-length, removable end, permanently embedded body type and shall have sufficient strength and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders.
- B. Form ties shall be designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.
- C. Provide ties that, when removed, will leave holes not larger than 1 inch and no smaller than 1/2 inch in diameter in the concrete surface. Form ties for exposed concrete shall be of the conewasher type. The cones shall be made of approved wood or plastic.
- D. Form ties in structures exposed to hydrostatic pressure and any liquid containment structures shall have waterstops that are an integral part of the form tie and embedded portion of the ties shall terminate not less than 1-1/2 inches from the formed face.
- E. Gang form ties shall be filled from one end with a compressible plug a minimum of 1-1/2 inches from the edge of wall and shall have a bentonite plug in the center of the wall.
- F. Common wire will not be allowed for form ties.

2.3 ACCESSORIES

- A. CHAMFER STRIPS. Unless noted otherwise on the Drawings all exposed corners of beams, columns, walls, slabs, etc. shall have 3/4 inch chamfers including opening for doors, windows, and other similar opening.

- B. ACCESSORIES. Form accessories shall be of commercially manufactured types suitable for the formwork and intended usage.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with Drawings.
- B. All surfaces of forms and embedded materials shall be cleaned of any accumulated mortar or grout from previous concreting.
- C. All items which are to be embedded in concrete and which must be built into formwork shall be located and readied for installation prior to placement of any concrete. Coordinate all items with the various trades.

3.2 INSTALLATION

- A. Construction and erection of formwork shall be in accordance with ACI 347, ACI SP-4 and as specified herein.
- B. All formwork, supports, braces, shoring, etc. shall be of sufficient strength to properly support the concrete, the construction loads, and any superimposed loads and to maintain the work in perfect alignment until the formwork can be safely removed. Forms shall be sufficiently tight to prevent loss of mortar from the concrete. Chamfer strips shall be placed in the corners of forms and on the edges of formed joints to produce beveled edges on permanently exposed surfaces. To maintain the specified tolerances, the formwork shall be cambered to compensate for anticipated deflections in the formwork prior to hardening of the concrete. Positive means of adjustment (wedges or jacks) of shoes and struts shall be provided and all settlement shall be taken up during concrete placing operation. Temporary openings shall be provided at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed. At construction joints, contact surface of the form sheathing for flush surfaces exposed to view shall overlap the hardened concrete in the previous placement by not more than one inch. The forms shall be held against the hardened concrete to prevent offsets or loss of mortar at the construction joint and to maintain a true surface. All forms shall be clean and free of sawdust, dirt and debris before concrete placement.
- C. All items to be embedded in the concrete shall be properly located and braced to the formwork. Blockouts or openings necessary for future work shall be properly built into the formwork. Coordinate the location of embedded items and blockouts with other trades involved in the project. Blockouts shall be approved by the Owner's consultant.
- D. Install waterstops continuous without displacing reinforcement. Heat seal joints watertight.

- E. After cleaning forms and before placing either the reinforcement or the concrete, the surfaces of the forms shall be covered with a coating material that will effectively prevent absorption of moisture and prevent bond with the concrete and will not stain the concrete surfaces. A field-applied form release agent or sealer or a factory-applied nonabsorptive liner may be used. Manufacturer's recommendations should be followed in the use of coatings, sealers, release agents, and liners, but independent investigation by the Contractor of their performance is recommended before use. Where surface treatments and finishes are to be applied to formed concrete surfaces, adhesion of such surface treatments and finishes shall not be impaired or prevented by use of the coating, sealer, release agent, or liner. Excess form coating material shall not be allowed to stand in puddles in the forms, nor shall such coating be allowed to come in contact with hardened concrete against which fresh concrete is to be placed, or with reinforcement.
- F. The Contractor shall set and maintain concrete forms to ensure that, after removal of the forms and prior to patching and finishing, no portion of the concrete work will exceed any of tolerances specified. Variations in floor levels shall be measured before removal of supporting shores. The Contractor shall be responsible for variations due to deflection, when the latter results from concrete quality or curing other than that which has been specified. The tolerances specified shall not be exceeded by any portion of any concrete surface; the specified tolerance for one element of the structure to exceed its allowable variations.
- G. Flush with water or use Compressed air to remove foreign matter from the formwork. Ensure that the water debris drain to exterior through clean-out ports.
- H. During cold weather, remove ice and snow from within forms. Do not use deicing salts or water to clean out forms, unless formwork and concrete construction proceed within heat enclosure. Use compressed air or other, means to remove foreign matter.

3.3 EDGES AND CORNERS

- A. Chamfer strips shall be placed in forms to bevel all salient edges and corners except the top edges of walls and slabs which are to be tooled and edges which are to be buried. Unless otherwise noted, bevels shall be 3/4" wide.

3.4 TOLERANCES

- A. Vertical or Horizontal wall surface tolerances shall be within 1/4" in 10 feet or a maximum of 1" on walls over 40 feet high. Wall thickness tolerances shall be within 1/4" minus or 1/2" plus from plan dimensions.
- B. Slab finish tolerances shall be within 1/8" in 10 feet. Slab thickness tolerances shall be within 1/4" minus or 1/4" plus from plan dimensions.
- C. Anchor bolt placement shall be within 1/8-inch center to center of any two anchor bolts in a group, within 1/4 inch center to center of adjacent groups, and 1/4 inch within specified elevation.

3.5 FORM REMOVAL

- A. Forms shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead and live loads. Care shall be taken in form removal to avoid surface gouging, corner or edge breakage, and other damage to the concrete.
- B. Forms shall not be removed until the member supported thereby has acquired sufficient strength to safely support its own weight, and the load imposed on it. Tie rod clamps shall be loosened 24 hours after concrete has been placed. Standard snap ties shall be removed when forms are stripped; care shall be taken to avoid spoiling concrete surface. Cutting ties back from the face of the wall will not be permitted. Under normal conditions, the time elapsing before the forms may be stripped shall be not less than that shown in the following schedule from the completion of the concrete pour: the use of the schedule shall not relieve the Contractor from his responsibility for the safety of the structure. Wood forms shall be completely removed from all portions of the work so that no material will remain for termite infestation.
 - 1. Slab Edges on Grade: 2 Days
 - 2. Columns and Pedestals: 7 Days
 - 3. Walls and Vertical Faces Not Supporting Other Work: 2 Days
 - 4. Beams and Elevated Slabs: 14 Days
- C. In no case shall forms for wall or columns be removed in less than 24 hours from the completion of the pour. Form work supporting weight of concrete, such as beams and elevated slab shall remain until the concrete has attained a minimum of 80% of the 28 day design strength.

END OF SECTION

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**SECTION 03 20 00
CONCRETE REINFORCING**

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 01 33 00 Submittals Procedures
- B. Section 03 10 00 Concrete Forming and Accessories
- C. Section 03 30 00 Cast-In-Place Concrete

1.2 SCOPE

- A. The work covered by this Section of Specifications consists of furnishing all materials and equipment and performing all labor necessary for furnishing and installing all reinforcing steel, as indicated on the Drawings, as specified, and as required for completion of all work under this Contract.

1.3 SUBMITTALS

- A. The Contractor shall furnish to the Engineer, for checking and approval, the reinforcing steel schedules including bending and placing details for reinforcing steel which shall show bar size, spacing, bending, tagging identification, special details, and placement drawings. Create rebar shop drawing in accordance with ACI 315 latest edition. No manufacture or fabrication shall commence until such drawings have been approved.

1.4 PRODUCT HANDLING

- A. Delivery: Deliver reinforcement to the job site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- B. Storage: Store reinforcement above the surface of the ground upon wooden platforms, skids, or other supports in a manner which will prevent damage and accumulation of dirt, excessive rust, and surface deterioration. The surface of the ground beneath all stored reinforcement shall be covered with plastic sheeting to further assure isolation from dirt and dust.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Reinforcing steel shall be furnished by domestic steel mills.
- B. Reinforcing bars: Comply with ASTM A615.
- C. Welded wire fabric: Comply with ASTM A185.

- D. Supports for reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place:
 - 1. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, and other unacceptable materials.
 - 2. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support legs.
 - 3. 3. For exposed to view concrete surfaces, where legs of supports are in contact with forms, provide supports with either hot dip galvanized or plastic protected legs.

2.2 FABRICATION

- A. General: Fabricate reinforcing bars to conform to required shapes and dimensions as indicated on the Drawings, with fabrication tolerances complying with CRSI Manual. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material.
- B. Steel bar reinforcement shall be cold bent to shapes indicated on the Drawings. Bending shall be done in the shop before shipment unless otherwise specified. Bending details for steel bar reinforcement shall conform to the requirements of the ACI Building Code (ACI 318 latest edition) unless otherwise indicated on the Drawings or specified. Steel bar reinforcement shall be bent, bundled, and tagged in accordance with details furnished by the fabricator.
- C. Steel bar reinforcement shall be furnished full length unless otherwise indicated on the Drawings or approved by the Engineer. Splices, where permitted, shall be well distributed or located at points of low tensile stress. Splices and dowels, except when used in cantilever wall or slab construction shall lap not less than 30 times the diameter of the bar. Splices and dowels used in cantilever wall or slab construction shall lap 40 diameters. Splices in horizontal reinforcement shall be staggered. The minimum clear distance between spliced bars, except when bar clamps are specified, shall be 1 1/2 bar diameters, but in no case less than 1 inch, nor less than 1 1/2 times the maximum size of coarse aggregate.
- D. Hooks of 180 degrees shall have a radius of bend on the axis of the bar of not less than three bar diameters plus an extension of four bar diameters at the free end. Hooks of 90 degrees shall have a radius of bend on the axis of the bar of not less than four bar diameters plus an extension of twelve bar diameters at the free end.
- E. Unacceptable Materials: Reinforcement with any of the following defects will not be permitted in the Work.
 - 1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
 - 2. Bend or kinks not indicated on Drawings or final Shop Drawings.
 - 3. Bars with reduced cross section due to excessive rusting or other cause.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine the foundation, formwork, and the conditions under which concrete reinforcement is to be placed, and correct conditions which would prevent proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General

1. Comply with the specified standards for details and methods of reinforcement placement and supports, and as herein specified.
2. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
3. Position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers as required.
4. Place reinforcement to obtain the minimum coverage for concrete protection. Arrange, space, and securely tie bars and bar supports together with 16 gage wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
5. Install welded wire fabrics in as long lengths as practicable. Lap adjoining pieces at least one full mesh.
6. Provide sufficient numbers of supports and of strength to carry reinforcements. Do not place reinforcing bars more than 2" beyond that last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
7. Place reinforcing steel in the locations shown on the Drawings and held securely in place during the placing of concrete. The pushing of short bars into new concrete work will not be permitted. Bar reinforcing in walls shall be spaced the proper distance from the face of the wall by the use of approved rebar support. Bar reinforcing in slabs or beams shall be spaced the proper distance from the bottom of the slabs or beams by use of approved precast concrete mortar blocks or stainless steel chairs. Vertical stirrups shall always pass around main tension members and be securely attached thereto. Bar spacing, covering, minimum clearance, bond and anchorage shall conform to the requirements of the ACI Building Code (ACI 318) latest edition, except as otherwise indicated on the Drawings or specified.

8. Prior to the placing of concrete, all mortar and other foreign matter which may reduce or destroy bond shall be removed from the reinforcement. No concrete shall be deposited until the placement of the reinforcing has been approved by the Engineer.

3.3 BAR COVER

- A. Reinforcing bars shall be fabricated, tied, and supported to ensure a protective concrete cover as shown on the structural drawings.

3.4 LAP SPLICES

- A. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying. See splice schedule on Drawings. Bars marked continuous shall be lapped as required by splice schedule, and at corners, corner bars shall be provided.

3.5 OPENINGS IN CONCRETE

- A. Openings 12 inches and larger through concrete walls and slabs shall have a minimum of 8 extra diagonal bars in each face of the wall or slab of the same size as the largest bar in the wall or slab. The length of extra diagonal bars at openings shall be as shown on the Drawings, or as directed by the Engineer.

3.6 MISCELLANEOUS

- A. Concrete walls, slabs, and other concrete work shown on the Drawings to have no reinforcing, shall have a minimum area of steel bar reinforcing equal to 0.003 times the cross sectional area of the concrete work.

END OF SECTION

**SECTION 03 30 00
CAST-IN-PLACE CONCRETE**

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 03 10 00 Concrete Forming and Accessories
- C. Section 03 20 00 Concrete Reinforcing

1.2 SCOPE

- A. The work covered by this Section consists of furnishing all materials and equipment and performing all labor necessary for the complete construction of all cast-in-place concrete work as shown on the Contract Drawings and as specified.
- B. The work shall include the installation of all sleeves, inserts, piping, hangers, anchors, frames and all other items to be built into the concrete work and all other work and appurtenances, for proper execution of the work.
- C. All items of work shall be inspected and approved by the Engineer before any concrete is placed.

1.3 GENERAL REQUIREMENTS

- A. Concrete shall be composed of cement, fine aggregate, coarse aggregate, and water proportioned and mixed to produce a plastic workable mix in accord with the requirements of this Section.
- B. Concrete shall be classified as Class "A" or "B"; shall have normal setting characteristics; shall have 28 day compressive strengths (two-cylinder average strength) not less than those listed below. High early strength cement may be used under special conditions and its use must be approved by the Engineer. Concrete containing high early cement shall have a 7 day compressive strength not less than those listed below.
 - 1. Class "A" concrete shall have a compressive strength of not less than 4,000 psi and shall be used for all reinforced concrete work, unless otherwise indicated.
 - 2. Class "B" concrete shall have a compressive strength of not less than 3,000 psi and shall be used for concrete duct bank, pipe thrust block and all other work as indicated on the Drawings.
- C. Concrete shall comply with all provisions of ACI 350-01, or latest edition.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Admixture shall be added to Class "A" and Class "B". The admixture shall be Master Builders' "Pozzolith", or approved equal, and shall be added in accord with the admixture manufacturer's printed instructions. A standard dispenser shall be used to introduce the admixture into the mix, and the services of the admixture manufacturer's representative to install and establish the operation of the dispenser shall be furnished by the Contractor. Plasticizing agents or other moisture reducing agents should be used to increase concrete workability for low W/C ratio mixes. Air-entraining admixtures shall conform to "Specification for Air-Entraining Admixtures for Concrete", ASTM C260.
- B. Fine aggregate shall be natural and consisting of hard, strong, durable, and uncoated particles having fineness modulus of not less than 2.30 nor more than 3.00; variation in fineness modulus shall be limited to +0.20 from the average of all tests. Aggregate shall satisfy the requirements of Federal Specifications SS A 281b, Class 1, Grade A, or ASTM C33, and have gradation as follows:

<u>Sieve Size</u>	<u>Percent Passing, By Weight</u>
No. 4 Sieve	94 to 100
No. 16 Sieve	50 to 85
No. 50 Sieve	10 to 30
No. 100 Sieve	2 to 10

- C. Coarse aggregate shall be washed gravel or crushed stone consisting of hard, strong, durable, and uncoated particles, and shall contain neither vegetable matter nor soft, friable, thin, and elongated particles in quantities considered deleterious by the Engineer. Coarse aggregate shall satisfy the requirements of Federal Specifications SS A 281b, Class 2, Grade A, or ASTM C33; and have gradation as follows:

<u>Sieve Size</u>	<u>Percent Passing, By Weight</u>
1 to 1/2" Sieve	95 to 100
2" Sieve	25 to 60
No. 4 Sieve	0 to 10
No. 8 Sieve	0 to 5

- D. Cement shall satisfy the requirements of ASTM C150; cement for normal Class "A" and "B" concrete shall be Type IA or IIA; cement for high early strength Class "A" concrete shall be Type IIIA. Type III cement shall be used only if its use is approved by the Engineer. In lieu of Type IA, IIA or IIA cement, Type I, II or III cement may be used with approved air entrainment add mixtures as specified below.
- E. Ground granulated blast-furnace slag shall not be used in Class "A" concrete.

2.2 LIMITING REQUIREMENTS FOR CLASS “A” AND CLASS “B”

- A. Total Water Content for Class "A": Total water content of concrete shall not exceed 5.40 gallons of water per hundred pounds of cement in the mix, i.e., W/C less than 0.45 by weight.
- B. Slump for Class "A" and Class "B": Concrete slump shall be kept as low as possible consistent with proper handling and thorough compaction. Unless otherwise authorized by the Engineer, slump shall not exceed 4", before the addition of admixtures.
- C. Air-Entrainment for Class "A": The minimum air-entrainment shall be 5 percent, plus or minus 1 percent.
- D. Total Water Content for Class "B": The total water content of concrete shall not exceed 6.90 gallons of water per hundred pounds of cement in the mix, i.e., water content less than 0.57 by weight.

2.3 DESIGN MIX

- A. Design mix for each classification of concrete to be used in the work shall be prepared and tested by the independent, commercial, testing laboratory selected by the Contractor and approved by the Engineer for the testing of materials. Design mix shall be on the basis of 95% of 28-day two-cylinder averages being greater than the required design strength. The design mix shall be prepared using samples of the cement, admixture (if re-quired), and the aggregates to be used in the work. Not fewer than eight (8) cylinders shall be made from the design mix for each classification of concrete; two (2) shall be tested at 7 days, two (2) tested at 14 days, two (2) tested at 28 days and two (2) shall be tested at 56 days. Cylinders shall be made and tested in accord with ASTM C31 and C39.
- B. If the design mix, based on trial batches, does not have sufficient data to establish a standard deviation, it shall not be considered acceptable if the concrete resulting from the design mix does not produce an average 28-day compressive strength at least 1,200 psi higher than specified for Class A concrete.

2.4 PROPORTIONING

- A. Proportioning of material shall be accomplished in a manner which will produce a workable mixture having a slump within the required limits and having minimum water content.
- B. The exact portion of materials to be used in concrete shall be as determined by the Laboratory Design Mix, and as directed by the Engineer. The equipment necessary to positively determine and control actual amounts of materials entering into the concrete shall be furnished by the Contractor. The proportions of materials used in the mix shall be changed whenever, in the opinion of the Engineer, a change is necessary to obtain the required strength and the desired density for uniformity and workability. In structures intended to be watertight, good workability will be considered to be of primary importance.

- C. All materials shall be measured by weight, except for water, which may be measured by volume. One (1) bag of Portland cement shall be considered to weigh 94 lbs., and one (1) gallon of water to weigh 8.33 lbs.
- D. Cement content for each class of concrete shall be as follows and each cubic yard of concrete shall contain not less than the following quantities:

Class "A"	_____	564 lbs. (6 Bags)
Class "B"	_____	520 lbs. (5.53 Bags)

- E. In calculating the total water content of mixes, the amount of water borne on the surfaces of the aggregate particles shall be included. The amount of water to be used in the mix shall, in all cases, be the least amount necessary to produce a plastic mix having the required strength and the desired density, uniformity, workability, and characteristics within the required slump limits.
- F. The total volume of aggregates to be used in each cubic yard of concrete, and the proportion of fine aggregate to coarse aggregate, shall be that necessary to produce a dense mixture having the required workability, as determined by the Laboratory Design Mix, and as directed by the Engineer.

PART 3 EXECUTION

3.1 MIXING

- A. Concrete may be proportioned and mixed by the Contractor on the job site or may be proportioned and mixed at a central plant.
- B. When concrete is proportioned and mixed at the job site, the Contractor shall provide the equipment necessary to positively determine and control the actual amounts of materials entering into the mix. Mixing shall be done in a batch mixer of approved design and shall ensure a uniform distribution of the material throughout the mass. The entire contents of the drum shall be discharged before recharging. The volume of the mixed material, per batch, shall not exceed the rated capacity of the machine.
- C. The Contractor shall, during the mixing and placing of concrete, have no fewer than two concrete mixers on the site so as to maintain continuity of the placing in the event of mechanical failure of one of the mixers. The mixing of each batch shall continue not less than 1 1/2 minutes after all materials are in the mixer, during which time the mixer shall rotate at a peripheral speed of not fewer than 200 feet per minute.

- D. When concrete is proportioned and mixed at a central plant, plant layout and equipment shall be subject to approval by the Engineer. Concrete shall be proportioned, mixed, and transported under the following conditions:
1. The Contractor shall furnish the services of a representative of an approved testing laboratory, who shall be present at the central mix plant when Class "A" concrete is proportioned and mixed for the work, and shall control proportioning and mixing operations, except when otherwise approved by the Engineer.
 2. Loading tickets shall be initialed by the laboratory representative, and the time of loading stamped thereon. Tickets shall be handed to the inspector upon arrival of the mixer trucks at the job site, and before placing the load.
 3. Concrete shall be transported to the job site in approved mixer trucks, which will mix the concrete en route.
 4. The mixing and handling of ready mix concrete, except as otherwise specified above, shall satisfy the requirements of ASTM C94. In the event the above conditions are not satisfied, the concrete will be subject to rejection.

3.2 BATCHING AND MIXING

- A. Concrete shall be furnished by an acceptable ready mixed concrete supplier and shall conform to ASTM C94.
- B. The consistency of concrete shall be suitable for the placement conditions. Aggregates shall float uniformly throughout the mass and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.
- C. A delivery ticket shall be prepared for each load of ready-mixed concrete. A copy of each ticket shall be handed to the Engineer by the truck operator at the time of delivery. Tickets shall show the quantity delivered, the amount of each material in the ¹ outdoor temperature in the shade, the time at which the cement was added, and the numerical sequence of the delivery.

3.3 PLACING:

- A. Before concrete is placed, the depth and character of the foundations, the adequacy of forms and falsework, and the placing of steel and appurtenant work shall be inspected and must be approved by the Engineer; that approval, however, shall not relieve the Contractor from the responsibility to produce the finished work.

- B. Accumulated water and debris shall be removed from excavations and from form work into which concrete is to be placed; flow of water into those places shall be diverted into side drains or sumps and be removed without disturbing newly placed concrete. Forms, unless lined, shall be thoroughly wetted with water before concrete is placed so as to tighten joints and prevent leakage of the mix. Runways for buggies and wheelbarrows, if used, shall not be supported by form work. Concrete shall be conveyed in a manner which will not disturb forms.
- C. Concrete shall be placed in daylight; placing of concrete in a portion of the work shall not be started if that portion of the work cannot be completed during daylight, unless otherwise specifically approved by the Engineer. That approval will not be given unless an adequate lighting system is provided, and that system is approved by the Engineer.
- D. Concrete shall not be placed when the atmospheric temperature is cooler than 35°F. If, after placing concrete, the atmospheric temperature becomes cooler than 35°F, the Contractor shall enclose, heat, and protect the concrete in a manner which will keep the air surrounding the fresh concrete at a temperature not cooler than 45°F for a period of 5 days after concrete is placed. The Contractor shall assume all risk connected with the cool weather placing and protecting of concrete, and should that concrete be unsatisfactory, it shall be rejected.
- E. Concrete shall be transported from the mixer to the point of deposit with a crane handled bottom dump concrete bucket, with concrete buggies, or with wheelbarrows. In the event the quality of the concrete as it reaches the forms, and the method and placing thereof, in the opinion of the Engineer, is not satisfactory, the Contractor shall change his method of operation so as to place concrete in a manner approved by the Engineer.
- F. Concrete shall be placed in a manner which will prevent the segregating of aggregates, displacing reinforcing, and coating and splattering chutes, and canvas tremies shall be arranged and used in a manner which will ensure that the concrete is placed in the manner specified. The placing of concrete within form work shall be regulated in a manner which will ensure that the pressure within the form work shall not exceed the design pressure of the form work. Concrete shall be placed in continuous horizontal layers, the thickness of which, in general, shall not exceed 12 inches. When placing concrete, each batch and each layer shall be placed immediately following the preceding batch and layer so that there will be no "cold joints" in the work. Care shall be used to fill each part of the forms; concrete shall be deposited to as near final position as possible. After concrete has taken its initial set, care shall be used to avoid jarring the form work and placing strain and vibration on the ends of projecting concrete reinforcements. If concrete must be dropped more than five feet (5'), it shall be deposited through a tremie.

- G. Concrete when placed shall be compacted with mechanical, internal vibrating equipment supplemented with hand spading with a steel slicing rod. Vibrating shall not be used to transport concrete within forms. Vibrating equipment shall maintain an impulse rate of not less than 5,000 impulses per minute, when submerged in concrete. Not less than one (1) spare vibrator shall be maintained on the job site as a relief. The duration of vibration shall be limited to that necessary to satisfactorily consolidate the concrete without causing objectionable segregation. The vibrator shall not be inserted into lower layers which have begun to set.
- H. Thin section work shall be thoroughly worked with a steel rod; faces shall be shaped, and mortar flushed to the surface of the form. Small diameter holes shall be drilled in form work beneath large wall sleeves and inserts to prevent the entrapment of air beneath those sleeves and inserts when concrete is placed.
- I. Concrete shall be placed and compacted in a manner which will form a dense, compact, impervious structure having smooth faces on exposed surfaces. Concrete found to be porous, plastered, and otherwise defective, in the opinion of the Engineer, shall be removed and replaced in whole, or in part, as directed by the Engineer, at no additional expense to the Owner.

3.4 CONSTRUCTION JOINTS

- A. Surface of concrete construction joints shall be cleaned and laitance removed.
- B. Immediately before new concrete is placed, all construction joints shall be wetted and standing water removed.
- C. Construction joints shall be located where shown and were directed by the Engineer. Concrete shall be placed continuously between construction joints so that the unit will be monolithic in construction. Not less than 72 hours shall elapse between casting of adjoining units, unless otherwise approved by the Engineer.
- D. Construction joints in footings and walls, required for proper execution of the work, but not shown on the Drawings shall be located where directed by the Engineer, and across regions of low shearing stress so as to least impair the strength and appearance of the work. Special provisions shall be made for joining successive units as shown and as directed by the Engineer.
- E. Construction joints in slabs, required for proper execution of the work but not shown on the Drawings, shall be located where directed by the Engineer. Special provisions, including concrete footings for construction joints in slabs on earth shall be made for joining successive units, as shown and as may be directed by the Engineer.
- F. Keys shall be constructed in construction joints where shown, and as directed by the Engineer. Keys and water stops shall be placed in those construction joints which will be subject to water pressure.

3.5 EXPANSION JOINTS

- A. Expansion joints shall be constructed as detailed on the drawing and in the locations shown.

3.6 BONDING

- A. The surfaces of recently poured concrete work shall be thoroughly roughened and made free from all foreign matter and latence, the forms placed and tightened, and the surfaces of that concrete slushed with grout before placing new concrete work. New concrete shall be placed before grout has attained its initial set; bonding work shall be accomplished in a manner which will ensure complete bonding. Two to four inches (2" 4") of grout shall be applied to construction joints.

3.7 FINISHING

- A. Exterior concrete surfaces shall be finished to levels not shallower than 12 inches below finish grade levels; interior concrete surfaces and concrete surfaces exposed to view shall be finished.
- B. Interior of basins shall be finished to a level not less than 12 inches below water level. Concrete not exposed to view shall have edges tooled off and shall be pointed and spot finished to fill irregularities. Concrete to be painted or waterproofed shall be finished.
- C. When concrete has set sufficiently to permit, forms and form ties shall be carefully removed. Depressions resulting from removal of form ties, and other holes and rough places, shall be thoroughly wetted with water and pointed with non-staining, non-shrink sand cement mortar.
- D. After pointed surfaces have sufficiently set, surfaces specified to be finished shall be kept wet with water and shall be rubbed with a carborundum stone of medium fineness, or other equally as good abrasive, to bring the surface to a smooth texture and to remove all form and other marks. The paste formed by the rubbing may be rubbed down by floating with a canvas, carpet faced, or cork float, or may be rubbed down with dry burlap.
- E. Recesses from form ties shall be filled flush with mortar. Fins and other surface projections shall be removed from all formed surfaces except exterior surfaces that will be in contact with earth backfill.
- F. Slabs, pavement, curbs, and other unformed surfaces shall be screeded and given an initial float finish followed by additional floating or belting. Unformed surfaces shall be given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float, or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance with no unnecessary working on the surface.
- G. Initial floating shall be followed by belting or a second floating at the time of initial set. The belting or second floating shall produce a finish of uniform texture and color. The completed finish for unformed surfaces shall be the finish produced by the belting or second floating.

3.8 CURING AND PROTECTING

- A. Concrete shall be protected from loss of moisture by water saturation or membrane curing for at least 7 days after placement.
- B. Water saturation of concrete surfaces shall begin as quickly as possible after initial set of the concrete. Unformed surfaces shall be covered with polyethylene film, tarpaulins, or sand to retain the water. Water shall be applied as often as necessary to keep the concrete saturated for the entire curing period.
- C. Two (2) coats of an acrylic copolymer solution may be used in lieu of water curing. The curing compound shall be Dress & Seal, as manufactured by L & M Construction Chemicals, Inc., or another approved equal. When the concrete surface is to have another surface applied to it, L & M cure shall be used. All curing membranes shall be applied in strict accordance with the manufacturer's recommendations.
- D. Concrete shall be protected against freezing for at least 7 days after placement.

3.9 WATERTIGHTNESS

- A. Concrete required to be watertight shall be proportioned, mixed, and placed in strict accordance with this Section.
- B. All concrete structures for holding and transporting water, and pits below ground level, shall be tested and shall be watertight; a drop in the water level of more than 1 1/4" in 24 hours will not be permitted when water holding structures are filled. All exposed surfaces of water holding structures and interiors of pits below groundwater level shall be free from visible damp spots and seepage before acceptance.

3.10 SILICONE JOINT SEALANT

- A. Provide silicone joint sealant that exceeds both Federal Specifications TT-S-001543A Class A (one-part silicone sealants) and TT-S-00230C Class A (one-component sealants) that were written for construction sealants requiring extremely high movement capability.
- B. Install silicone joint sealant in accordance with manufacturer's recommendations.
- C. Dow Corning 7888 meets the above specifications and is represented locally by Fred R. Hiller Company (770) 451-4551.

3.11 BACKER ROD

- A. Provide cylindrical flexible sealant backings composed of closed cellular material, as defined in ASTM C1330 for use with cold applied sealants.
- B. Install in accordance with manufacturer's recommendations.

- C. HBR7, manufactured by Nomaco, Inc., meets the above specifications and is represented locally by Fred R. Hiller Company (770) 451-4551.

3.12 IMPERFECT AND DAMAGED WORK

- A. All imperfect and damaged work shall be satisfactorily removed; new work and materials, which are in accordance with the requirement of the Drawings and construction Specifications shall be furnished and installed at no additional expense to the Owner. Removal of concrete work and installation of subsequent work and materials shall be accomplished in a manner which will not impair the strength of the structure.

3.13 REPAIRING DEFECTIVE CONCRETE

- A. Defects in concrete surfaces, such as honeycombs or cracks, shall be repaired to the satisfaction of the Engineer.
- B. Concrete repair work shall conform to Chapter 9 of ACI 301 and shall be performed in a manner that will not interfere with thorough curing of surrounding concrete. Repair work shall be adequately cured.

3.14 CLEANING UP

- A. Upon completion of work, all forms, equipment, protective covering and rubbish resulting there from shall be removed from the premises. Finished concrete surfaces shall be left in a condition satisfactory to the Engineer.

3.15 CONCRETE FLOORS AND SLABS

- A. All piping which will be under floors and slabs shall be tested and retested until there are no leaks before constructing concrete slabs.
- B. The subgrade for slabs on earth shall provide a solid bearing and shall be brought to a true and even plane. Where floor drains occur, floors shall be pitched thereto, as shown. The concrete shall have a comparatively dry consistency, and shall be screeded level, or to the proper grade. After compacting and vibrating the concrete, the surface shall be prepared to receive the specified finish. All floors, walks, platforms, stairs and other slab work shall have a wood float finish. Settling basin and tank floors shall have a smooth steel troweled finish. After screeding to the required grade while the concrete is still green, but has hardened sufficiently to bear the finisher's weight, the concrete surface shall be floated with wood float to a true and even plane, have no visible coarse aggregate, and be sufficiently rough to prevent slipping.

3.16 STORAGE

- A. Cement shall be stored in suitable moisture-proof enclosures. Cement which has been caked or lumpy shall not be used.

- B. Aggregates shall be stored so that segregation and the inclusion of foreign materials are prevented. The bottom 6" of aggregate piles in contact with the ground shall not be used.
- C. Reinforcing steel shall be carefully handled and shall be stored on supports which will keep the steel from contact with the ground.

3.17 SAMPLING AND TESTING

- A. Cement aggregates shall be tested by a recognized testing laboratory which has been selected by the Contractor and accepted by the Engineer. The testing laboratory shall prepare written reports of such tests which shall certify that the material covered by the report complies in all respects with these Specifications. The tests and reports shall be made on each shipment of cement and on each bin or stockpile of aggregates used in the work. When aggregate is being furnished from the same source, tests subsequent to the initial tests may be suspended when specifically, authorized by the Engineer. These tests, however, may be resumed when requested by the Engineer. When specifically authorized by the Engineer, mill test certificates shall be submitted for cement shipments. Certified test reports and certificates shall be submitted to the Engineer in duplicate.
- B. The Contractor shall determine the source, kind and quality of cement and aggregates to be used in the work well in advance of the scheduled start of the work, in order to permit proper sampling and testing. He shall be fully responsible for delays in the progress of the work due to delays in sampling, testing and reporting on cement or aggregates. No cement or aggregates shall be incorporated in the work prior to receipt and acceptance of certified test reports or certificates by the Engineer. The cost of sampling and testing cement aggregates will be borne by the Contractor.
- C. Concrete cylinder for testing purposes shall be made in accord with the procedure described in ASTM C31. Compression tests shall be made at the age of 7 days, 14 days and two (2) at 28 days by the testing laboratory in accord with the procedure described in ASTM C39, and as required by the Engineer. After beginning work, the number of tests shall be as listed in the following table but shall not be less than one for each type of concrete for each pour. Each test shall consist of at least 8 specimens. Two (2) cylinders shall be held in reserve and tested at 56 days, if required.

<u>Total Cu. Yds. Concrete Placed</u>	<u>Minimum Number of Tests</u>
1 to 1/2" Sieve	95 to 100
2" Sieve	25 to 60
No. 4 Sieve	0 to 10
No. 8 Sieve	0 to 5

- D. Slump test of concrete shall be made in the field by the Contractor for each pour with an accurately made sheet iron test cone, and in accord with the procedure described in ASTM C143. The slump of concrete shall be not less than 3 inches, or more than 4 inches, before the addition of admixtures.

END OF SECTION

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**SECTION 03 62 00
NON-SHRINK GROUTING**

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 03 10 00 Concrete Forming and Accessories
- C. Section 03 20 00 Concrete Reinforcing
- D. Section 03 30 00 Cast-In-Place Concrete

1.2 GENERAL

- A. The work covered by this Section of the Specifications consists of furnishing all equipment, materials, labor, and performing all operations required for the installation of non-shrink cementitious grouts at locations shown on the Contract Drawings or as directed by the Engineer.
- B. Non-shrink cementitious grouts are used for static and low dynamic loading associated with column baseplates, sole plates, pumps, anchor bolts or in areas in conjunction with high operating temperatures.
- C. The following codes and standard specifications establish the minimum requirements for cementitious grouts. Referenced test methods, specifications and recommended practices are to be used to verify material properties and identify acceptable practices applicable to cementitious grouts:
 - 1. ASTM C109 Standard Test Method for Compressive Strength of Hydraulic-Cement Mortars (using 2 in or 50 mm cube specimens)
 - 2. ASTM C230 Standard Specifications for Flow Table in Tests of Hydraulic Cement
 - 3. ASTM C827 Standard Test Method for the Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
 - 4. ASTM C1090 Test Method for Measuring Change in Height of Cylindrical Specimens from Hydraulic-Cement Grout
 - 5. ASTM C1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
- D. Submittals: The Contractor must submit the manufacturer's literature and certified test data to the Engineer prior to installation. The Engineer may choose to buy any submitted material in the open market at the Contractor's expense, without the Contractor or manufacturer's

knowledge, and test the material at an independent lab to verify compliance with this Specification.

- E. Delivery, Storage and Handling: All materials shall be delivered to the job site in original, unopened packages, clearly labeled with the manufacturer's identification and printed instructions. All cementitious materials shall be stored and handled in accordance with the recommendations of the manufacturer and the American Concrete Institute.
- F. Project/Site Conditions: Refer to the manufacturer's literature or contact the manufacturer directly for any physical or environmental limitations required by the project.
- G. Warranty: The material manufacturer shall warranty that the non-shrink grout shall never go below its initial placement volume when tested in accordance with ASTM C827.
- H. Grout shall be Five Star7 Grout, Five Star7 Grout 100 or Five Star7 Instant Grout as manufactured by Five Star Products, Inc. Fairfield, CT (203)336-7900. No like, equivalent, or "or equal" items or no substitution is permitted.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Non-shrink cementitious grout shall be a pre-proportioned product packaged according to ASTM C1107 requiring only the addition of potable water and shall not contain metallic substances or aluminum powder.
 - 1. Dimensional Stability/Compressive Strength: The grout shall meet the requirements of ASTM C1107 Grade C, when prepared according to manufacturer's instructions and tested at 40°F and 90°F (5°C and 32°C).
 - 2. Placability: The grout shall be capable of maintaining at least a flowable consistency for a minimum of 45 minutes at 70°F (21°C) measured under ASTM C230, using 5 drops in 3 seconds.
 - 3. Mixing Water: Water shall be clean and free of oils, acids, alkalis, organics and other deleterious materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Inspect concrete surfaces to receive grout and verify that they are free of ice, frost, dirt, grease, oil, curing compounds, paints, impregnations and all loose material or foreign matter likely to affect the bond or performance of the grout.
- B. Inspect the baseplate or anchor system for rust, oil and other deleterious substances that may affect the bond or performance of the grout.

- C. Confirm newly placed concrete has been cured sufficiently to attain its design strength and limit further shrinkage.

3.2 PREPARATION

- A. Roughen all concrete surfaces by sandblasting or other mechanical means to assure bond. Loose or broken concrete shall be removed.
- B. All grease, oil, dirt, curing compounds, latence and other deleterious materials that were identified in the inspection process shall be completely removed from the concrete and bottom of baseplate.
- C. Concrete surfaces shall be saturated with water.
- D. All standing water shall be removed just prior to placement of grout.
- E. Forms for grout shall be built of materials with adequate strength to withstand the placement of grout.
- F. Forms for grout shall be watertight. An approved form release agent shall be used for easy form release.
- G. Forms shall be 4 to 6 inches (100 to 150 mm) higher than the baseplate on one side of baseplate when using hydrostatic head pressure for placement.
- H. Air relief holes a minimum of 2" (6 mm) in diameter must be provided when required by the baseplate configuration to minimize the amount of air entrapped under the plate.

3.3 INSTALLATION

- A. Grout shall be mixed in accordance with manufacturer's recommendations. Carefully read and understand the manufacturer's instructions as printed on each unit.
- B. A mortar mixer with moving blades shall be used for mixing of grout. A wheelbarrow and a mortar hoe are acceptable for smaller quantities. Pre-wet the mixer and empty excess water before mixing begins.
- C. Non-shrink cementitious grout shall be added to a premeasured amount of water that does not exceed the manufacturer's maximum.
- D. Mix the cementitious grout for 3 to 5 minutes for uniform consistency.
- E. Grout may be dry packed, flowed or pumped into place. All grouting shall take place from one side of a baseplate to the other to avoid trapping air.
- F. Retempering of grout by adding more water after stiffening is not permitted.
- G. Hydrostatic head pressure shall be maintained by keeping the level of the grout in the headbox above the bottom of the baseplate. The headbox should be filled to the maximum level and

the grout worked down to top of baseplate.

3.4 CURING

- A. The grout must be cut back to the lower edge of the baseplate after it has reached its initial set. A 45° angle or a vertical cut back is recommended.
- B. Equipment and tools shall be cleaned as recommended by the grout manufacturer.
- C. Grout shall be cured in accordance with manufacturer's specifications and recommendations. It shall be kept moist for a minimum of three days. The method needed to protect the grout will depend on temperature, humidity and wind. Wet burlap, a soaker hose, sun shading, ponding and, in extreme conditions, a combination of methods shall be employed.
- D. Grout shall be maintained above 40°F (5°C) for a minimum of three days or above 70°F (21°C) for a minimum of 24 hours to avoid damage from subsequent freezing.

3.5 FIELD QUALITY CONTROL

- A. Non-shrink cementitious grouts should be tested for the 24-hour compressive strength under ASTM C109.

END OF SECTION

**SECTION 04 22 00
CONCRETE MASONRY UNIT**

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 07 21 16 Blanket Insulation
- C. Section 07 41 13 Standing Seam Metal Roofing
- D. Section 07 71 23 Gutters and Downspouts
- E. Section 08 11 13 Hollow Metal Doors and Frames
- F. Section 09 91 00 Painting

1.2 DESCRIPTION OF WORK

- A. The extent of each type of unit masonry work is shown on the Contract Drawings.

1.3 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For lines and surfaces of columns, walls and arises, do not exceed 1/4 inch in 10 feet, 3/8 inch in a story height or 20 foot maximum, nor 2 inch in 40 feet or more; except for external corners, expansion joints and other conspicuous lines, do not exceed 1/4 inch in any story or 20 foot maximum, nor 2 inch in 40 feet or more.
- B. Variation from Level: For grades shown for exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4 inch in any bay or 20 foot maximum, nor 1/2 inch in 40 feet or more.
- C. Variation from Linear Building Line: For position shown in plan and related portion of columns, wall and partitions, do not exceed 2 inch in any bay or 20 foot maximum, nor 3/4 inch in 40 feet or more.

1.4 QUALITY ASSURANCE

- A. Applicable standards include, but are not limited to the following:
 - 1. ASTM
 - 2. Southern Brick Institute
 - 3. Brick Institute of America

1.5 MANUFACTURER'S DATA

- A. For information only, submit manufacturer's specifications and other data for each type of masonry unit and accessory required including certification that each type complies with the specified requirements. Include instructions for handling, storage, installation, cleaning procedures and protection of each. Indicate by transmittal that the installer has received a copy of each instruction.

1.6 MANUFACTURER

- A. Obtain masonry units from one manufacturer of uniform texture and color for each kind required, for each continuous area and visually related areas.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Manufacturer's standard units with nominal face dimensions of 16 inches long by 8 inches high (15-5/8 inches by 7-5/8 inches actual), unless otherwise shown or required.
- B. Provide where shown and where required for lintels, corners, jambs, sash, control joints, headers, bonding and other special conditions.
- C. ASTM C90, hollow load bearing concrete masonry units. Unit compressive strength 2,000 psi. Specified compressive strength of masonry, f_m , 1500 psi.
- D. Lightweight aggregate, ASTM C331 having a dry net weight of no more than 105 pounds per cubic foot.
- E. Cure units in a moisture-controlled atmosphere or in an autoclave at normal pressure and temperature to comply with ASTM C90, Type I.
- F. For exposed face, provide manufacturer's standard color and texture, unless otherwise indicated.
- G. Outside Corners: Square edged units except where otherwise indicated.

2.2 MORTAR MATERIALS

- A. Portland Cement: ASTM C150, Type I, except Type III may be used for cold weather protection. Provide natural color cement.
- B. Hydrated Lime: ASTM C207, Type M.
- C. Sand: Sand shall be clean, sharp and uncoated, graded from coarse to fine conforming to ASTM C144, except for joints less than 1/4 inch, use aggregate graded with 100 percent passing the No. 16 sieve.

- D. Submit manufacturer's full range of premixed colored masonry cements for selection.

2.3 CONCRETE INSERTS FOR MASONRY

- A. Furnish dovetail slots with filler strips at every vertical concrete surface abutting masonry work, unless otherwise indicated. Fabricate slots from 24 ga. galvanized steel.
- B. For installation of inserts, see Concrete Sections of these Specifications. Advise concrete installer of specific requirements regarding his placement of inserts which are to be used by the masonry installer for anchoring of masonry work.

2.4 FLASHINGS FOR MASONRY

- A. Provide concealed flashing, shown to be built into masonry.
- B. Concealed flashing material, as indicated on the Contract Drawings, may be:
 - 1. Copper: Meeting ASTM B370-98, cold-rolled temper, minimum 16 oz/SF.
 - 2. Stainless Steel: Minimum 24 ga., AISI type 302/304 alloy, 2B finish.
 - 3. Self-Adhering, Flexible Membrane: W.R. Grace & Co. – Perm-A-Barrier wall flashing.

2.5 REINFORCING BARS

- A. Reinforcing bars shall be as specified in the REINFORCING STEEL Section of these Specifications.

2.6 BOND BREAKER STRIPS

- A. Asphalt roofing felt, 15 pounds, complying with ASTM D226.

2.7 SILICONE SEALANT

- A. Use silicone sealant for all exterior masonry perimeter wall opening joints. Silicone sealant shall be a one-part low modulus silicone rubber meeting ASTM C920-98, Type S, Grade NS, Class 25. It shall have a joint movement capability of + 100% extension, and -50% compression. Products meeting this specification include Dow Corning Corp. 790, and Tremco, Inc. Spectrum 1.

2.8 POLYURETHANE SEALANT

- A. Use polyurethane sealant for caulking inside face of all concrete masonry control joints. Polyurethane sealant shall be a non-sag multi-part sealant meeting ASTM C920-87, Type M, Grade NS, Class 25. Products meeting this specification include: Tremco, Inc. Dymeric, and Pecor-A Corp. Dynatrol II.

2.9 MORTAR BEDDING AND JOINTING

- A. Mortar Mixes: ASTM C270, Type M-below grade, Type N-above grade Proportion Specifications.
- B. Mix mortar ingredients for a minimum of 5 minutes in a mechanical batch mixer. Use water clear and free of deleterious materials which would impair the work. Do not use mortar which has begun to set, or if more than 2-1/2 hours has elapsed since initial mixing. Retemper mortar during 2-1/2-hour period as required to restore workability.
- C. Lay brick and other solid masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.
- D. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells; also bed webs in mortar in starting course on footings and foundation walls and in all cells or cavities to be reinforced or to be filled with concrete or grout.
- E. Joints: Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8-inch joints. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials. Tool exposed joints slightly concave. Rake out mortar in preparation for application of caulking or sealants where shown.
- F. Remove masonry units disturbed after laying; clean and re-lay in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in positions. If adjustments are required, remove units, clean off mortar, and reset in fresh mortar.
- G. Provide weep holes in exterior wythe of cavity wall located immediately above ledges and flashing spaced 16-inches on center unless otherwise shown. Weeps to be weephole ventilators for full head joint – Dur-O-Wall-Cell Vent D/A 1006.

2.10 MASONRY GROUT

- A. Grout for use in masonry construction shall comply with ASTM C476.

PART 3 EXECUTION

3.1 JOB CONDITIONS

- A. Protect partially completed masonry against weather, when work is not in progress, by covering top of walls with strong, waterproof, non-staining membrane. Extend membrane at least 2 feet down both sides of walls and anchor securely in place. Remove misplaced mortar or grout immediately.
- B. No masonry work to be performed when temperature is below 40°F. Protect masonry against freezing when the temperature of the surrounding air is 40°F and falling. Heat materials and provide temporary protection of completed portions of masonry work. Comply with the requirements of the governing code and with the "Construction and Protection

Recommendations for Cold Weather Masonry Construction" of the Technical Notes on Brick and Tile Construction by the Brick Institute of America (BIA).

3.2 INSTALLATION - GENERAL

- A. Build masonry construction to the full thickness shown, except build single-wythe walls (if any) to the actual thickness of the masonry units, using units of nominal thickness shown or specified.
- B. Build chases and recesses as shown and as required for the work of other trades. Provide not less than 8 inches of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.
- C. Cut masonry units with motor-driven saw designed to cut masonry with clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full units without cutting wherever possible.
- D. Wet brick having ASTM C67 absorption rates greater than 0.025 ounce per square inch per minute. Determine absorption by drawing a circle the size of a quarter on typical units and place 20 drops of water inside the circle. Wet brick units only if water is absorbed within 1-1/2 minutes.
- E. Do not wet concrete masonry units.
- F. Do not use frozen materials or materials mixed or coated with ice or frost. For masonry which is specified to be wetted, comply with BIA recommendations. Do not build on frozen work. Remove and replace masonry work damaged by frost or freezing.
- G. Do not lower the freezing point of mortar by use of admixtures or antifreeze agents. Do not use calcium chloride in mortar or grout.
- H. Lay exposed masonry in the bond pattern shown, or if not shown, lay in running bond with vertical joint in each course centered on units in courses above and below. Lay concealed masonry with all units in a wythe bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners, unless otherwise shown. Match coursing, bonding, color and texture of new masonry work with existing work where indicated.
- I. Layout walls in advance for accurate spacing of surface bond patterns, with uniform joint widths and to properly locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.
- J. Lay-up walls plump and true and with courses level, accurately spaced and coordinated with other work.
- K. Stopping and Resuming Work: Rack back 2-masonry unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if specified to be wetted) and remove loose masonry units and mortar prior to laying fresh masonry.

- L. As work progresses, build-in items specified under this and other Sections of these Specifications. Fill in solidly with masonry around built-in items. Fill space between hollow metal frames and masonry solidly with mortar. Where built-in items are to be imbedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
- M. Intersecting Load-Bearing Walls: If carried up separately, provide rigid steel anchors at not more than 2 feet on center vertically. Form anchors of galvanized steel not less than 1-1/2 inch by 1/4 inch by 2 feet long with ends turned up not less than 2 inches. If used with hollow masonry units, embed ends in mortar filled cores.
- N. Non-Bearing Interior Partitions: Build full height of story to underside of structure above, unless otherwise shown.

3.3 INSPECTION

- A. Masonry installer must examine the areas and conditions under which masonry is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to masonry installer.

3.4 HORIZONTAL JOINT REINFORCING

- A. Place continuous wire reinforcement in horizontal joints of all masonry walls and partitions. Install reinforcement at not over 16 inches on center vertically. Provide continuity at corners and intersections using prefabricated ell and tee units. Cut and bend units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls and 2 inch at other locations. Lap reinforcement a minimum of 6 inches at ends of units. Do not bridge expansion joints with reinforcing.
- B. For multi-wythe walls (solid or cavity), use reinforcement unit of correct width to span entire wall thickness less required cover.
- C. Reinforce masonry openings greater than 1 foot wide, with horizontal joint reinforcing placed in 2 horizontal joints approximately 8 inches apart, both immediately above the lintel and immediately below the sill. Extend reinforcing a minimum of 2 feet beyond jambs of the opening.

3.5 VERTICAL MASONRY REINFORCEMENT

- A. Where shown on the Contract Drawings, provide vertical reinforcement of masonry walls. Reinforcement steel to be Grade 60, in accordance with ASTM A615-75 and the REINFORCED STEEL section of these Specifications.
- B. The CMU cells shown to be reinforced shall be filled with grout at the time the unit is laid.

3.6 CONTROL AND EXPANSION JOINTS

- A. General: Provide vertical expansion, control and isolation joints in masonry where shown. Build-in related masonry accessory items as the masonry work progresses. Rake out mortar in preparation for application of caulking and sealants. See 7T - Series sections for sealants and caulking.
- B. Control Joint Spacing: If locations of control joints are not shown, place vertical joints spaced not to exceed 30 feet on center between joints for clay masonry or 35 feet on center for concrete or composite wythes. Locate control joints at points of natural weakness in the masonry work, as approved by the Engineer.

3.7 FLASHING FOR MASONRY WORK

- A. Provide concealed flashings in masonry work as shown. Prepare masonry surfaces smooth and free from projections which might puncture flashing. Terminate flashing 1/4 -inch from face of wall unless otherwise shown. Extend flashings at least 4 inches beyond edge of lintels and sills (if any) and fold ends of flashings up to form pan to direct moisture to exterior. Provide weep holes in the head joints of the first course of masonry immediately above concealed flashings, spaced 16 inches on center unless otherwise shown. Use additional flashing details and installation recommended by manufacturer, including sloped bed.
- B. Install reglets and nailers for flashing and other related work where required to be built into masonry work.
- C. Seal all joints in flashing watertight.

3.8 CAVITIES

- A. Keep clear of mortar droppings and strike plush mortar joints facing cavity.
- B. Provide high density polyethylene woven into a 90% open mesh designed to catch and hold mortar droppings in an irregular pattern. Provide full thickness of cavity directly above through wall flashing, or as indicated on the Contract Drawings. Mortar Net U.S.A. "Mortar Net".

3.9 REPAIR, POINTING AND CLEANING

- A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints at corners, openings and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.
- C. Clean exposed brick masonry surfaces as recommended by BIA Technical Notes 20 "Cleaning Clay Products Masonry". Confirm with manufacturer's requirements.
- D. Clean exposed concrete masonry by dry brushing at the end of each day's work and after final pointing to remove mortar spots and droppings.

END OF SECTION

**SECTION 05 10 00
MISCELLANEOUS METALS**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Provide miscellaneous metal products and metal fabrications, including appurtenances, as specified, and as shown on the Contract Documents.
- B. This Section includes requirements for the following:
 - 1. Miscellaneous structural steel such as used for framing at overhead doors,
 - 2. Castings,
 - 3. Ladders,
 - 4. Stairs,
 - 5. Checkered safety plate,
 - 6. Handrail and railings,
 - 7. Miscellaneous items such as anchors, safety chains, fasteners, hardware, and accessories necessary to complete the work.

1.2 QUALITY ASSURANCE

- A. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.
 - 1. A single manufacturer shall provide all like items.
 - 2. The manufacturer shall be responsible for the design, construction, and proper operation of all components.
- B. Comply with applicable standards including, but not limited to the most recent edition of the following:
 - 1. American Association of State Highway Transportation Officials (AASHTO)
 - 2. American Society for Testing and Materials (ASTM)
 - a. ASTM A27, Steel Castings, Carbon, for General Application
 - b. ASTM A36, Carbon Structural Steel
 - c. ASTM A53, Pipe, Steel, Black, and Hot-Dipped, Zinc-Coated, Welded and

Seamless

3. American Welding Society (AWS)
4. American National Standards Institute (ANSI)
5. American Water Works Association (AWWA)
6. National Association of Architectural Metal Manufacturers (NAAMM)
7. 29 CFR 1910, Occupational Safety and Health Administration (OSHA)

C. Qualifications

1. Welders: Certified in accordance with AWS D1.1-92, Chapter 5.
2. Vinyl Ester and Epoxy Anchor Manufacturers: Experience on at least three similar projects within the last 3 years.
3. Vinyl Ester and Epoxy Anchor Installers: Trained and certified by manufacturer.

D. Welding Procedures: Follow the requirements of AWS D1.1-92 and AWS D1.2-90.

1.3 SUBMITTALS

A. Comply with Section 01 33 00.

B. Submit the following information:

1. Shop drawings:
 - a. Show size, finish, location, required hardware and accessories, and details for all fabricated metal work, threaded fasteners, and welds.
 - b. Show materials, construction and fabrication details, layout and erection diagrams and method of anchorage to adjacent construction.
 - c. Indicate welds, both shop and field, by symbols conforming to AWS Standards.
 - d. Prior to Submittal, coordinate Shop Drawings with related trades to ensure proper mating of assemblies.
 - e. Shop drawings for continually furnished items may be waived
 - (1) Submit a letter naming the manufacturer who will furnish these items
 - (2) Named manufacturer has a certified standard drawing on file with the Engineer that contains the above information, and which has been approved by the Engineer.

2. Setting diagrams, erection plans, templates, and directions for the installation of backing plates, anchors, and other items.
3. Catalog descriptions of manufacturers' standard items. Show illustrated cuts of item to be furnished, scale details, capacities, dimensions, and similar information.
4. Working Drawings and calculations for Contractor designed hatches and gratings.
5. Metal fabrications, including welding and fastener information.
6. Anchors
 - a. Specific instructions for all phases of installation including hole size, preparation, placement, procedures, and instructions for safe handling of anchoring systems.
 - b. Vinyl Ester and Epoxy Anchors
 - (1) Manufacturer's past project experience data
 - (2) Test reports for each batch of vinyl ester or epoxy delivered to site.
 - (3) Current test data indicating that cured adhesive anchors meet or exceed design loads.
7. Welders: Evidence of certification.
8. Signed and sealed calculations for railings and rail accessories.
9. Samples
 - a. Handrail and railing assembly to show joints, bends, toe plate, posts, and anchorage.
 - b. Grating and checkered plates: 8 inches by 8 inches.
 - c. Stair treads and safety nosings, 8 inches long. Include color samples of abrasive nosings.
 - d. Epoxy Anchors: Two (2) self-contained epoxy adhesive cartridges for each batch of epoxy delivered to site, for independent testing.
 - e. Vinyl Ester Anchors: Two (2) self-contained adhesive cartridges for each batch of adhesive delivered to site, for independent testing.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle, and store the equipment in accordance with Section 01 45 34.
- B. Identify and match mark, if applicable, all materials, items and fabrications for installation or field assembly.

- C. Wherever practicable, deliver items to Contract site as complete units, ready for installation. Include all anchors, hangers, fasteners and miscellaneous metal items needed for installation.
- D. Provide adequate storage facilities at the Contract site for the protection and storage of all delivered materials.
 - 1. Handle and store in such a manner as to not damage factory finishes.
 - 2. Repair damaged finishes as required, at no cost to the Owner.

PART 2 PRODUCTS

2.1 MATERIALS – GENERAL

- A. Structural Shapes and Bars
 - 1. Mild steel: ASTM A36, unless otherwise indicated.
 - 2. Corrosion resistant steel: ASTM A242.
 - 3. Stainless steel: ASTM A276, type 316.
 - 4. Aluminum:
 - a. ASTM B221 with alloy and temper of 6061, T6.
 - b. Structural members: ASTM B308 with alloy and temper of 6061, T6.
 - c. Handrail: alloy 6061 or 6063 and temper as provided by the manufacturer.
- B. Plate, Sheet, Strip
 - 1. Mild steel: ASTM A36.
 - 2. High strength steel: ASTM A242.
 - 3. Corrosion resistant steel: ASTM A264.
 - 4. Stainless Steel
 - a. Over 1/8-inch thickness: ASTM A264 and type 316 in accordance with ASTM A240.
 - b. Under 1/8-inch thickness: ASTM A167, type 316.
 - 5. Aluminum: ASTM B209 with alloy and temper of 6061, T6.
- C. Pipe and Tube

1. Mild Steel
 - a. ASTM A53, type S, Grade B, black.
 - b. When Used for Welding: Schedule 40 minimum.
 - c. Handrail posts: Schedule 80 minimum.
2. Stainless:
 - a. Welded: ASTM A312, grade TP 316L, schedule 10S minimum.
 - b. Screwed Connections: ASTM A312, grade TP 316, schedule 40S
 - c. Press Fits: ASTM A312, grade TP 316, schedule 5S minimum.
3. Aluminum:
 - a. ASTM B221 with alloy and temper of 6061, T6.
 - b. Wall thickness: Schedule 80, per ANSI H35.2 unless otherwise shown on the Drawings.

D. Mild Steel Forgings: ASTM A235, class F

2.2 CASTINGS AND FORGINGS

A. Materials

1. Gray iron: ASTM A48, grade 25 except valve and curb boxes shall be minimum class 20.
2. Malleable iron: ASTM A47, grade 35018.
3. Ductile iron: ASTM A536, grade 60-40-18.
4. Nodular iron: ASTM A220, grade 45008.
5. Steel: ASTM A27, grade 65-35.
6. Aluminum: ASTM B108 with alloy and temper of 356.0, T6.

B. Fabrication

1. Provide uniform quality, true to pattern, strong, tough, of even grain, sound, smooth, without cold sheets, scabs, blisters and sand holes, cracks, or other defects.
2. Plugs filled holes and welding will not be allowed.

3. Provide thicknesses and configurations shown on the Standard Details.
4. Sand blast as required to remove scale and sand and achieve a uniform smooth clean surface.
5. Paint with asphaltic or coal tar paint meeting requirements of AWWA C203, where indicated.
6. Provide raised letters where indicated.

C. Valve boxes

1. Comply with Standard Details
2. Use sliding type extension.
3. Lid shall be removable only by lifting straight up from the shaft shoulder.
4. Provide raised letters as indicated on the Drawings.

D. Electric and instrumentation manhole covers

1. Provide intended covers of the solid top design with two drop handles.
2. The diameter shall be 36 ½-inches.
3. Provide raised cast letters, minimum 2-inches in height, on upper surface of cover as follows.
 - a. ELECTRIC HV for electric manholes carrying greater than 600 volts
 - b. ELECTRIC LV for electric manholes carrying 600 volts and below
 - c. INSTRUMENTATION for manholes on signal conduits
4. Manufacturers
 - a. Neenah Foundry Co.,
 - b. Dewey Brothers, Inc.,
 - c. East Jordan Iron Works,
 - d. Or equal.

E. Trench drain frames and grates

1. Gray or Ductile Cast iron

2. Suitable for H-20 loading as defined by AASHTO.
3. Provide in convenient lengths for handling. Make the width as shown on the Drawings.
4. Total free open area of grate shall be approximately 0.7 square feet per linear foot.
5. Provide standard support frames, including frame end pieces, with anchor lugs for installation in cast-in-place concrete.
6. Manufacturers
 - a. Neenah Foundry Co.,
 - b. East Jordan Iron Works,
 - c. Or equal.

2.3 LADDERS

- A. Permanent fixed type ladders.
 1. Construct of 6061-T6 Aluminum.
 2. Use all welded construction.
 3. Design, fabricate, and install in accordance with OSHA (1910.27) 31:4815-7, Requirements for Fixed Ladders.
 4. Provide required brackets, bolts, and anchors.
 5. Use serrated rungs.
- B. Provide ladders with an aluminum safety extension.
 1. Design extension poles to meet requirements of ASTM B221. Use alloy and temper of 6061, T6.
 2. Design castings to comply with ASTM B108. Use alloy and temper of 356, T6.
 3. Use stainless steel hardware. Provide with safety extension for mounting to ladder.
 4. Provide standard mill finish.
- C. Manufacturer.
 1. Washington Aluminum Company, Inc., Baltimore, Maryland
 2. Or equal

2.4 STAIRS

- A. Fabricate stairs from structural shapes and plate
 - 1. Steel
 - a. ASTM A-36
 - b. Hot dip galvanizes after fabrication
 - 2. Aluminum
 - a. 6061-T6
 - b. Comply with Aluminum Association Specifications and Guidelines for Aluminum Structures.
- B. Design
 - 1. Minimum clear width of not less than 22-inches or as shown on the Drawings.
 - 2. Rise angle between 30 and 50 degrees or as shown on the Drawings.
 - 3. Rise to tread run shall conform to Table D of OSHA (1910.24) 31.4806.
- C. Treads and platforms
 - 1. Provide a non-slip surface.
 - 2. Use an ADA compliant nosing.
 - 3. Galvanized metal stair systems:
 - a. Provide solid treads of checkered safety plate.
 - b. Make landing kick plates four inches high by ¼-inch thick plate.
 - 4. Abrasive cast aluminum stair treads
 - a. Acceptable Manufacturers
 - (1) Wooster Products, Inc., Wooster, OH, Type 105
 - (2) American Safety Tread Company, Incorporated, Helena, AL, Style 804,
 - b. Provide width and length shown on the Drawings. Make at least ½ inch thick.
 - 5. May use open aluminum grating for stair treads and platforms.
 - 6. Provide landing kick plates 4-inches high by 1/4-inch thick.

2.5 2.5 CONCRETE STAIR NOSINGS

- A. Form abrasive safety nosings for concrete stair treads and landings from FS RR-T-650, nonskid tread
 - 1. Make 3 to 8 inches wide but less than the concrete width,
 - 2. Use suitable anchoring devices.
- B. Provide bolted-on nonskid treads for all plain metal stair treads.

2.6 HANDRAILING AND KICKPLATES

- A. Fabricate railings, handrails and kickplates as indicated on the drawings
 - 1. Fabricate from aluminum alloy
 - a. Fabricate handrail and posts from minimum 1-1/2 inch inside diameter, schedule 40 aluminum pipe.
 - b. Use 6063-T-6 alloy and temper for top and intermediate railings, posts, returns and handrails.
 - c. Do not exceed 20 feet between splices for railing sections.
 - d. Grind all exposed welds smooth.
 - e. Fabricate flanges for posts from 3/8-inch minimum thickness plate.
 - (1) Weld to the bottom of the posts
 - (2) Fasten to the stringer or concrete with two 1/2-inch diameter stainless steel bolts.
 - f. Fabricate stand-offs from not less than 3/16-inch thickness plate.
 - 2. Conform to OSHA requirements.
 - 3. Fabricate with all intersections and joints neatly fitted, fully welded and ground smooth and flush.
 - a. Heat and bend smoothly, without distortion.
 - b. Fabricate posts and stand-offs for pipe railing of the same material as the railing
 - (1) Space evenly as shown,
 - (2) Provide anchor flanges.
 - c. Use quarter round bends and welded flanges to make handrails along walls return to the wall at each end.

- d. Cope and continuously weld or mechanically connect members at all junctions.
 - e. Run top rails continuously over posts.
- 4. Deliver all aluminum pipe railings, posts and handrails to the job protected by polyethylene tubing with a minimum wall thickness of 0.05-inches. Tubing shall remain during construction and shall be removed only when directed.
- B. Interior handrails at stairs
 - 1. Use a single rail
 - 2. Turn 90 degrees to terminate 1/8-inch from walls.
 - 3. Secure brackets to the walls with stainless steel expansion bolts.
 - 4. Grout hollow walls at attachment locations.
 - 5. Locate terminal brackets not more than eight inches from the end of the handrails.
 - 6. Make the maximum bracket spacing 6 feet on centers.
 - 7. Provide backing plates where brackets are to be attached to gypsum board constructed partitions.
- C. Frame, anchor and mount handrails and posts such that the complete structure is capable of withstanding a load of at least 200 pounds applied at any direction at any point on the top rail, exceeding or meeting OSHA requirements.
 - 1. Do not space posts and mounts at more than 5 feet on centers.
 - 2. Reinforce end posts as specified in this Section.
- D. Coatings
 - 1. Interior aluminum pipe railings and posts, and handrails
 - a. Provide a NAAMM, Architectural Class II, AAM10C22A31, clear natural coating.
 - 2. Exterior aluminum pipe railings and posts, and handrails
 - a. Provide a NAAMM, Architectural Class I, AAM10C22A41, clear natural coating.
- E. Safety Chain:
 - 1. Stainless steel,

- a. Type 316.
 - b. Minimum 9/32-inch thick.
 - c. Working load limit at least 2,000 pounds.
2. Provide chain with eye, snap hook, and staple across gaps formed by railing sections or other locations.
- F. Contractor's Option: Use manufactured modular railings restricted to one of the following manufacturers. Prefabricated aluminum railings shall be generally as specified and as shown.
 1. Universal "Uni-rail"
 2. Moultrie "Wesrail"

2.7 CHECKERED SAFETY PLATE

- A. Steel:
 1. FS QQ-F-461, class k,
 2. Flat back,
 3. Standard four-way raised pattern,
 4. Rolled from ASTM A36, grade A,
 5. Thickness and span for 16ksi maximum fiber stress.
 6. Hot dip galvanizes after fabrication.
- B. Aluminum:
 1. ASTM B221, with alloy and temper of 6063 T6,
 2. Flat back.
 3. Diamond pattern.
 4. Thickness and span for 16 ksi maximum fiber stress.

2.8 MISCELLANEOUS ITEMS

- A. Fasteners and Anchors
 1. General
 - a. Use galvanized with galvanized material.

- b. Use stainless steel with stainless steel and aluminum material.
- c. Provide cadmium plated for use with all other materials.
- 2. Stainless Steel
 - a. Bolts: ASTM A193, grade B8M.
 - b. Nuts: ASTM A194, grade 811.
 - c. Washers: ANSI B18.22.1 and be of the same material as the bolts and nuts.
- 3. Expansion anchors
 - a. Comply with FS FF-S-325.
 - b. Concrete
 - (1) Wedge type: Group II, Type 4, Class 1 or 2.
 - (2) Self-drilling type: Group III, Type 1.
 - (3) Non-drilling type: Group VIII, Type 1 or 2.
 - c. Masonry
 - (1) Lag shield type: Group II, Type 1.
 - (2) Split shield type: Group II, Type 3, Class 3.
- 4. Vinyl Ester Adhesive Anchor Systems
 - a. Use two-component type that is insensitive to moisture and designed to be installed in adverse freeze/thaw environments.
 - b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
 - c. Container Markings:
 - (1) Manufacturer's name
 - (2) Product name
 - (3) Batch number
 - (4) Product expiration date
 - (5) ANSI hazard classification
 - (6) ANSI handling precautions.
 - d. Anchor Rods:
 - (1) Stainless steel threaded rods,

- (2) Sized by adhesive manufacturer for design loads required and adhesive system used.
- 5. Headed steel anchors:
 - a. Fabricate from cold finished carbon steel as shown on the drawings.
 - b. Comply with ASTM A108.
- B. Aluminum Plank Grating: Removable type, fabricated panel sizes and thickness as indicated on Drawings. Where panel sizes are not indicated, limit panel weights to a maximum of 120 pounds each. Construction details in conformance with NAAMM Metal Bar Grating Manual.
 - 1. Performance Criteria: Grating depth designed for maximum deflection of 1/4 inch under 100 psf uniform load.
 - a. Maximum Stress: 12,000 psi for clear span shown on Drawings.
 - b. Aluminum alloy 6063-T6 conforming to ASTM B221.
 - c. Anchor Clips: Galvanized steel or stainless steel saddle clips, number as recommended by manufacturer.
 - d. Aluminum Bearing Angle: Aluminum alloy 6061-T6 conforming to ASTM B308.
 - e. Fabrication Tolerances shall be in accordance with ANSI/NAAMM MBG 531-09 Metal Bar Grating Manual.
 - f. Finish: Gratings shall be A-41 Clear Anodized.
 - 2. Acceptable Manufacturers:
 - a. Ohio Gratings, Inc.; Heavy Duty Light Series, Upset Pattern WACO
 - b. IKG Borden; HD-50 Style RU
 - c. Or equal.
- C. Pipe Sleeves for Concrete Construction
 - 1. Standard weight, black steel pipe,
 - 2. Weld anchors to exterior to serve as a waterstop,
 - 3. Size as required to accommodate passage of conduits, pipes, ducts and similar items.
- D. Backing Plates
 - 1. Use minimum 16-gauge galvanized steel

2. Secure plates in position by welding to studs or with bolts in expansion shields as appropriate.

2.9 SHOP FINISHES

A. Galvanizing.

1. Iron and Steel: Hot-dip galvanized, ASTM A123, with average coating weight per square foot of 2.0 ounces and not less than 1.8 ounces per square foot.
2. Ferrous Metal Hardware Items: ASTM A153 with average coating weight of 1.3 ounces per square foot.
3. Touch-up Material for Galvanized Coatings: DRYGALV as manufactured by the American Solder and Flux company, Galvalloy, Galvion.

B. Ferrous metals other than galvanized steel, stainless steel, and cast iron shall be shop primed with one coat of primer compatible with the appropriate painting system specified in Section 09900.

C. Bituminous Coating: MS MIL-C-450.

PART 3 EXECUTION

3.1 FABRICATION

A. General

1. Fabricate items as indicated in the Contract Documents and as shown on approved Contractor's drawings.
 - a. Straighten any work bent by shearing or punching.
 - b. Press exposed edges and ends of metal smooth
 - c. Finish exposed surfaces to provide smooth, sharp, well-defined lines. Grind cut edges smooth and straight.
 - d. Conceal fastenings where practical. Flush countersink where exposed.
 - e. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
2. Construct connections and joints exposed to weather to exclude water.
3. Provide sufficient anchors to properly fasten of the work.
4. Provide the necessary rabbets, lugs, and brackets so the work can be assembled in a neat and substantial manner.

5. Drill metalwork and countersink holes as required for attaching hardware or other materials.
6. Fit and assemble in largest practical sections for delivery to site.
7. Weld connections and grind exposed welds smooth.
 - a. Miter corners.
 - b. When required to be watertight, make welds continuous.
8. Use fasteners as shown, scheduled or required by the application.
9. Provide cutouts, fittings, and anchors as required to coordinate assembly and installation with other work.
 - a. Provide anchors, welded to trim, (if required)
 - b. Space 6-inches from ends or corners and 24-inches on center typically, unless otherwise indicated.

B. Welding

1. Comply with AWS D1.1.
2. Use either A-233 Class E70 series electrodes or submerged arc Grade AWS-2.
3. Thoroughly wire-brush steel before fabrication to remove scale and rust.
4. Straighten by approved methods that will not injure the materials being worked.
5. Use continuous welding along the entire line of contact except where tack or intermittent welding is permitted. Where exposed, clean welds of flux and slag and grind smooth.
6. Use welders who are currently qualified as prescribed by AWS D1.1.

3.2 INSTALLATION

A. General

1. Install miscellaneous metal and appurtenances in accordance with the instructions of the manufacturer and in accordance with the Contract Documents.
 - a. Comply with the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings and the AISC Code of Standard Practice for Steel Buildings and Bridges, where applicable.
 - (1) Provide additional shims, washers, anchors, and corrective work as required to ensure that installation is firm, tight, anchored, in true alignment with

neat fits, without distortions, unsightly fastenings, raw edges or protrusions.

- (2) Touch up damaged painted areas and field coat at connecting ends as required, using same paint as shop paint. Touch up galvanized items with zinc dust coating.
2. Install plumb or level, accurately fitted, and free from distortion or defects.
3. Install rigid, substantial, and neat in appearance.
4. Erect steel in accordance with applicable portions of AISC Code of Standard Practice, except as modified herein.
5. Allow for erection loads and provide temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
6. Field weld components indicated. Perform field welding in accordance with AWS D1.1-92.
7. Obtain Engineer approval prior to site cutting or making adjustments not scheduled.
8. Apply primer or galvanize coating to welds, abrasions, and surfaces not in contact with concrete after erection.

B. Erection Tolerances

1. Maximum Variation from Plumb: 1/4-inch per story, noncumulative.
2. Maximum Offset from True Alignment: 1/4-inch

C. Aluminum

1. Erect in accordance with the Aluminum Association specifications.
2. Do not remove mill markings from concealed surfaces.
3. After installed material has been inspected and approved, remove inked or painted identification marks from exposed surfaces not otherwise coated.

D. Pipe Sleeves

1. Provide where shown on the drawings and where pipes pass through masonry.
 - a. May drill holes in lieu of sleeves in existing concrete walls.
 - b. Provide a center flange for water stoppage on sleeves in exterior or water-bearing walls.
2. Use a modular mechanical seal to form a watertight seal in the annular space between pipes and sleeves.

E. Safety Chain

1. Install quick links with anti-seize lubricant at mating threads.
2. Install eye bolts with load applied to plane of eye.
3. Do not use safety chains or accessories for overhead lifting or dynamic loading conditions.

F. Non-slip stair nosings

1. Provide at the top of the stairs, in the concrete stair treads and at door sills.
2. Install flush with the finished surfaces.

G. Railing Installation

- a. Expansion Joints
 - (1) Locate joints within 12-inches of posts.
 - (2) Provide at structural joints. Locate expansion joints in rails that span expansion joints in structural walls and floors supporting the posts.
 - c. Use slip joint with internal sleeve.
 - (1) Extend 2-inches beyond each side of joint.
 - (2) Provide 1/2-inch gap to allow for expansion.
 - d. Fasten to one side using 3/8-inch diameter setscrew. Place setscrew at bottom of pipe.
2. Surface Mounting
 - a. Bolt post baseplate connectors firmly in place.
 - b. Use of shims, wedges, grout, and similar devices for handrail post alignment not permitted.
 3. Posts and Rails
 - a. Set posts plumb and aligned to within 1/8-inch in 12 feet.
 - b. Set rails horizontal or parallel to slope of steps to within 1/8-inch in 12 feet.
 - c. Install posts and rails in same plane.
 - (1) Remove projections or irregularities and provide a smooth surface for

sliding hands continuously along top rail.

- (2) Use offset rail on stairs and platforms if post is attached to web of stringers or structural platform supports.

- d. Support 1 1/2-inch rails directly above stairway stringers with offset fittings.

4. Handrail Wall Brackets

- a. Support wall rails on brackets

- (1) Space at maximum 6 feet on centers for steel
- (2) Space at maximum 5 feet on centers for aluminum
- (3) Measure spacing on the horizontal projection.

- b. Install wall anchor backing plates on solid blocking in stud walls.

5. Toeboard

- a. Provide at all handrails except where 4-inch or higher concrete curbs are installed or at gates.
- b. Accurately measure in field for correct length. Cut and secure to posts after handrail post installation.
- c. Dimension between bottom of toeboard and walking surface not to exceed 1/4-inch.
- d. Aluminum Toeboards: Provide expansion and contraction connections between each post.

6. Cleaning

- a. Wash railing system thoroughly using clean water and soap. Rinse with clean water.
- b. Do not use acid solution, steel wool, or other harsh abrasive.
- c. If stain remains after washing, restore in accordance with manufacturer's or fabricators recommendations, or replace stained handrails.

7. Prefabricated Railings

- a. Provide railing posts longer than needed and field cut to exact dimensions required.
 - (1) Install railing with a base that provides plus or minus 1/4-inch vertical adjustment inside the base fitting.
 - (2) If field adjustment exceeds plus or minus 1/4-inch, adjust the post length.

- b. Modifications to structure where handrail is attached are not permitted.
- c. Mount handrails only on completed walls. Do not support handrails temporarily by means not satisfying structural performance requirements.

H. Concrete Anchoring Systems

- 1. Begin installation only after concrete or masonry receiving anchors has attained design strength.
 - 2. Do not install an anchor closer than six (6) times its diameter to either an edge of concrete or masonry, or to another anchor, unless specifically shown otherwise.
 - 3. Install in accordance with manufacturer's specific quality control submittal instructions.
 - a. Hole diameters are critical to installation.
 - b. Use only drills recommended by anchor manufacturer.
 - c. Follow manufacturer's safe handling instructions.
 - 4. Epoxy Anchors: Do not install when temperature of concrete is below 35 degrees F or above 110 degrees F.
- I. Where titanium equipment is in contact with concrete or dissimilar metals, provide full-face neoprene insulation gasket.**
- 1. Use 3/32-inch minimum thickness
 - 2. Provide 70 durometer hardness.

3.3 FIELD PAINTING

- A. Field prepare and paint required surfaces as specified in Section 09 91 00.**
- B. Electrolytic Protection for Aluminum**
- 1. Where in contact with dissimilar metals, or embedded in masonry or concrete, isolate surfaces per manufacturer's recommendation.
 - 2. Allow paint to dry before installation of the material.
 - 3. Protect painted surfaces during installation.
 - 4. Should coating become marred, prepare, and touch up in accordance with paint manufacturer's written instructions.

END OF SECTION

**SECTION 06 10 00
CARPENTRY**

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 04 22 00 Concrete Masonry Unit
- B. Section 07 21 16 Blanket Insulation
- C. Section 07 41 13 Standing Seam Metal Roofing
- D. Section 07 71 23 Gutters and Downspouts
- E. Section 08 11 13 Hollow Metal Doors and Frames
- F. Section 09 91 00 Painting

1.2 DESCRIPTION OF WORK

- A. The extent of the carpentry work is shown on the Contract Drawings and in schedules.

1.3 QUALITY ASSURANCE

- A. Comply with requirements of the following U.S. Department of Commerce standards:
 - 1. Lumber Standard: Comply with PS 20, except as otherwise indicated.
 - 2. Plywood Standard: Comply with PS 1, except as otherwise indicated.
- B. Shop-fabricate carpentry work to the extent feasible and where shop fabrication will result in better workmanship than feasible for on-site fabrication.
- C. ASTM International.
- D. American Wood Preservers Association (AWPA).
- E. APA Engineered Wood Association.

1.4 SUBMITTALS

- A. Wood Treatment Data: For information only, submit chemical treatment manufacturer's instructions for proper use of each type of treated material. Indicated by transmittal form that copy of each instruction has been distributed to the installer.
- B. Pressure Treatment: For each type specified, include certification by treating plant stating chemicals and process used, net amount of salts retained and conformance with applicable standards.

- C. For water-borne preservatives, include statement that moisture content of treated materials was reduced to a maximum of 15% prior to shipment to project site.

PART 2 PRODUCTS

2.1 LUMBER - GENERAL

- A. Use southern pine or western fir unless otherwise shown or specified.
- B. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for the moisture content specified for each use.
- C. Provide dressed lumber, S4S, unless otherwise shown or specified.
- D. Provide seasoned lumber with 19% maximum moisture content at time of dressing.
- E. For light framing (less than 6 inches wide), provide "Stud" grade lumber for stud framing and "Standard" grade for other light framing, any species.
- F. Boards (less than 2 inches thick): Provide boards having 19% maximum moisture content (S-Dry).
- G. For exposed boards, use Southern Pine No. 2 Boards (SPIB), pressure treated. Boards to have a maximum moisture content of 19% at time of painting.
- H. For concealed boards, use Southern Pine No. 3 Boards (SPIB), or any species graded Standard Boards (WCIB or WWPA).

2.2 MISCELLANEOUS MATERIALS

- A. Fasteners and Anchorages: Provide size and type as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices.
- B. Cement Board: Use mineral fiber-cement sheets meeting Federal Specification SS-B-755 and ASTM C220, Type F.

2.3 WOOD TREATMENT

- A. Preservative Treatment: Where lumber or plywood is indicated as "Trt-Wd" or "Treated", or is specified herein to be treated, comply with the applicable requirements of the American Wood Preservers Association (AWPA). Mark each treated item to comply with the AWPA Quality Mark requirements for the specified requirements.
- B. Pressure-treat above-ground items with water-borne preservatives complying with AWPA C1, C2, C9. Preservatives shall conform to AWPA P5. After treatment, kiln-dry to a maximum moisture content of 19%. Treat indicated items and the following:
 - 1. Wood products in contact with slab-on-grade, nailers or blocking cast into concrete or

masonry, wood products in contact with exterior walls.

2. Wood cants, nailers, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers and waterproofing.
- C. Complete fabrication of treated items prior to treatment, wherever possible. If cut after treatment, coat cut surfaces with heavy brush coat of same chemical used for treatment. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.4 LUMBER FOR FASCIAS

- A. Lumber for facias and sub-facias shall be preservation treated and shall be prime painted and back primed.

2.5 PLYWOOD ROOF DECKING

- A. Plywood roof decking shall be APA rated sheeting, exterior, Group 1.

PART 3 EXECUTION

3.1 JOB CONDITIONS

- A. Installer must examine the substrates and supporting structure and the conditions under which the carpentry work is to be installed and notify the Contractor in writing of conditions detrimental to the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow proper attachment to other work.

3.2 PRODUCT HANDLING

- A. Keep materials dry during delivery and storage. Protect against exposure to weather and contact with damp or wet surfaces. Store minimum 6-inches above ground on blocking. Stack lumber and plywood and provide air circulation within stacks.

3.3 INSTALLATION – GENERAL

- A. Discard units of material with defects which might impair the quality of the work, and units which are too small to fabricate the work with minimum joints or the optimum joint arrangement.
- B. Set carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.
- C. Securely attach carpentry work to substrates by anchoring and fastening as shown and as required by recognized standards. Countersink nail heads on exposed carpentry work and fill

holes. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; pre-drill as required.

3.4 WOOD GROUNDS, NAILERS, BLOCKING AND SLEEPERS

- A. Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
- B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise shown. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

3.5 WOOD FURRING

- A. Install plumb and level with closure strips at all edges and openings. Shim with wood as required for tolerance of finished work.
- B. Suspended Furring: Provide size and spacing shown, including hangers and attachment devices. Level to a tolerance of 1/8 inch 10 feet.

3.6 WOOD FRAMING – GENERAL

- A. Provide framing members of sizes and on spacing shown, and frame openings as shown, or if not shown, comply with the recommendations of the “Manual for House Framing” of the National Forest Products Association. Do not splice structural members between supports.
- B. Anchor and nail as shown, and to comply with the “Recommended Nailing Schedule - Table I” of the “Manual for House Framing” and other recommendations of the N.F.P.A.

END OF SECTION

**SECTION 06 17 53
SHOP FABRICATED WOOD TRUSSES**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Provide shop fabricated wood trusses and appurtenances as specified and as shown on the Contract Documents.

1.2 REFERENCE STANDARDS

- A. ASTM International:
 - 1. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 2. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 3. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 4. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 - 5. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 6. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 7. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit truss plate connections, bearing plates, anchor connections, wind uplift connections, bridging and bracing.
- C. Shop Drawings: Indicate truss sizes, dimensions, spacing of trusses, associated components, uplift connectors, web and chord sizes, plate sizes, loads and truss cambers, framed openings.
- D. Design Calculations: Indicate design loads, truss reactions, and member forces, deflections, and stresses.
- E. Manufacturer's/Fabricator's Certificate: Certify that products meet or exceed specified requirements.

- F. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for sizes, dimensions, spacing of trusses, associated components, uplift connectors, web and chord sizes, plate sizes, design loads, truss cambers, framed openings.
- G. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- H. Qualifications Statements:
 - 1. Submit qualifications for manufacturer/fabricator, erector, and licensed professional.
 - 2. Submit manufacturer's/fabricator's approval of erector.

1.4 QUALIFICATIONS

- A. Manufacturer/Fabricator: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
- B. Erector: Company specializing in performing Work of this Section with minimum three years' experience.
- C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Georgia.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Design Roof Loads: As noted on Project Drawings.

2.2 MATERIALS

- A. Steel Plate Connectors:
 - 1. Comply with TPI 1, Section 6.
 - 2. Die stamped with integral teeth.
 - 3. Finish: Hot dip galvanized.
 - 4. Truss Bridging: Type, size, and spacing as recommended by truss manufacturer/fabricator.

2.3 FABRICATION

- A. Fabricate trusses to achieve specified structural requirements.
- B. Fabricate top chord extensions as indicated on Drawings.

C. Fabricate to achieve minimum end bearing of:

1. 7 - 1/2 inches on masonry.

2.4 ACCESSORIES

A. Wood blocking:

1. As specified in Section 061000 - Rough Carpentry
2. Moisture Content:
 - a. Maximum: 19 percent.
 - b. Minimum: 7 percent.

B. Fasteners and Anchors:

1. Material:
 - a. High Humidity and Treated Wood Locations: ASTM A153, hot dipped galvanized steel.
 - b. Elsewhere: Unfinished steel.
2. Nails and Staples: Comply with ASTM F1667.

2.5 SOURCE QUALITY CONTROL

- A. Inspection: Inspect Work performed at manufacturer's/fabricator's facility to verify conformance to Contract Documents.
- B. Certificate of Compliance:
 1. If manufacturer/fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's/fabricator's facility conforms to Contract Documents.
 2. Specified shop tests are not required for Work performed by approved manufacturer/fabricator.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that supports and openings are ready to receive trusses.

3.2 PREPARATION

1. Coordinate placement of bearing items.

3.3 ERECTION

- A. Set members level, plumb, and in correct position.
- B. Make provisions for erection loads and sufficient temporary bracing to maintain plumb and aligned structure until completion of erection and installation of permanent bracing.
- C. Do not field cut or alter structural members without approval of Architect/Engineer.
- D. Place headers and supports to frame openings.
- E. Frame openings between trusses with lumber.

3.4 TOLERANCES

- A. Maximum Variation from Indicated Position:
 1. Framing Members: 1/4 inch.

END OF SECTION

**SECTION 07 20 00
INSULATION**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Provide thermal insulation applied to exterior masonry walls, suspended ceilings, and perimeter of foundations and appurtenances as specified and as shown on the Contract Documents.

1.2 QUALITY ASSURANCE

- A. Provide insulation that meets local codes and regulations for fire and smoke hazard.
- B. Manufacturer certified installer.

1.3 SUBMITTALS

- A. Comply with Section 01 33 00. Include the following information:
 - 1. Manufacturer's catalog information that describes each type of insulation provided. Include
 - a. Specifications
 - b. A complete bill of materials that identifies all materials of construction.
 - 2. Samples
 - a. 12-inch squares of insulated materials, labeled with manufacturers and product name, location, "R" value, applicable ASTM or FS designation.
 - b. Pint container of adhesives.
 - c. Fasteners.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle, and store the equipment in manufacturer's original unbroken packages clearly labeled with:
 - 1. Manufacturer's name
 - 2. Fire rating
 - 3. Smoke rating
 - 4. Insulation rating

- B. Store material in approved dry area off the ground and as recommended by the manufacturer.

1.5 JOB CONDITIONS

- A. Environmental Requirements.

1. Prohibited when ambient temperature is lower than 40 degrees F., or when ice, frost or dampness are visible on decks or subgrade.
2. Maintain temperature of 50 degrees F. minimum in structure for 48 hours prior to 48 hours after application of wall insulation.

- B. Coordination.

1. Coordinate insulation with items that must be installed before or with insulation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Certain Teed Corp., Insulation Group
- B. Johns Manville
- C. Owens Corning
- D. Or Equal.

2.2 GENERAL

- A. Provide insulation in a total thickness that will produce an R value as listed below.
- B. Do not exceed specified thickness.

2.3 INSULATION BOARD

- A. Insulation Boards for Cavity Spaces:

1. Extruded polystyrene foam insulation complies with ASTM C578, Type.
2. Use R-value of 5.0, minimum.
3. Use R-value of 5.0, minimum.

- B. Perimeter Insulation Boards:

1. Extruded polystyrene boards shall.
 - a. Meet the requirements of ASTM C578, Type IV.

- b. R-value of 5.0, minimum.
- c. 48 inches wide by 96 inches long and one inch thick, with square edges.

2.4 FLEXIBLE BATTS AND BLANKET ROLLS

- A. Glass fibers and resinous binders formed into flexible blankets shall comply with ASTM C553 or ASTM C665:
- B. Outside Walls: Thermal insulation; Type III, Class A (blankets with reflective vapor-retarder membrane facing and flame spread of 25 or less); 2 ½ inch minimum thickness.
- C. Interior Walls: Acoustical insulation; Type I (unfaced, with fibers manufactured from glass); 2 ½ inch thickness

2.5 PIPE INSULATION

- A. Insulation - shall be FOAMGLAS cellular glass insulation manufactured in accordance with ASTM C 552, "Standard Specification for Cellular Glass Thermal Insulation," by Pittsburgh Corning Corporation, Johns Manville or equal.
- B. Insulation shall be fabricated in half sections wherever possible. For large diameter piping where half sections are not practical, curved sidewall segments are preferred.
- C. Metal Jacket -0.016" smooth aluminum jacket for insulation O.D.'s of 24" or less. For larger O.D.'s use 0.020" embossed aluminum jacket.

2.6 ADHESIVES

- A. Insulation adhesives as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

- A. Examine the substrate. Provide written notification to the Engineer of unsatisfactory conditions.
- B. Do not begin until conditions are corrected.
- C. Prepare surfaces so they are smooth, dry, clean, and free of projections and other substances that might prevent proper application of insulation.

3.2 INSTALLATION

- A. General
 - 1. Comply with insulation manufacturer's handling and installation recommendations.

2. Extend insulation full thickness, over entire area to be insulated.
3. Cut and fit around obstructions and fill voids with insulation.

B. Wall and Ceiling Insulation

1. Insulation Board
 - a. Apply insulation board where shown on the Drawings.
 - b. Support and fasten as indicated or in accordance with insulation manufacturer's recommendations.

C. Perimeter Insulation

1. Install on the inside surface of the foundation wall to a depth of at least two feet below the underside of the slab using a thin layer of adhesive as recommended by the manufacturer.
2. Adhere a layer of 15 pound felt to the insulation the full thickness of the floor slab to prevent bonding of the concrete slab to the insulation.

3.3 PROTECTION

- A. Provide temporary protection for the installed insulation until permanent cover or protection.

END OF SECTION

**SECTION 07 21 16
BLANKET INSULATION**

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 01 33 00 Submittals
- B. Section 04 22 00 Concrete Masonry Unit
- C. Section 06 10 00 Carpentry

1.2 SCOPE

- A. The work in this Section of the Specifications consists of furnishing all materials and equipment and performing all labor necessary for the installation of blanket insulation as indicated on the Contract Drawings and/or as specified.

PART 2 PRODUCTS

2.1 FIBERGLASS INSULATION

- A. Glass fiber insulation shall be as manufactured by Owens-Corning Fiberglass Corporation or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install insulation in strict conformance with manufacturer's printed instructions.
- B. Fit insulation between framing members such as joists and studs, behind electrical receptacles and piping, to form a completely insulated area.
- C. Insulation with stapling tabs shall be stapled to the wood stud framing at 8 inches to 12-inch centers; friction-fit insulation in metal stud framed partitions.
- D. Insulations faced with Kraft paper, standard foil, or (FRK) foil reinforced kraft vapor barriers shall be installed with facing to the warm-in-winter side.
- E. Do not install fiberglass insulation on top of or within 3 inches of recessed light fixtures, this is a requirement of the National Electric Code to prevent fixture overheating.

END OF SECTION

**SECTION 07 21 19
FOAMED-IN-PLACE INSULATION**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Provide masonry core-fill insulation for interior and exterior concrete block and appurtenances as specified and as shown on the Contract Documents.

1.2 QUALITY ASSURANCE

- A. Comply with applicable portions of Section 01 33 00.
- B. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.
 - 1. Insulation produced by a single and approved manufacturer. Pre-mixed to ensure consistency.
 - 2. One year product and installation warranty issued by both the manufacturer and installer.
- C. Comply with applicable standards including, but not limited to the most recent edition of the following:
 - 1. Fire Resistance Ratings: ASTM E-119
 - 2. Surface Burning Characteristics: ASTM E-84
 - 3. Combustion Characteristics: ASTM E-136
- D. Design to provide satisfactory performance under the specified conditions.

1.3 SUBMITTALS

- A. Include the following information:
 - 1. Product and technical presentation provided by the manufacturer.
 - 2. Manufacturer's catalog information that describes each type of Insulation provided. Include:
 - a. Specifications
 - b. A complete bill of materials that identifies all materials of construction.
 - c. Demonstrate acceptable performance for specified conditions.

1. Manufacturer's installation instructions.
- B. Submit certified test reports.
 1. R-values, fire performance and sound abatement characteristics.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers of Foamed-In-Place Masonry Insulation: Subject to compliance with requirements, provide products from the following:
 1. Tailored Chemical Products, P.O. Drawer 4186, Hickory, N.C. 28603, Core-Fill 500™
 2. Dow Chemical
 3. Or Equal

2.2 INSULATING MATERIALS

- A. Insulating materials which comply with requirements indicated for materials, compliance with referenced standards, and other characteristics.
- B. Foamed-In-Place Masonry Insulation: Two component thermal insulation produced by combining a plastic resin and catalyst foaming agent surfactant which, when properly ratioed and mixed, together with compressed air produce a cold-setting foam insulation in the hollow cores of hollow unit masonry walls.
 1. Fire-Resistance Ratings: Minimum four (4) hour fire resistance wall rating (ASTM E-119) for 8" and 12" concrete masonry units when used in standard two (2) hour rated CMUs.
 2. Surface Burning Characteristics: Maximum flame spread, smoke developed, and fuel contributed of 0, 5 and 0 respectively.
 3. Combustion Characteristics: Must be noncombustible, Class A building material.
 4. Thermal Values: "R" Value of 4.91/inch @ 32 degrees F mean; ASTM C-177.
 5. Sound Abatement: Minimum Sound Transmission Class ("STC") rating of 53 and a minimum Outdoor Indoor Transmission Class ("OITC") rating of 44 for 8" wall assembly (ASTM E 90-90).

PART 3 EXECUTION

3.1 INSPECTION AND PREPARATION

A. Application Assemblies:

1. Block Walls: 6", 8", 10" or 12" concrete masonry units.
2. Cavity Walls: 2" cavity or greater

3.2 INSTALLATION OF FOAMED-IN-PLACE INSULATION

- A. Install foamed-in-place insulation from interior, or as specified, prior to installation of interior finish work and after all masonry and structural concrete work is in place; comply with manufacturer's instructions.
- B. Fill all open cells and voids in hollow concrete masonry walls where shown on drawings.
- C. Field prepare and paint required surfaces as specified in Section 09 91 00.

END OF SECTION

**SECTION 07 26 00
VAPOR BARRIER**

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 03 10 00 Concrete Forming and Accessories
- B. Section 03 20 00 Concrete Reinforcement
- C. Section 03 30 00 Cast-In-Place Concrete

1.2 SCOPE

- A. The work in this Section of the Specifications consists of furnishing polyethylene sheeting.

1.3 REFERENCES

- A. Standards of the following as referenced:
 - 1. American Society for Testing and Materials (ASTM).

1.4 SUBMITTALS

- A. Product data: Submit manufacturer's product literature and instructions for vapor barrier material. Refer to 01 33 00.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- A. Vapor barrier: ten mil thickness polyethylene sheeting (Building) and six mil thickness under Structures; meeting requirements of ASTM E154-68(1979) for serviceability.
- B. Adhesive or tape: acceptable to manufacturer of vapor barrier material.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install vapor barrier over compacted, clean subgrade material, free of debris and protrusions.
- B. Lay vapor barrier over interior building area to receive concrete slab; lap edges 6" and sealing with mastic or tape over entire lap. Lay membrane with seams perpendicular to and lapped in direction of pour. Turn membrane edges up to within 1/2" of slab top at vertical surfaces intersection.
- C. Lay vapor barrier continuous under joint filler where expansion or control joints are indicated

in slab.

- D. Seal openings in vapor barrier around pipes and other protrusions with mastic. Fold at corners to form envelope.
- E. Protect vapor barrier installation from damage until concrete slab is in place.

END OF SECTION

**SECTION 07 41 13
STANDING SEAM METAL ROOFING**

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 06 10 00 Carpentry
- C. Section 04 22 00 Concrete Masonry Unit
- D. Section 07 71 23 Manufactured Gutters and Downspouts

1.2 SCOPE

- A. The work in this Section of the Specifications consists of furnishing all materials and equipment and performing all labor necessary for the installation of a standing seam metal roof as indicated on the Contract Drawings and/or as specified.

PART 2 PRODUCTS

2.1 STANDING SEAM METAL ROOF

- A. The roof systems shall be a MBIC double-loc 1247, or approved equal.
- B. The roof materials shall be as follows:
 - 1. Metal roof system profile: 3-inch-high rib x 24-inch-wide panel.
 - 2. Metal roof system style: trapezoidal rib, double lock standing seam, containing a Factory applied hot melt mastic, continuously locked together by an electrically powered mechanical seaming device during installation.
 - 3. Gauge: 24 gauge (UL-90 rated – Underwriters Laboratories).
 - 4. Substrate: galvalume steel sheet, 0.5 ounces/square foot, minimum yield of 50,000 psi.
 - 5. Clip: articulating clip, providing thermal expansion or contraction, correcting for out-of-plane sub-framing alignment to a maximum of 7 degrees (UL-90 rated- Under-Writers Laboratories).
 - 6. Texture: smooth.
 - 7. Finish: premium fluorocarbon coating produced with Kynar 500 or Hylar 500 resin (with 20-year warranty).
- C. Shop Drawings:

1. Submit complete shop drawings and erection details, approved by the general contractor's third-party metal roof consultant, to the Engineer for review. Do not proceed with manufacture prior to review of shop drawings. Do not use drawings prepared by the Engineer for shop or erection drawings.
 2. Shop drawings show methods of erection, elevations and plans of roof and wall panels, sections and details, anticipated loads, flashing, roof curbs, vents, sealants, interfaces with all materials not supplied and proposed identification of component parts and their finishes.
- D. Performance Tests: Submit certified test results by a recognized testing laboratory or manufacturer's lab (witnessed by a professional engineer) in accordance with specified test methods for each panel system.
- E. Calculations:
1. Submit engineering calculations defining cladding loads for all roof areas based on specified building codes, allowable clip loads and required number of fasteners to secure the panel clips to the designated substructure.
 2. Compute uplift loads on clip fasteners with full recognition of prying forces and eccentric clip loading. Calculate holding strength of fasteners in accordance with submitted test data provided by Fastener Manufacturer based on length of embedment and properties of materials.
- F. Warranty:
1. Metal roof system manufacturer, upon final acceptance for project, furnish a warranty covering bare metal against rupture, structural failure, and perforation due to normal atmospheric corrosion exposure for a period of 20 years.
 2. Covering paint finish against cracking, checking, blistering, peeling, flaking, chipping, chalking.
- G. Surface Conditions:
1. Examination: Inspect installed work of other trades and verify that such work is complete to a point where this work may continue.
 2. Verify that installation may be made in accordance with approved shop drawings and manufacturer's instruction. This specifically includes verifying that secondary structural and /or decking are installed to meet U: and building code requirements. Coordinate with metal roof system manufacturer to insure that reduced clip spacing are eave, rake, ridge, and corner areas are accommodated.
 3. Discrepancies: In event of discrepancy, notify the Engineer. Do not proceed with installation until discrepancies have been resolved.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install metal roof system so that it is watertight, without waves, warps, buckles, fastening stresses or distortion, allowing for expansion and contraction.
- B. Install metal roof system in accordance with manufacturer's instructions and shop drawings.
 - 1. Provide concealed anchors at all panel attachment locations.
 - 2. Install panels plumb, level and straight with seams and ribs parallel, conforming to design as indicated.
- C. Roof Curb Installation: Comply with metal roof system manufacturer's shop drawings, instructions and recommendations for installation of roof curbs. Refer to metal roof system manufacturer's standard installation details. Anchor curbs securely in place with provisions for thermal and structural movement.

3.2 CLEANING AND PROTECTION

- A. Dispose of excess materials and remove debris from site.
- B. Clean work in accordance with manufacturer's recommendations.
- C. Protect work against damage until final acceptance. Replace or repair to the satisfaction of the Owner any work that becomes damaged prior to final acceptance.
- D. Touch up minor scratches and abrasions.
- E. Do not allow panels or trim to come into contact with dissimilar metals such as copper, lead or graphite. Water runoff from these materials is also prohibited. This specifically includes condensate from roof top A/C units.

END OF SECTION

**SECTION 07 60 00
FLASHING AND SHEET METAL**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Provide flashing and sheet metal and appurtenances as specified and as shown on the Contract Documents.

1.2 QUALITY ASSURANCE

- A. All components shall be the standard product of a manufacturer regularly engaged in the production of required materials.
- B. All equipment and material shall be designed and constructed in accordance with applicable standards as indicated.

1.3 SUBMITTALS

- A. Comply with Section 01 33 00 and shall include:
 - 1. Contractor's Drawings in accordance with Section 01 33 00.
 - a. Show joints, types and location of fasteners, and special shapes.
 - b. Catalog data for stock manufactured items.
- B. Samples for the following in accordance with Section 01 33 00.
 - 1. Color samples for items to be factory finished. Submit color selection.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle, and store the equipment in accordance with Section 01 45 34.
- B. Inspect for damage, dampness, and wet storage stains upon delivery to the Work site.
- C. Remove and replace damaged or permanently stained materials.
- D. Carefully handle to avoid damage to surfaces, edges, and ends.
- E. Do not open packages until ready for use.
- F. Store materials in dry, weathertight, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

A. Metals

1. Aluminum Sheet: ASTM B209, Alloy 5005-H34, 0.032-inch thick, unless otherwise shown, with Kynar 500, or equal, color coating.
2. Stainless-Steel Sheet: ASTM A 167, Type 304, soft annealed, with No. 2D finish, except where harder temper is required for forming or performance; minimum 0.0187 inch thick, unless otherwise indicated.
3. For Masonry Stainless Steel: Minimum 24 ga., AISI type 302/304 alloy, 2B finish.

B. Reglets

1. For Concrete: Reglets and flashing of stainless steel, 0.020 inch.
2. For Masonry: Stainless steel, 0.015-inch minimum.
3. Surface Mounted: Stainless steel, 0.020 inch.

C. Copings and Flashings

1. Pre-finished aluminum Sheet, 0.050-inch minimum thickness.

D. Counterflashing:

1. Stainless Steel Sheet.

E. Scupper and Downspouts: Comply with SMACNA recommendations, and as follows:

1. Scuppers: Factory pre-finished aluminum (0.050-inch thickness) hung type. Support on the top side by brackets, formed from 1/8 inch thick by 2-inch-wide aluminum strap at maximum spacing of 16 inches on center, that permit free thermal movement of the gutter. Provide end caps, outlets, brackets, and other accessories for complete installation. The outer edge of the gutter shall be beaded or reinforced with a stiffening bar of material compatible with the gutter. Gutters shall be fabricated in sections not less than twelve feet long. The sections shall be lapped a minimum of 1-1/2 inches in the direction of flow. Gutters shall be joined by riveted and soldered joints. Expansion-type joints shall be provided midway between outlets, at 32 feet maximum spacing.
2. Downspouts: Same material and finish as Scupper. Rectangular shape, plain type, with welded elbows. Include hangers and offsets as required. Maximum length: ten feet. End joints shall lap a minimum of 1-1/2 inches in the direction of water flow. Longitudinal joints shall be locked. Provide elbow at discharge location, as required, to direct flow of water into splash block, away from the building face, or into drainpipe, as applicable.

- F. Emergency Overflow Scupper
 - 1. Same metal and thickness as flashing.

2.2 ANCILLARY MATERIALS

- A. Solder: ASTM B32-89, alloy composition Sn 50.
- B. Soldering Flux: ASTM B32-89, Type RA.
- C. Isolation Paint: ASTM D1187-82, asphalt.
- D. Isolation Tape: Butyl or polyisobutylene, internally reinforced, or 20-mil thick minimum polyester.
- E. Fasteners
 - 1. For Aluminum Work: Stainless steel or aluminum.
 - 2. For Stainless Steelwork: Stainless steel.
 - 3. Nails: Roofing nail head, 10-gauge spiral or ring shank, lengths as required to penetrate wood at least 3/4 inch.

2.3 FABRICATION OF FLASHING

- A. Field measure prior to fabrication.
- B. Fabricate in accordance with SMACNA Architectural Sheet Metal Manual.
- C. Accurately form flashings to shapes shown and detailed, with angles and lines in true alignment.
- D. Form arcs and angles true to line and surfaces free of waves and buckles.
- E. Form bends to 1/16-inch inside radius.
- F. Hem exposed edges.
- G. Reinforcements and Supports: Provide same material as flashing unless other material is shown.
- H. Rigid Joints and Seams: Make mechanically strong. Seal aluminum joints with sealant.
- I. Fabricate sheet metal in 10-foot maximum lengths, unless otherwise indicated.
- J. At exposed ends of counterflashing furnish weathertight closures.
- K. Fabricate corners in one-piece with legs extending 30 inches each way to field joint. Lap and

rivet corner seams watertight.

- L. Solvent clean sheet metal. Surfaces to be in contact with roofing or otherwise concealed shall be coated with isolation paint.

2.4 FABRICATION OF EMERGENCY OVERFLOW SCUPPER:

- A. Fabricate in accordance with SMACNA Architectural Sheet Metal Manual.

2.5 PRE-FINISHED ALUMINUM

- A. Exposed areas of copings, downspouts, gutters and accessories shall be finished with Kynar 500, or equal, fluoropolymer coating color to match the aluminum window frames.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual."
 - 1. Anchor units of Work securely in place, providing for thermal expansion of metal units.
 - 2. Conceal fasteners.
 - 3. Set units true to line and level.
 - 4. Install Work with laps, joints, and seams permanently watertight and weatherproof.
- B. Install exposed sheet metal Work that is.
 - 1. Without excessive oil canning, buckling, and tool marks.
 - 2. And that is true to line and levels indicated.
 - 3. With exposed edges folded back to form hems.
 - 4. Fit substrates and to result in waterproof and weather-resistant performance.
 - 5. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- C. Flashing
 - 1. Coordinate flashing Work with roofing Work for weathertight and watertight assembly.
 - 2. Isolate metal from wood and concrete and from dissimilar metal with two coats of specified isolation paint or tape.

3. Use only stainless-steel fasteners to connect isolated dissimilar metals.
 4. Joints:
 - a. 10-foot maximum spacing and 2-1/2 feet from corners, butted with 3/16-inch space centered over matching 8-inch long backing plate with sealer tape in laps.
 5. Set flanges of flashings and roof accessories on continuous sealer tape.
 - a. Nail flanges through sealer tape and at 3-inch maximum spacing.
 - b. Touch up isolation paint on flanges.
 6. Joints, Fastenings, Reinforcements, and Supports:
 - a. Sized and located as required to preclude distortion or displacement due to thermal expansion and contraction.
 7. Provide continuous hold-down clips at counterflashing.
 8. Conceal fastenings wherever possible.
 9. Set flashing and sheet metal to straight, true lines with exposed faces aligned in proper plane without bulges or waves.
- D. Emergency Overflow Scuppers: Install as indicated on Drawings.
- E. Reglet: Install in accordance with manufacturer's latest printed instructions.

END OF SECTION

**SECTION 07 71 23
MANUFACTURED GUTTERS AND DOWNSPOUTS**

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 04 22 00 Concrete Masonry Unit
- B. Section 07 41 13 Standing Seam Metal Roofing
- C. Section 01 33 00 Submittals

1.2 SCOPE

- A. The work in this Section of the Specifications consists of furnishing all materials and equipment and performing all labor necessary for the installation of gutters and downspouts as indicated on the Contract Drawings and/or as specified.

PART 2 PRODUCTS

2.1 GUTTERS AND DOWNSPOUTS

- A. Gutters shall be Alcoa, Ogee prefinished fluoropolymer aluminum, minimum 0.050" thickness, with strap hangers, or approved equal and sized in accordance with SMACNA Tables 1-1, 1-2, 1-3, and 1-4.
- B. Downspouts shall be Alcoa, round prefinished fluoropolymer aluminum, minimum 0.032" thickness, with wall straps, or approved equal and sized in accordance with SMACNA Tables 1-1, 1-2, 1-3, and 1-4.
- C. Comply with Sheet Metal and Air Conditioning Contractors' National Association, Inc., Architectural Sheet Metal Manual latest edition, for all gutter joints, hanger details, etc. Do not use ferrule and splice type hanger system.
- D. Aluminum: 3003-H14 alloy meeting ASTM B209-02A.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Gutters and downspouts shall be installed in accordance with manufacturer's recommendations.

END OF SECTION

**SECTION 07 92 00
SEALANTS AND CAULKING**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Provide sealants, caulking and related accessories to weather seal and fill joints except for roadway pavements and glazing, as specified and shown on the Contract Documents.

1.2 QUALITY ASSURANCE

- A. Use a Manufacturing company that has been specializing in the products for a minimum of three years' experience.
- B. Use an Applicator company that has been specializing in applying the work for a minimum of three years documented experience.

1.3 SUBMITTALS

- A. Comply with section 01 33 00.
- B. Product Data:
 - 1. Manufacturer's descriptive product data and certification of compliance with reference specification.
 - 2. Manufacturer's detailed description for handling, recommendation on intended use and installation recommendations.
 - 3. Color Selection:
 - a. Select from full range of colors available on color charts.
 - b. Provide actual samples of sealant colors for final selections, including custom colors if required.
 - c. Selection of colors for the products specified may be dependent on the coordinated selection of other products specified elsewhere.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in manufacturer's original unopened containers with labels intact along with referenced specification number, type and class as applicable.
- B. Handle and store products in accordance with manufacturer's recommendations.
- C. Maintain sealants and calking at a temperature of at least 70 degrees F. for a period of not less than 24 hours prior to installation.

1.5 JOB CONDITIONS

A. Environmental Requirements

1. Apply sealants and caulking when temperature is above 40 degrees F. and when there is no ice, frost or dampness visible on surfaces to be sealed.

B. Safety Requirements

1. Avoid contact with skin.
2. Wear protective clothing, goggles, gloves and/or barrier creams.
3. Avoid breathing vapors in confined areas.

PART 2 MATERIALS

2.1 SEALANTS, CAULKINGS AND PRIMERS

- A. Use un-staining type of a color specified or selected by the Engineer from the Manufacturer's standard color chart.
- B. Primers, where applicable, comply with sealant manufacturer's recommendations.
- C. Provide backup materials, fillers and joint packing compatible with sealant and primer.
 - 1. Use back-up material to control calking depth.
 - 2. Use closed-cell tube or rope shaped stock expanded polyethylene or polyurethane foam.
 - 3. The width or diameter of backup material to be 1-1/3 to 1-1/2 times the width of the joint.
 - 4. Use semi-rigid vinyl or polyethylene foam, solid neoprene rod or similar approved backing for joints subject to horizontal traffic or puncture.
 - 5. Do not use bituminous or oily products as a backup material.
- D. Use Acrylic sealant single component water based latex and single component solvent release type with limited number of fillers and plasticizers.
- E. Use Polysulfide base sealant with two components.
- F. Do not apply Polysulfide sealants with joint fillers and surfaces coated with asphaltic materials, oil base materials, lacquer or paint or any other sealants in which the bonding properties and adverse effects resulting from the combination are not known.
- G. Use Polyurethane based sealants with two components formulated to provide excellent resiliency and resistance to compression.

- H. Use Low-Modulus Silicone sealant rubber based with pigments and fillers formulated to provide excellent weather and ultraviolet rays resistance.
- I. Mildew-Resistant Silicone Sealant: Use Rubber-based pigments and fillers formulated to resist mildew when exposed to hot, humid environments.

PART 3 EXECUTION

3.1 PREPARATION

- A. Inspect joint surfaces before starting work. Verify surfaces are dry and meet sealant manufacturer's requirements.
- B. Clean joint surfaces immediately before installation of gaskets and sealants. Remove dirt, moisture, frost, coatings and other foreign substances that will interfere with performance of compression seal and sealants.
- C. Etch concrete and masonry joint surfaces as recommended by sealant manufacturer.
- D. Prime or seal joints surfaces as recommended by the sealant manufacturer and as shown.
- E. Confine primer or sealer to areas of the compression seal and sealant bond area.
- F. Install bond breaker tape in locations and of type recommended by the sealant manufacturer to prevent bond of sealant to surfaces where such bond could impair the performance of the sealant.
- G. In all joints to receive sealant, install bond breaker specified over backup, unless otherwise recommended by the sealant manufacturer.

3.2 APPLICATION

- A. General
 - 1. Use appropriate and approved equipment to install material in accordance with manufacturer's recommendations for materials intended except where more stringent requirements are shown or specified.
 - 2. Prevent sealants and compounds from spilling onto adjoining surfaces or to migrate into voids of exposed finishes by using masking tape other methods.
 - 3. Clean spills on adjoining surfaces immediately.
- B. Sealant and Accessories
 - 1. Install backup material in joints using blunt instruments to avoid puncturing and to control caulking depth.
 - 2. Do not twist rod while installing.

3. Install backing to provide joint depth of:
 - a. Window joints: 1/2-inch wide by 1/2-inch deep.
 - b. Metal louvers and metal door frame joints: 1/4-inch wide by 1/4-inch deep.
 - c. All other joints: 1/2-inch to one-inch wide by 1/2-inch deep.
4. Place sealant in a manner that will fill the joint without air pockets and form a smooth surface.
5. For exposed surfaces of gun and knife grade sealant that cannot be made smooth during initial application, smooth with tool moistened with either water or sealant solvent.
6. Prepare sealant mixtures in quantities that can be applied within the time period recommended by the manufacturer.
7. Discard Materials mixed and not used within this time period.
8. Finish joint to a smooth concave surface slightly lower than adjoining surfaces
9. Use joints that are finished for horizontal surfaces so moisture and debris will not be entrapped.
10. Provide Finished surface free of wrinkles and sags.
11. Use mildew-resistant silicone sealant in toilet, shower, and locker areas.
12. Use acrylic sealant at interior locations only, in non-moving joints where paintable characteristics are required, such as gypsum board partitions, where caulking is shown, at joints requiring sealant to fill intersections of materials, and only if approved by the Engineer.
13. Use Elastomeric sealants (polyurethane, polysulfide or silicone) at all exterior locations where sealant is required or shown, and at interior locations typically, such as joints adjacent to door and window frames, at masonry construction and control joints.

3.3 CURING AND PROTECTION

- A. Cure joint sealers and accessories in accordance with manufacturer's instructions.
- B. Protect joint sealers during construction period to prevent damage, soiling or deterioration other than normal wear and weathering up to time of final acceptance.
- C. Replace or restore joint sealers damaged, soiled or deteriorated.

3.4 CLEANUP

- A. Clean adjacent surfaces of sealant and soiling.

- B. Use cleaning materials and methods recommended by manufacturer for the different surfaces.

END OF SECTION

**SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 06 10 00 Carpentry
- C. Section 04 22 00 Concrete Masonry Unit

1.2 SCOPE

- A. The work in this Section of the Specifications consists of furnishing all materials and equipment and performing all labor necessary for the installation of all hollow metal doors and frames as indicated on the Contract Drawings and/or as specified.

PART 2 PRODUCTS

2.1 COMMERCIAL HOLLOW METAL DOORS AND FRAMES

- A. All hollow metal work shall be warranted from defects in workmanship and quality for a period of one (1) year from shipment.
- B. Materials:
 - 1. Doors shall be made of commercial quality, level, cold-rolled steel conforming to ASTM A1008 and ASTM A568 or hot-rolled, pickled and oiled steel conforming to ASTM A1011 and ASTM A568. The steel shall be free of scale, pitting, coil breaks or other surface blemishes. It shall also be free of buckles, waves or any other defects caused by the use of improperly leveled sheets. Provide Hasp manufactured by ABUS model 110/155 Art. No. 01475 or approved equal.
 - 2. Frames shall be constructed of commercial quality, cold rolled steel conforming to ASTM A1008 and ASTM A568 or hot-rolled, pickled and oiled steel conforming to ASTM A1011 and ASTM A568, the steel shall be free of scale, pitting, coilbreaks or other surface defects.
 - 3. Exterior Openings: All openings shall have a zinc coating applied by the hot-dip process conforming to ASTM A526, A60 or G60, with a coating weight of not less than 0.60 ounces per square foot (0.30 ounces per square foot per side). In openings 4'-0" or less, steel shall be 16 gage minimum thickness. In openings greater than 4'-0", steel shall be 16 gage minimum thickness.

2.2 CONSTRUCTION

- A. All frames shall have integral stops and be welded units of the sizes and types shown on approved submittal drawings. Frames shall be constructed in accordance with these Specifications. Knock down frames are not acceptable.
- B. All finished work shall be neat in appearance, square and free of defects, warps or buckles. Pressed steel members shall be straight and of uniform profile through their lengths.
- C. Jamb, header, mullion and sill profiles shall be in accordance with the frame schedule and as shown on the approved submittal drawings.
- D. Corner joints shall have all contact edges closed tight with faces mitered and stops either butted or mitered. Faces and soffits shall be continuously welded, and the faces finished smooth. The use of gussets or splice plates as a substitute for welding shall not be acceptable.
- E. All other face joints should be continuously welded and smoothly finished.
- F. Minimum depth of stops shall be 5/8". Cut-off stops, where shown, shall be capped at 45° and 90° at heights as shown on approved submittal drawings, and jamb joints below cut-off stops shall be welded, filled and ground smooth so that there are no visible seams.
- G. When shipping limitations are so dictated, frames for large openings shall be fabricated in sections designated for assembly in the field by others. Alignment plates or angles shall be installed at each joint. Such components shall be the same gage thickness as the frame. Field joints shall be made in accordance with approved submittal drawings and shall be filed welded by others.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Hollow metal doors and frames shall be installed in accordance with manufacturer's recommendations.

END OF SECTION

**SECTION 08 71 00
DOOR HARDWARE**

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 08 11 13 Hollow Metal Doors and Frames

1.2 DESCRIPTION OF WORK

- A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.
- B. This Section includes the following:
 - 1. Hinges
 - 2. Continuous hinges
 - 3. Key control system
 - 4. Lock cylinders and keys
 - 5. Lock and latch sets
 - 6. Bolts
 - 7. Push/Pull units
 - 8. Closers
 - 9. Overhead holders
 - 10. Protection plates
 - 11. Weatherstripping for exterior doors
 - 12. Sound stripping for interior doors
 - 13. Automatic drop seals (door bottoms)
 - 14. Astragals or meeting seals on pairs of doors
 - 15. Thresholds

1.3 REFERENCES

- A. Standards of the following as referenced:
 - 1. American National Standards Institute (ANSI)
 - 2. Door and Hardware Institute (DHI)
 - 3. Factory Mutual (FM)
 - 4. National Fire Protection Association (NFPA)
 - 5. Underwriters' Laboratories, Inc. (UL)
 - a. UL 10C - Fire Tests Door Assemblies
 - 6. Warnock Hersey
- B. Regulatory standards of the following as referenced:
 - 1. Department of Justice, Office of the Attorney General, *Americans with Disabilities Act*, Public Law 101-336 (ADA).
 - 2. CABO/ANSI A117.1: Providing Accessibility and Usability for Physically Handicap People, 1992 edition.

1.4 SUBMITTALS

- A. Shop Drawings: Provide shop drawings in accordance with Section 01330.
- B. Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements. For items other than those scheduled in the "Headings" of Section 3, provide catalog information for the specified items and for those submitted.
- C. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into vertical format "hardware sets" indicating complete designations of every item required for each door or opening. Use specification Heading numbers with any variations suffixed a, b, etc. Include the following information:
 - a. Type, style, function, size, and finish of each hardware item.
 - b. Name and manufacturer of each item.
 - c. Fastenings and other pertinent information.

- d. Location of each hardware set cross-referenced to indications on Drawings both on floor plans and in door and frame schedule.
- e. Explanation of all abbreviations, symbols, and codes contained in schedule.
- f. Mounting locations for hardware.
- g. Door and frame sizes and materials.
- h. Keying information.
- i. Cross-reference numbers used within schedule deviating from those specified.
 - (1) Column 1: State specified item and manufacturer.
 - (2) Column 2: State prior approved substituted item and its manufacturer.
- 2. Submittal Sequence: Submit final schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work that is critical in the Project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by door hardware, and other information essential to the coordinated review of schedule.
- 3. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- D. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- E. Contract closeout submittals
 - 1. Operation and maintenance data: Complete information for installed door hardware.
 - 2. Warranty: Completed and executed warranty forms.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.

1. Require supplier to meet with Owner to finalize keying requirements and to obtain final instructions in writing.
2. Required supplier to meet with installer prior to beginning of installation of door hardware.

1.6 PRODUCT HANDLING

- A. Tag each item or package separately with identification related to final hardware schedule and include basic installation instructions with each item or package.
- B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.
- C. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.
- D. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).
- E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.7 WARRANTY

- A. Special warranties:
 1. Door Closers: Ten-year period
 2. Locks and Cylinders: Three-year period

PART 2 PRODUCTS

2.1 MANUFACTURERD UNITS

- A. Hinges:
 1. Acceptable manufacturers:
 - a. Hager Hinge Company
 - b. Stanley Works
 - c. Ives*

2. Characteristics:

- a. Templates: Provide only template-produced units.
- b. Screws: Provide Phillips flat-head screws complying with the following requirements:
 - (1) For metal doors and frames install machine screws into drilled and tapped holes.
 - (2) For wood doors and frames install threaded-to-the-head woodscrews.
 - (3) For fire-rated wood doors install #12 x 1-1/4 inch, threaded-to-the-head steel wood screws.
 - (4) Finish screw heads to match surface of hinges or pivots.
- c. Hinge pins: Except as otherwise indicated, provide hinge pins as follows:
 - (1) Out-Swing Exterior Doors: Non-removable pins.
 - (2) Interior Doors: Non-rising pins.
 - (3) Tips: Flat button and matching plug. Finished to match leafs.
- d. Size: Size hinges in accordance with specified manufacturer's published recommendations.
- e. Quantity: Furnish one pair of hinges for all doors up to 5'0" high. Furnish one hinge for each additional 2-1/2 feet or fraction thereof.

B. Continuous Hinges

1. Acceptable manufacturers:

- a. Markar
- b. Select Products*
- c. Stanley

2. Characteristics:

- a. Continuous gear hinges to be manufactured of extruded 6063-T6 aluminum alloy with anodized finish, or factory painted finish as scheduled.
- b. All hinges are to be manufactured to template. Uncut hinges shall be non-handed and shall be a pinless assembly of three interlocking extrusions applied to the full height of the door and frame without mortising.
- c. Vertical door loads shall be carried on chemically lubricated polyacetal thrust bearings. The door and frame leaves shall be continually geared together for the

entire hinge length and secured with a full cover channel. Hinge to operate to a full 180°.

- d. Hinges to be milled, anodized, and assembled in matching pairs. Fasteners supplied shall be 410 stainless steel, plated and hardened.
- e. Provide UL listed continuous hinges at fire doors. Continuous hinges at fire doors (suffix -FR) shall meet the required ratings without the use of auxiliary fused pins or studs.

C. Cylinders

1. Acceptable manufacturers:

- a. Corbin/Russwin
- b. Sargent
- c. Schlage* Everest

2. Characteristics:

- a. Review the keying system with the Owner and provide the type required (master, grandmaster or great grandmaster), either new or integrated with Owner's existing system.
- b. Equip locksets with cylinders featuring construction master key feature. Construction master key feature permits voiding of construction keying without cylinder removal. Patented key and cylinder design shall be valid for a period of 15 years.
- c. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.
- d. Comply with Owner's instructions for master keying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks.
 - (1) Permanently inscribe each key with number of locks that identifies cylinder manufacturer's key symbol, and notation, "DO NOT DUPLICATE."
- e. Key Material: Provide keys of nickel silver only.
- f. Key Quantity: Furnish 3 change keys for each lock, 5 master keys for each master system, 5 grandmaster keys for each grandmaster system, and 6 construction master keys.
 - (1) Deliver keys to Owner.

D. Locksets, Latchsets, Deadbolts:

1. Acceptable manufacturers:
 - a. Corbin/Ruswin
 - b. Sargent
 - c. Schlage*
2. Mortise Locksets and Latchsets: as scheduled.
 - a. Chassis: cold-rolled steel, handing field-changeable without disassembly.
 - b. Latchbolts: 3/4-inch throw stainless steel anti-friction type.
 - c. Lever Trim: through-bolted, accessible design, cast or solid rod lever as scheduled. Spindles: independent break-away.
 - d. Thumbturns: accessible design not requiring pinching or twisting motionsto operate.
 - e. Deadbolts: stainless steel 1-inch throw.
 - f. Electric operation: Manufacturer-installed continuous duty solenoid.
 - g. Strikes: 16 gage curved stainless steel, bronze or brass with 1" deep box construction, lips of sufficient length to clear trim and protect clothing.
 - h. Scheduled Lock Series and Design: Schlage L series, 06A design.
 - i. Certifications:
 - (1) ANSI A156.13, 1994, Grade 1 Operational, Grade 1 Security.
 - (2) ANSI/ASTM F476-84 Grade 30 UL Listed.

E. Closers and Door Control Devices:

1. Acceptable manufacturers:
 - a. LCN Closers*
2. Characteristics:
 - a. Door closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder.

- b. All closers shall utilize a stable fluid withstanding temperature range of 120°F to -30°F without seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with standards UBC 7-2 (1997) and UL 10C.
- c. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for the physically handicapped. Spring power adjustment (LCN Fast™ Power Adjust) allows for quick and accurate power adjustment and visually shows closer power size settings by way of dial adjustment gauge located on closer spring tube. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed and back check.
- d. All closers shall have solid forged steel main arms (and forearms for parallel arm closers) and where specified shall have a cast-in solid stop on the closer shoe (“CNS”). Where door travel on out-swing doors must be limited, use “CNS” or “S-CNS” type closers. Auxiliary stops are not required when cushion type closers are used.
- e. Overhead concealed closers shall have spring power adjustable for 50% increase in closing power and fully mortised door tracks.
- f. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped provide adjustable units complying with ADA and ANSI A-117.1 provisions for door opening force.
- g. Closers to be installed to allow door swing as shown on plans. Doors swinging into exit corridors shall provide for corridor clear width as required by code. Where possible, mount closers inside rooms.
- h. Powder coating finish to be certified to exceed 100 hours salt spray testing by ETL, an independent testing laboratory used by BHMA for ANSI certification.

F. Overhead Door Holders:

- 1. Acceptable manufacturers:
 - a. Glynn Johnson*
 - b. Rixson Firemark
- 2. Characteristics:
 - a. Provide heavy duty door holders of stainless steel.
 - b. Concealed holders to be installed with the jamb bracket mortised flush with the bottom of the jamb. The arm and channel to be mortised into the door.

- c. Surface holders to be installed with the jamb bracket mounted on the stop.

G. Floor Stops and Wall Bumpers:

- 1. Acceptable manufacturers:
 - a. Trimco
 - b. Ives*
 - c. Rockwood Manufacturing
- 2. Characteristics: Refer to Hardware Headings.

H. Door Bolts:

- 1. Acceptable manufacturers:
 - a. Trimco
 - b. Ives*
 - c. Rockwood Manufacturing
- 2. Characteristics:
 - a. Flush bolts to be forged brass 6-3/4" x 1", with 1/2" diameter bolts. Plungerto be supplied with milled surface one side that fits into a matching guide.

I. Push Pull Sets:

- 1. Acceptable manufacturers:
 - a. Trimco
 - b. Ives*
 - c. Rockwood Manufacturing
- 2. Characteristics:
 - a. Provide mounting systems as shown in hardware sets.
 - b. Material to be solid rod, stainless steel.
 - c. Provide Push/Pull sets sized as shown in Hardware Headings.

J. Protective Plates:

- 1. Acceptable manufacturers:

- a. Trimco
 - b. Ives*
 - c. Rockwood Manufacturing
- 2. Characteristics:
 - a. Provide manufacturers standard exposed fasteners for door trim units consisting of either machine screws or self-tapping screws.
 - b. Materials:
 - (1) Metal Plates: Stainless Steel, .050 inch (U.S. 18 gage).
 - c. Fabricate protection plates not more than 2 inches less than door width on hinge side and not more than 1 inch less than door width on pull side.
 - d. Heights:
 - (1) Kick plates to be 8 inches in height.
 - (2) Mop plates to be 8 inches in height.
- K. Thresholds:
 - 1. Acceptable manufacturers:
 - a. National Guard Products, Inc.*
 - b. Reese Industries
 - c. Zero Weatherstripping Co., Inc.
 - 2. Types: Indicated in Hardware Headings.
- L. Door Seals/Gasketing:
 - 1. Acceptable manufacturers:
 - a. National Guard Products, Inc.*
 - b. Reese Industries
 - c. Zero Weatherstripping Co., Inc.
 - 2. Types: Indicated in Hardware Headings.
- M. Silencers:

1. Acceptable manufacturers:
 - a. Hager
 - b. Ives*
 - c. Rockwood Manufacturing
 2. Three for each single doors; four for pairs of doors.
- N. Key Cabinet and System:
1. Acceptable manufacturers:
 - a. Telkee, Inc.
 2. Provide a key control system including envelopes, labels, tags with self-locking keyclips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150 percent of the number of locks required for the Project.
 - a. Provide hinged-panel type cabinet for wall mounting.

2.2 MISCELLANEOUS MATERIALS

- A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.
1. Manufacturer's identification will be permitted on rim of lock cylinders only.
- B. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.
- C. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
1. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
 2. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.

3. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners.
4. Use thru bolts for installation of all overhead holders and stops. Coordinate with wood doors and metal doors and frames where thru-bolts are used as a means of reinforcing the work; provide sleeves for each thru-bolt.

2.3 HARDWARE FINISHES

- A. Match items to the manufacturer's standard color and texture finish for the latch and lock sets (or push-pull units if no latch or lock sets).
- B. Provide finishes that match those established by ANSI or, if none established, match the Architect's sample.
- C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- D. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze, and aluminum, except as otherwise indicated. The suffix "-NL" is used with standard finish designations to indicate "no lacquer."
- E. The designations used to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.
 1. Hinges (Exterior): 630 (US32D) Satin Stainless Steel
 2. Hinges (Interior metal doors): 600 (USP)
 3. Continuous Hinges: 628 (US28) Clear Anodized Aluminum
 4. Flush Bolts: 626 (US26D) Satin Chrome Plated Brass/Bronze
 5. Locks: 630 (US32D) Satin Stainless Steel
 6. Door Closers: 689 Powder Coat Aluminum
 7. Protective Plates: 630 (US32D) Satin Stainless Steel
 8. Door Stops: 626 (US26D) Satin Chrome Plated Brass/Bronze
 9. Overhead Holders: 630 Satin Stainless Steel
 10. Thresholds/Weatherstripping: 627/628 (US27/US28) Aluminum

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Architect.
 - 1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.
 - 2. "Recommended Locations for Builders Hardware for Custom Steel Doors and Frames" by the Door and Hardware Institute.
 - 3. NWWDA Industry Standard I.S.1.7, "Hardware Locations for Wood Flush Doors."
- B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.
- C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7 Section "Joint Sealers".
- F. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.2 ADJUSTING CLEANING AND DEMONSTRATION

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
 - 1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to function properly with final operation of heating and ventilating equipment.

- B. Clean adjacent surfaces soiled by hardware installation.
- C. Door Hardware Supplier's Field Service
 - 1. Inspect door hardware items for correct installation and adjustment after complete installation of door hardware.
 - 2. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.
 - 3. File written report of this inspection to Architect.
- D. Prior to project completion, representatives of the lock, exit device and overhead closer manufacturers shall inspect and adjust all units and certify that all units are installed in accordance with the manufacturer's instructions, and are regulated properly and functioning correctly. A written report shall be provided to the Architect as to the inspection and shall include appropriate certificates.

3.3 HARDWARE SCHEDULE

<u>SET</u>	<u>QUANTITY, DESCRIPTION AND FINISH</u>
A	Single Exterior Door Panic 1 ½" Pair – Ball Bearing Butt Hinges 1- Keyed Entry Lockset 1- Exit Device 1- Closer 1- Threshold 1- Kickplate Weatherstripping Silencers
B	Pair Exterior Door Panic 3" Pair – Ball Bearing Butt Hinges 1- Keyed Entry Lockset 1- Exit Device 1- Closer 1- Threshold 1- Kickplate Weatherstripping Silencers

C	Single Exterior Door Panic 1 ½” Pair – Ball Bearing Butt Hinges 1- Passage Lockset 1- Exit Device 1- Closer 1- Threshold 1- Kickplate Silencers
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D	Single Interior Door 1 ½” Pair – Ball Bearing Butt Hinges 1- Keyed Entry Lockset 1- Door stop 1- Kickplate Silencers
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E	Single Interior Door 1 ½” Pair – Ball Bearing Butt Hinges 1- Privacy Lockset 1- Closer 1- Door stop 1- Kickplate Silencers
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F	Single Interior Door 1 ½” Pair – Ball Bearing Butt Hinges 1- Passage Lockset 1- Door stop 1- Kickplate Silencers
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END OF SECTION

**SECTION 09 29 00
GYPSUM BOARD**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to installed fully finished interior gypsum board in the locations shown on the Drawings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Submit in accordance with the Section 01 33 00 of these Specifications and show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
- C. Samples: Provide samples for the following products:
 - 1. Trim Accessories: Full-size sample in 12" (300-mm) long length for each trim accessory indicated.

1.3 QUALITY CONTROL

- A. Subject to compliance with requirements, provide products by American Gypsum Co., G-P Gypsum Corp., National Gypsum Company, United States Gypsum Co., or equal.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Interior Gypsum Wallboard
 - 1. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
 - 2. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. with moisture- and mold-resistant core and paper surfaces
 - a. Core: $\frac{5}{8}$ ", Type X
 - b. Long Edges: Tapered
 - c. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274
- B. Trim Accessories

- C. Interior Trim: ASTM C 1047
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Corner Bead: Use at outside corners, unless otherwise indicated.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
 - c. L-Bead: L-shaped; exposed long leg receives joint compound; use where indicated.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound; use at exposed panel edges where indicated.
 - e. Expansion (Control) Joint: Use where indicated.
 - f. Curved-Edge Corner Bead: With notched or flexible flanges; use at curved openings.
- D. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 - a. Manufacturers: Subject to compliance with requirements, provide products by Fry Reglet Corp., Gordon, Inc., MM Systems Corporation, Pittcon Industries, or equal.
 - b. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), alloy 6063-T5.
- E. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.
- F. Joint Treatment Materials:
 - 1. General: Comply with ASTM C 475.
 - 2. Joint Tape: Interior Gypsum Wallboard: Paper
 - 3. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - a. Pre-filling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - b. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.

- c. Use setting-type compound for installing paper-faced metal trim accessories.
- d. Fill Coat: For second coat, use sandable drying-type, all-purpose compound.
- e. Finish Coat: For third coat, use drying-type, all-purpose compound.
- f. Skim Coat: For final coat of Level 5 finish, use sandable drying-type, all-purpose compound.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16" (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- F. Attach gypsum panels to framing provided at openings and cutouts.
- G. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members using resilient channels or provide control joints to counteract wood shrinkage.
- H. Form control and expansion joints with space between edges of adjoining gypsum panels.
- I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
- J. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 square feet (0.7 m2) in area.
- K. Fit gypsum panels around ducts, pipes and conduits.
- L. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit

profile formed by coffers, joists, and other structural members; allow ¼" to ⅜" (6.4 to 9.5-mm) wide joints to install sealant.

- M. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide ¼" to ⅜" (6.4 to 12.7-mm) wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- N. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
- O. Space screws a maximum of 12" (304.8 mm) O.C. for vertical applications.
- P. Space fasteners in panels that are tile substrates a maximum of 8" (203.2 mm) O.C.
- Q. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- R. Pre-fill open joints, rounded edges, and damaged surface areas.
- S. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- T. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
 - 1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 - 2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.
 - 3. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view at typical area, unless otherwise indicated.
- U. Cementitious Backer Units: Finish according to manufacturer's written instructions.

END OF SECTION

**SECTION 09 30 13
FLOOR TILING**

PART 1 GENERAL

1.1 SCOPE

- A. The work in this Section of the Specifications consists of furnishing all materials and equipment and performing all labor necessary for the installation of all Porcelain floor tile as indicated on the Contract Drawings and/or as specified.

1.2 SUBMITTALS

- A. Product Data: Submit product data, including manufacturer's specification summary sheet for specified products. Refer to 01 33 00.
- B. Samples
 - 1. Each type and composition of tile and for each color and finish required.

PART 2 PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

- A. Tile Type: Porcelain Floor Tile
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Virginia Tile.
 - b. Daltile
 - c. Florim
- B. Module Size: 8" x 8" floor tile in Shower Room.
 - 1. Thickness: 3/8 inch.

2. Face: Pattern of design indicated, with manufacturer's standard edges.
3. Finish: Unglazed, full bodied.
4. Tile Pattern: Match existing.
5. Tile Color: Match existing.

2.3 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

2.4 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Chlorinated Polyethylene Sheet: Non-plasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch nominal thickness.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Noble Company (The); Nobleseal CIS.

2.5 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
 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. Boiardi Products; a QEP company.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.

- f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Mer-Kote Products, Inc.
 - j. Southern Grouts & Mortars, Inc.
 - k. Summitville Tiles, Inc.
 - l. TEC; a subsidiary of H. B. Fuller Company.
2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.6 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. Polymer-Modified Tile Grout: ANSI A118.7.
 - 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. Boiardi Products; a QEP company.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Southern Grouts & Mortars, Inc.
 - j. Summitville Tiles, Inc.
 - k. TEC; a subsidiary of H. B. Fuller Company.

2.7 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants."
 - 1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
- C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with adhesives or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Preparation: The following work should be complete and approved before installation of porcelain ceramic tile has begun:
 - 1. Verify that concrete substrates for tile floors installed with thin set mortar comply with surface finish requirements in ANSI A108.01.
 - 2. Surface to receive tile shall be plumb, level and true with square corners, maximum variation from required plan shall be 1/8" in 10 feet.

- a. Concrete surface to be troweled with a broom finish with no curing compounds. It is the responsibility of the flooring contractor to meet the 1/8" in 10 feet tolerance requirement.
- b. The existing terrazzo floor shall have all sealers and waves removed and the floor shall be abraded as required floor installation of new porcelain ceramic tile.
3. Apply Self-Leveling Underlayment to concrete floor and existing terrazzo floors where determined by architect conjunction with the tile contractor. Leveling shall be compatible with setting mortar.
4. Before setting, ensure that substrates for setting tile are firm, dry, clean free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone.
5. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
6. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
7. Report all unacceptable surfaces to the architect; do not set until surface areas are corrected.
8. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect. Crack Isolation Membrane to be used on non-directional cracks, shrinkage cracks, and all areas where crack transfer is suspected.
9. Locate and determine expansion joints based on building control joints, cold joints, sawed joints and recommended expansion joints based on TCA specifications current issue of EJ 171.

3.3 TILE INSTALLATION

- A. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- B. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- C. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- D. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.

- E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Floor Tile: 1/8 inch.
 - 2. Wall Tile: 1/16 inch.
- G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless
- J. Metal Edge Strips: Install at all floor transitions from tile to other materials. All outside and insider corners and material transitions on walls.
 - 1. Schluter Systems:
 - a. Floors – 304 Stainless Steel
 - b. Walls –
 - c. Outside corners – RONDEC
 - d. Inside corners - DILEX
- K. Grout Sealer: Apply grout sealer to grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
- L. Install cementitious panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.
- M. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- N. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

END OF SECTION

**SECTION 09 91 00
PAINTING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Work included under this Section shall consist of furnishing all materials and equipment and performance of all labor necessary to paint and waterproof exterior and interior surfaces as outlined in this Section.

1.2 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 03 30 00 Cast in Place Concrete
- C. Section 04 22 00 Concrete Masonry Unit
- D. Section 06 10 00 Carpentry
- E. Section 26 00 00 General Electrical Provisions
- F. Section 33 35 00 Process Valves and Appurtenances
- G. Division 40, 43, and 46

1.3 PAINTING INCLUDED

- A. The work includes painting and finishing of interior and exterior exposed items and surfaces throughout the project, except as otherwise specified. Surface preparation, priming and coats of paint specified under this Section are in addition to shop-priming and surface treatment specified under other Sections, except as otherwise specified.
- B. The work includes field painting of all bare and covered pipes and ducts (including color coding), and of hangers, exposed steel and iron work, and primed metal surfaces of equipment installed under the mechanical and electrical work, except as otherwise specified.
- C. "Paint", as used herein, means all coating systems materials, including primers, emulsions, enamels, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.
- D. Paint all exposed surfaces whether or not colors are designated in "schedules", except where the natural finish of the material is obviously intended or specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas. If color or finish is not designated, the Engineer will select these from standard colors available for the materials systems as specified.

1.4 PAINTING NOT INCLUDED

- A. The following categories of work are not included as part of the painter-applied finish work, or are included in other Sections of these Specifications, unless otherwise shown or specified.
1. Shop Priming: Unless otherwise specified, shop priming of ferrous and other metal items is included under the various Sections for structural steel, miscellaneous metal, hollow metal work, and similar items. Also, for fabricated components such as wood casework, and shop-fabricated or factory-built mechanical and electrical equipment or accessories.
 2. Pre-Finished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) metal toilet enclosures, acoustic materials, pre-finished woodwork, and casework, finished mechanical and electrical equipment including light fixtures, switchgear and distribution cabinets, doors, and equipment.
 3. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, and duct shafts. Paint all piping, equipment, and other such items in concealed spaces, unless otherwise indicated.
 4. Finished Metal Surfaces: Metal surfaces of aluminum, stainless steel, chromium plate, copper, bronze, and similar finished materials will not require finish painting, except as otherwise indicated.
 5. Operating Parts and Labels: Do not paint any moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor, and fan shafts, unless otherwise indicated. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.
 6. Existing Piping, existing valves, existing equipment, unless otherwise noted:

1.5 SURFACE PREPARATION

- A. Surface preparation shall be in accordance with the specification and manufacturer's recommendations. All surfaces must be clean, dry, and free of oil, grease, and other contaminants prior to coating.
1. Ferrous Metals – Immersion & Severe Exposure: SSPC-SP10 Near-White Blast Cleaning
 2. Ferrous Metals – Non-Immersion: SSPC-SP6 Commercial Blast Cleaning
 3. Non-Ferrous Metals: SSPC-SP16 Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals

4. Concrete: Prepare concrete surfaces in accordance with NACE No. 6/SSPC-SP13 Joint Surface Preparation Standards and ICRI Technical Guidelines
5. Concrete Block (CMU) – Non-Submerged: Allow mortar to cure for 14 days. Level protrusions and mortar spatter.
6. Wood: Sand rough areas. Seal knots and pitch pockets. Fill cracks and nail holes after primer has cured.

PART 2 PRODUCTS

2.1 MATERIAL

- A. Material shall be delivered in unbroken original containers bearing the manufacturer's name, trade name, mixing instructions, and application instructions.
- B. The Owner will select the colors from manufacturer's standard color chart.
- C. Provide the best quality grade of the various types of coatings as regularly manufactured by approved paint materials manufacturers. Materials not displaying the manufacturer's identification as a standard, best-grade product will not be acceptable.
- D. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer and use only within recommended limits.
- E. Acceptable manufacturers include Induron, Carboline, Tnemec, and Sherwin-Williams according to the following schedules.
- F. Concrete coating for cast in place concrete shall be Thoroseal.

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Surface	Induron Coatings, Inc.	Induron Application
1. Structural Steel and Miscellaneous Iron and Steel	PermaClean II Primer	<u>Shop Primer</u> One (1) Coat 3.0 to 5.0 mils dft
A. All interior miscellaneous iron and steel	PermaClean II	<u>Finish Coat</u> Two (2) Coats 3.0 to 5.0 mils dft per coat
B. All exterior miscellaneous iron and steel	PermaClean II	<u>Intermediate Coat</u> 3.0 to 5.0 mils dft per coat
	Indurethane 6600 Plus	<u>Finish Coat</u> 2.0 to 3.0 mils dft per coat
C. All miscellaneous iron and steel in vaults, pits, galleries and in areas exposed to extreme humidity and condensation	PermaClean II	<u>Finish Coat</u> Two (2) Coats 3.0 to 5.0 mils dft per coat
D. All structural Steel	PermaClean II	<u>Finish Coat</u> Two (2) Coats 3.0 to 5.0 mils dft per coat
E. All equipment, iron and steel in areas covered with sewage	PermaClean II Primer	<u>Primer Coat</u> One (1) Coat 0.3 to 5.0 mils dft per coat
	Ruff Stuff 2100 Coal Tar Epoxy	<u>Finish Coat</u> One (1) Coat 16.0 to 18.0 mils dft per coat
2. Exposed Cast Iron Piping System (primed in shop)	PermaClean II Primer	<u>Prime Coat</u> 3.0 to 5.0 mils dft per coat
	PermaClean II	<u>Intermediate Coat</u> 3.0 to 5.0 mils dft per coat
	Indurethane 6600 Plus	<u>Finish Coat</u> 2.0 to 3.0 mils dft per coat
3. Galvanized Iron	Vinyl Wash Primer	<u>Prime Coat</u> 0.5 mils dft
	PermaClean II	<u>Intermediate Coat</u> 3.0 to 5.0 mils dft per coat

	Indurethane 6600 Plus	<u>Finish Coat</u> 2.0 to 3.0 mils dft per coat
4. Exposed Electrical Work	Vinyl Wash Primer	<u>Prime Coat</u> 0.5 mils dft
	PermaClean II	<u>Intermediate Coat</u> 3.0 to 5.0 mils dft per coat
	Indurethane 6600 Plus	<u>Finish Coat</u> 2.0 to 3.0 mils dft per coat
5. Interior & Exterior Concrete Block, non-submerged	Polyfill Epoxy Block filler (Interior) AC403 Elastomeric Block Filler (Exterior)	<u>Prime Coat</u> Fill Porous Surface (Interior) 0.5 to 1.0 mils dft (Exterior)
	Induraguard Epoxy (Interior) AC403 Elastomeric (Exterior)	<u>Finish Coat</u> Two (2) coats (Interior) 3.0 to 5.0 mils dft each coat Two (2) coats (Exterior) 6.0 to 12.0 mils dft each coat
6. Ferrous metal Doors and Frames	PermaClean II Epoxy Primer	<u>Prime Coat</u> 3.0 to 5.0 mils dft per coat
	PermaClean II	<u>Finish Coat</u> Two (2) coats 3.0 to 5.0 mils dft per coat
7. Equipment	E-Bond 100	<u>Field Prime Coat</u> 1.0 to 2.0 mils dft per coat
	Indurethane 6600 Plus	<u>Finish Coat</u> 2.0 to 3.0 mils dft per coat
8. Interior and Exterior Wood Surface	Aquanaut Primer	<u>Prime Coat</u> 2.0 to 3.0 mils dft per coat
	Aquanaut II	<u>Finish Coat</u> Two (2) Coats 2.0 to 4.0 mils dft per coat
9. Galvanized Steel Trusses and Roof Deck	Vinyl Wash Primer	<u>Prime Coat</u> 0.5 mils dft
	PermaClean II	<u>Finish Coat</u> Two (2) Coats 3.0 to 5.0 mils dft per coat

10. Concrete Wet Well and manholes (as called out)	PermaClean II Primer	<u>Prime Coat</u>
		One (1) Coat
		3.0 to 5.0 mils dft per coat
	Ruff Stuff 2100 Coal Tar Epoxy	<u>Finish Coat</u>
		One (1) Coat
		16.0 to 18.0 mils dft per coat

Surface	Carboline Company	Carboline Application
1. Structural Steel and Miscellaneous Iron and Steel	Carboguard 60	<u>Shop Primer</u> One (1) Coat 4.0 to 6.0 mils dft
A. All interior miscellaneous iron and steel	Carboguard 890	<u>Finish Coat</u> Two (2) Coats 4.0 to 6.0 mils dft per coat
B. All exterior miscellaneous iron and steel	Carboguard 890	<u>Finish Coat</u> One (1) Coat 4.0 to 6.0 mils dft
	Carbothane 134 HG	<u>Finish Coat</u> One (1) Coat 2.0 to 3.0 mils dft
C. All miscellaneous iron and steel in vaults, pits, galleries and in areas exposed to extreme humidity and condensation	Carboguard 890	<u>Finish</u> Two (2) Coats 4.0 to 6.0 mils dft per coat
D. All structural Steel	Carbocoat 60	<u>Finish</u> Two (2) Coats 4.0 to 6.0 mils dft per coat
E. All equipment, iron and steel in areas covered with sewage	Carboguard 60	<u>Shop Primer</u> One (1) Coat 4.0 to 6.0 mils dft
	Carboline Bitumastic 300 M Coal tar Epoxy	<u>Finish</u> Two (2) Coats 8.0 mils dft per coat
2. Exposed Cast Iron Piping System (primed in shop)	Carboguard 890	<u>Prime Coat</u> One (1) Coat 4.0 to 6.0 mils dft per coat
	Carbothane 134 HG	<u>Finish Coat</u> One (1) Coat 2.0 to 3.0 mils dft
3. Galvanized Iron	Sanitile 120	<u>Prime Coat</u> One (1) Coat 1.0 to 2.0 mils dft
	Carbocrylic 3359	<u>Finish Coat</u> Two (2) Coats 2.0 to 3.0 mils dft per coat

4. Exposed Electrical Work	Sanitile 120	<u>Prime Coat</u> One (1) Coat 0.5 mils dft
	Carbocrylic 3359	<u>Finish Coat</u> One (1) Coat 2.0 to 3.0 mils dft per coat
5. Interior & Exterior Concrete Block, non-submerged	Sanitile 100	<u>Prime Coat</u> One (1) Coat 12.0 to 14.0 mils dft
	Sanitile 155 WB (Exterior) Carboguard 890 (Interior)	<u>Finish Coat</u> 2.0 to 3.0 mils dft (Exterior), 4.0 to 6.0 mils dft (Interior)
6. Ferrous Metal Doors and Frames	Sanitile 120	<u>Prime Coat</u> 1.0 to 2.0 mils dft
	Carbocrylic 3359	<u>Finish Coat</u> One (1) Coat 2.0 to 3.0 mils dft
7. Equipment	Carbocrylic 3359	<u>Finish Coat</u> One (1) Coat 2.0 to 3.0 mils dft
8. Interior and Exterior Wood Surface	Sanitile 120	<u>Prime Coat</u> 1.0 to 2.0 mils dft
	Carbocrylic 3359	<u>Finish Coat</u> One (1) Coat 2.0 to 3.0 mils dft
9. Galvanized Steel Trusses and Roof Deck	Carboline Rustbond Penetrating Sealer	<u>Prime Coat</u> One (1) Coat 1.0 to 2.0 mils dft
	Carboguard 890	<u>Finish Coat</u> Two (2) Coats 4.0 to 6.0 mils dft per coat
10. Concrete Wet Well and manholes (as called out)	Carboguard 510 SG	<u>Resurfacer</u> Up to 1/4" as needed in single coat
	Plasite 4500S	<u>Finish</u> Two (2) Coats 830.0 to 40.0 mils dft per coat

Surface	Tnemec Company, Inc.	Tnemec Application
1. Structural Steel and Miscellaneous Iron and Steel	Series N69F	<u>Shop Primer</u> One (1) Coat 3.0 to 5.0 mils dft
A. All interior miscellaneous iron and steel	Series N69	<u>Finish Coat</u> Two (2) Coats 3.0 to 5.0 mils dft per coat
B. All exterior miscellaneous iron and steel	Series N69	<u>Intermediate Coat</u> One (1) Coat 3.0 to 5.0 mils dft
	Series 72	<u>Finish Coat</u> One (1) Coat 2.0 to 3.0 mils dft
C. All miscellaneous iron and steel in vaults, pits, galleries and in areas exposed to extreme humidity and condensation	Series N69	<u>Finish</u> Two (2) Coats 4.0 to 6.0 mils dft per coat
D. All structural Steel	Series N69	<u>Finish</u> Two (2) Coats 3.0 to 5.0 mils dft per coat
E. All equipment, iron and steel in areas covered with sewage	Series N69-1211	<u>Prime Coat</u> One (1) Coat 3.0 to 5.0 mils dft
	Series 46H-413	<u>Finish Coat</u> One (1) Coat 16.0 to 20.0 mils dft
2. Exposed Cast Iron Piping System (primed in shop)	Series N140-1255 (shop primer)	<u>Shop Prime Coat</u> One (1) Coat 3.0 to 5.0 mils dft
	Series N69	Intermediate Coat One (1) Coat 3.0 to 5.0 mils dft
	Series 72	<u>Finish Coat</u> One (1) Coat 2.0 to 3.0 mils dft

3. Galvanized Iron	Series 115 Direct to Galvanized	<u>Prime Coat</u> One (1) Coat 2.0 to 3.0 mils dft
	Series 1029	<u>Finish Coat</u> One (1) Coat 2.0 to 3.0 mils dft
4. Exposed Electrical Work	Series 1029	<u>Finish Coat</u> Two (2) Coats 2.0 to 3.0 mils dft per coat
Surface	Tnemec Company, Inc.	Tnemec Application
5. Interior & Exterior Concrete Block, non-submerged	Series 130 (Interior and Exterior)	<u>Prime Coat</u> 80-100 sf per gallon (Interior and Exterior)
	Series 113 (interior) Series 156 (exterior)	<u>Finish Coat</u> Two (2) Coats 4.0 to 6.0 mils dft per coat (Interior and Exterior)
6. Ferrous Metal Doors and Frames	Series 151	<u>Prime Coat</u> One (1) Coat 1.0 to 1.5 mils dft
	Series 1029	<u>Finish Coat</u> Two (2) Coats 2.0 to 3.0 mils dft
7. Equipment	Series 1029	<u>Finish Coat</u> Two (2) Coats 2.0 to 3.0 mils dft
8. Interior and Exterior Wood Surface	Series 151	<u>Prime Coat</u> One (1) Coat 1.0 to 1.5 mils dft
	Series 1029	<u>Finish Coat</u> Two (2) Coats 1.5 to 2.5 mils dft
9. Galvanized Steel Trusses and Roof Deck	Series 115 Direct	<u>Finish Coat</u> Two (2) Coats 2.0 to 3.0 mils dft per coat

10. Concrete Wet Well and manholes (as called out)	Series 218	<u>Resurfacer</u> One (1) Coat 1/8" Nominal Thickness
	Series G435	<u>Finish Coat</u> Two (2) Coats 30.0 to 40.0 mils dft

Surface	Sherwin-Williams	S-W Application
1. Structural Steel and Miscellaneous Iron and Steel	Macropox 646 FC Epoxy	<u>Shop Primer</u> One (1) Coat 1.1 to 6.0 mils dft
A. All interior miscellaneous iron and steel	Macropoxy 646 FC Epoxy	<u>Finish Coat</u> Two (2) Coats 4.0 to 8.0 mils dft per coat
B. All exterior miscellaneous iron and steel	Macropoxy 646 FC Epoxy Acrolon 218	<u>Prime Coat</u> One (1) Coat 5.0 to 10.0 mils dft <u>Finish Coat</u> One (1) Coat 2.0 to 3.0 mils dft
C. All miscellaneous iron and steel in vaults, pits, galleries and in areas exposed to extreme humidity and condensation	Macropoxy 646	<u>Finish</u> Two (2) Coats 4.0 to 8.0 mils dft per coat
D. All structural Steel	Macropoxy 646 FC Epoxy	<u>Finish</u> Two (2) Coats 4.0 to 8.0 mils dft per coat
E. All equipment, iron and steel in areas covered with sewage	Macropoxy 240 Sher-Glass FF Epoxy	<u>Shop Primer</u> One (1) Coat 4.0 to 6.0 mils dft <u>Finish</u> Two (2) Coats (Direct to metal if blasted in the field) 8.0 to 20.0 mils dft per coat

2. Exposed Cast Iron Piping System (primed in shop)	Macropoxy 240	<u>Shop Primer</u> One (1) Coat 4.0 to 6.0 mils dft
	Sher-Glass FF Epoxy	<u>Finish</u> Two (2) Coats (Direct to metal if blasted in the field) 8.0 to 20.0 mils dft per coat
3. Galvanized Iron	Pro-Cryl Primer	<u>Prime Coat</u> One (1) Coat 1.8 to 3.6 mils dft
	Pro Industrial DTM Acrylic	<u>Finish Coat</u> Two (2) Coats 2.4 to 4.0 mils dft per coat
4. Exposed Electrical Work	Pro-Cryl Primer	<u>Prime Coat</u> One (1) Coat 1.8 to 3.6 mils dft
	Pro Industrial DTM Acrylic	<u>Finish Coat</u> Two (2) Coats 2.4 to 4.0 mils dft per coat
5. Interior & Exterior Concrete Block, non-submerged	Pro Industrial Block Filler	<u>Fill Coat</u> One (1) Coat 12.0 to 14.0 mils dft
	Loxon XP (Exterior), Pro Industrial WB Epoxy, B73-300 series (Interior)	<u>Finish Coat</u> 6.5 to 8.5 mils dft (Exterior), 2.0 to 5.0 mils dft (Interior)
6. Ferrous Metal Doors and Frames	Pro-Cryl Primer	<u>Prime Coat</u> 1.8 to 3.6 mils dft
	Pro Industrial DTM Acrylic	<u>Finish Coat</u> Two (2) Coats 2.4 to 4.0 mils dft per coat
7. Equipment	Pro Industrial DTM Acrylic	<u>Finish Coat</u> Two (2) Coats 2.4 to 4.0 mils dft per coat
8. Interior and Exterior Wood Surface	Pro Block Latex Primer	<u>Prime Coat</u> 1.4 min mils dft
	Pro Industrial DTM Acrylic	<u>Finish Coat</u> Two (2) Coats 2.4 to 4.0 mils dft per coat
9. Galvanized Steel Trusses and Roof Deck	Macropoxy 646 FC Epoxy	<u>Finish Coat</u> Two (2) Coats 4.0 to 8.0 mils dft per coat
10. Concrete Wet Well and manholes (as called out)	Hi Mil SherTar	<u>Finish</u> Two (2) Coats at 8-16 mils DFT Or one (1) at 16.0 to 18.0 mils Total dft

2.2 CONCRETE COATING

A. Exterior - Above Grade – Cement Based Waterproof System

1. Surface Preparation
 - a. Surfaces must be dry, clean, and free of oil, grease and other contaminants.
 - b. Allow concrete to cure 28 days.
2. 1st Coat
 - a. THOROSEAL, mixed per manufacturer recommendation.
 - b. Maximum Coverage: 2-lb./sq. yd
3. 2nd Coat
 - a. THOROSEAL, mixed per manufacturer recommendation.
 - b. Maximum Coverage: 1-lb./sq. yd

B. Exterior - Below Grade – Coal Tar System

1. Surface Preparation
 - a. Surfaces must be clean and dry.
2. 1st Coat
 - a. TNEMEC Series 46-465 H.B. Tnemecol or equal.
 - b. Maximum Coverage: 94 sf/gal
3. 2nd Coat:
 - a. TNEMEC Series 46-465 H.B. Tnemecol or equal.
 - b. Maximum Coverage: 94 sf/gal

C. Interior Exposure (Non-Submerged) – Epoxy System

1. Surface Preparation
 - a. Brush-Off Blast Cleaning
2. 1st Coat
 - a. TNEMEC Series 66 Hi-Build Epoxoline or equal.

- b. 4 – 5 mils dft.
- 3. 2nd Coat
 - a. TNEMEC Series 66 Hi-Build Epoxoline or equal.
 - b. 4 – 5 mils dft.

PART 3 EXECUTION

3.1 PAINTING

- A. Paint shall not be applied on damp or frosty surfaces, nor during wet, foggy, or weather below 50° F, or above 85% relative humidity. Comply with manufacturer's product data as to environmental conditions. Surfaces to be painted shall be made free of dust and other foreign matter before paint is applied; surfaces shall be completely dry before paint is applied. Iron and steel which have been shop primed, shall have all abrasions in the priming coat cleaned to bright metal to remove all scale, ridges, rust, and faults in the prime coat. Weld splatter shall be removed and that area re-primed. Voids and open and hollow places shall be repaired with a material compatible with the surface to be repaired.
- B. Paint shall be spread and brushed out so that there shall be no drops, runs, or sags in the coating. Where runs, sags, and drops do occur, they shall be removed, and the surface shall be re-coated. Paint shall be dry before additional coats are applied. Drop cloths shall be used to protect surfaces of the structure and equipment in place, and upon completion of work, paint spots shall be removed from surfaces and defaced surfaces shall be re-finished. Painting found to be defective, and that applied under adverse conditions, shall be removed and new paint shall be applied. Where more than one coat is required, undercoats shall be job-tinted.

3.2 CONCRETE COATING

- A. Mix and apply all products per the manufacturer recommendation. The substrate to be coated must be clean, dry, free of oil and grease. On exposed concrete, rub concrete with a carborundum brick to remove scale and ridges prior to application. Repair/patch honeycombing as needed, then apply coating. After first application allow time for coating to cure and re-apply a second coat.
- B. For Thoroseal application to exposed concrete, coat only the area that will be exposed and down to 12 inches below finish grade. Coat top of exposed wall. Area on the inside of a process basin to be rubbed smooth to a level 12 inches below top of water surface.

END OF SECTION

**SECTION 10 14 00
SIGNAGE**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and install signage as specified and scheduled herein.
- B. The types to be furnished are as follows:
 - 1. Restrictive Identification signs.
 - 2. Construction Entrance Banner.
- C. The entrance banner shall be in place before the date of formal groundbreaking ceremony.

1.2 RELATED WORK

- A. Piping and equipment identification is specified in Section 09 91 00.

1.3 SUBMITTALS

- A. Submit to the Engineer, the manufacturer's complete color range and type styles.
- B. Submit to the Engineer shop drawings showing details of construction and erection. Refer to Section 01 33 00.
- C. Submit
 - 1. Full size sample of each proposed plastic restrictive sign with proposed mounting systems.
 - 2. Other samples as directed.
- D. Submit to the Engineer cleaning and maintenance instructions for all signage components.
- E. Refer to PART 2 for the construction entrance banner submittal requirements.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Restrictive and Hazard Identification signs shall be:
 - 1. 60 mil, polished vinyl, overcoated with Tedlar sheet with four mounting holes and rounded corners for other locations.

2. Print (permanent type as approved) all with required graphics and letters. Print under overcoat where such occurs.
 3. Provide stainless steel fasteners and plastic drill-in anchors as required or stainless- steel wire for fastening where each is ordered.
 4. Signs shall be by Seton Name Plate Corp. or equal.
 5. Restrictive signs shall conform with OSHA regulations for accident prevention. Size of signs: 10-in high by 14-in. Refer to Schedule in Part 3 of this Section.
- B. Construction Entrance Banner shall meet the following:
1. Qty: 1
 2. Type: Solid vinyl, UV protected material, 100% blockage.
 3. Edge: Welded edge with border and black or brass grommets.
 4. Size: 5 feet tall and length as required.
 5. Color and Letter Size: Submit shop drawing example for Owner Selection.
 6. Information on Banner includes:
 - a. County Logo.
 - b. Name of Project and Date.
 - c. County Project Number.
 - d. Specific County Personnel Names (provided by Owner).
 - e. Prime Contractor Name.
 - f. Engineer Name.
 - g. Finance Source, if required. (provided by Owner)

PART 3 EXECUTION

3.1 INSTALLATION

- A. Signage shall be installed in accordance with the manufacturer's recommendations and approved shop drawings.
- B. Damaged units or components shall be removed and replaced at no cost to the Owner.
- C. Signage shall be cleaned to the satisfaction of the Engineer using the approved methods, upon

completion of the installation and again, just prior to acceptance of the Project.

- D. Mounting labor and stainless-steel hardware are required under this Section.
- E. Signage shall be located as follows:
 - 1. Restrictive Signage shall be mounted 60-in above the floor or at locations as directed by the Engineer or Owner.
 - 2. Construction Entrance Banner to be installed on existing fence near plant entrance gate.

3.2 SIGNAGE SCHEDULE

- A. Restrictive Signage Schedule

QUANTITY	SIGN COPY	LOCATION
3	DANGER High Voltage Electrical	As directed by the Engineer
3	Fire Extinguisher	As directed by the Engineer
6	CAUTION Equipment Starts Automatically	As directed by the Engineer
8	CAUTION Slippery When Wet	As directed by the Engineer
8	WARNING Reclaimed Water Do Not Drink	As directed by the Engineer
8	CAUTION Use Handrail	As directed by the Engineer
2	NOTICE Electrical Room Authorized Personnel Only	As directed by the Engineer
1	NOTICE Mechanical Room Authorized Personnel Only	As directed by the Engineer
10	Signage to be determined by Engineer and/or Owner	As directed by the Engineer

3.3 SIGNAGE LOCATIONS

- A. Signage shall be located as follows:
 - 1. Restrictive Signage shall be mounted at locations directed by the Engineer.

END OF SECTION

**SECTION 10 14 16
PLAQUES**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Furnish labor, equipment, and materials to install the plaque devices as herein specified and as shown on the drawings.

1.2 QUALITY ASSURANCE

- A. Manufacturer: For purposes of designating type and quality of products herein specified, the drawings and specifications are based on products manufactured or furnished by the firms listed in Part 2 Products. Manufacturers of products similar in design, quality and function may submit for approval prior to bidding.
- B. Acceptable Manufacturers:
 - 1. Andco Industries Corp.
 - 2. Spanjer Brothers, Inc.
 - 3. Leeds

1.3 SUBMITTALS

- A. Product data: Indicate material types, finishes and sizes, fabrication and installation details and requirements.
- B. Submit shop drawings in accordance with Section 01 33 00 of these specifications.

PART 2 PRODUCTS

2.1 PLAQUE

- A. Provide and install one (1) 16" x 21" aluminum plaque. The plaque shall be located at the entrance to the control building as directed by the Engineer.
 - 1. Plaque shall be 3/8" thick (minimum) with single line border and letters raised 1/8".
 - 2. Letters shall be Classic style on a painted black background.
 - 3. Letter and border shall be satin aluminum.
 - 4. Manufacturer of plaque shall provide all necessary anchors and fastening devices for attaching plaque to masonry wall.
- B. Inscription

1. Inscription shall be provided by the Owner. Contractor shall submit layout for approval.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's printed instruction, plumb, level and true to line and location.

END OF SECTION

**SECTION 10 44 16
FIRE EXTINGUISHERS AND ACCESSORIES**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and install fire extinguishers with brackets at other locations as shown and as directed.
- B. Refer to Section 10 14 00 for signage requirements.

1.2 SUBMITTALS

- A. Submit to the Engineer, as provided in Section 01 33 00, shop drawings showing details of construction and installation of fire extinguishers and brackets.
- B. Submit Operations and Maintenance Manuals. Refer to Section 01 78 23.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in manufacturer's original unopened and undamaged packages with labels legible and intact. Store materials in unopened packages in a manner to prevent damage from environment and construction operations. Handle in accordance with manufacturer's instructions.

1.4 REFERENCE STANDARDS

- A. Underwriters Laboratories (UL).
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Fire extinguishers shall be as specified below by J.L. Industries; Kidde Belleville; Elkhart Brass Mfg. Co. or equal. J.L Industries model numbers have been used to establish quality and type.
- B. Units as shown shall be 10 lb. nominal capacity, dry chemical type, U.L. rated for 4A-80BC. Units shall be red enameled aluminum cylinders, Cosmic 10E by J.L. Industries. Locate where shown/noted on the drawings.
- C. Surface mounted fire extinguishers shall be installed on concrete cast-in-place walls and columns shown on drawings. Mark Series fire extinguisher brackets, supporting bottom and sides of extinguishers as manufactured by J.L. Industries or equal, shall be provided for all surface mounted extinguishers.

- D. Provide 3 (three) fire extinguishers.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Verify the location of each fire extinguisher with the Fire Marshal.
- B. Fire extinguishers shall be installed at the locations and mounting heights shown and as indicated. If not indicated, at heights to comply with applicable regulations of governing authorities.
- C. Install fire extinguishers in strict compliance with the NFPA10.
- D. Install fire extinguishers in accordance with manufacturer's instructions.
 - 1. Surface mounted fire extinguishers shall be securely installed on brackets recommended by the manufacturer for fire extinguisher specified, and which shall be securely and properly anchored to the mounting surface.
 - a. Fire extinguishers installed under conditions where they are subject to dislodgement shall be installed in brackets specifically designed to cope with this problem.
 - 2. Fire extinguishers having a gross weight not exceeding 40 lb. shall be installed so that the top of the fire extinguisher is not more than 4 ft above the finished floor; greater than 40 lb. shall be installed so that the top of the fire extinguisher is not more than 3 ½ ft above the finished floor. In no case shall the clearance between the bottom of the fire extinguisher and the finished floor be less than 4 in.
- E. All fire extinguishers shall be inspected and certified within thirty days of substantial completion.
- F. Mount fire extinguisher signage above or adjacent to each extinguisher.

END OF SECTION

**SECTION 10 73 16
METAL CANOPIES**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Freestanding, pre-engineered metal canopies including structural steel framing, metal roof panels, accessories and trim. This work is through an Allowance.

1.2 QUALITY ASSURANCE

- A. Erector Qualifications: An erector with a minimum of five years of experienced who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for design and installations of metal canopy systems.

1.3 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 01 21 00 Allowances

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package roof and wall panels for protection during transportation and handling.
- B. Handling: Unload, store, and erect roof and wall panels to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weather tight and ventilated covering. Store roof and wall panels to ensure dryness. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturer's: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Arco Building Systems (678) 282-5085, TFC Canopy (800) 832-3212 or equal.

2.2 MATERIALS

- A. Structural-Steel Shapes: ASTM A 992/A 992M 50.0 ksi minimum yield strength.
- B. Steel Plate, Bar, or Strip: ASTM A 529/A 529M; 50.0 ksi minimum yield strength.
- C. Structural square HSS tube steel: A500 grade B; 46.0 ksi minimum yield strength.
- D. Structural round HSS tube steel: A500 grade B; 42.0 ksi minimum yield strength
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Grade 40, with G60 (Z180) coating designation.
- E. Metallic-Coated Steel Sheet Pre-painted with Coil Coating: Steel sheet metallic coated by the hot dip process and pre-painted by the coil-coating process to comply with ASTM A 755/A 755M and the following requirements:
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Grade 40, with G60 (Z180) coating designation.
- F. Primers: As selected by manufacturer for resistance to normal atmospheric corrosion, compatibility with finish paint systems, capability to provide a sound foundation for field-applied topcoats as follows:
- G. Primer: Manufacturer's standard, lead- and chromate-free, non-photochemically reactive, rust-inhibiting primer.

2.3 DECK MATERIALS

- A. Metallic-Coated Steel Sheet Pre-painted with Coil Coating: Steel sheet metallic coated by the hot dip process and pre-painted with polyester paint and compatible primer on the face side and wash coat on the back side by the coil-coating process to comply with ASTM A 755/A 755M and the following requirements:
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G60 (Z180) coating designation; Grade 50.
- B. Surface: Smooth, flat, mill finish.

2.4 STRUCTURAL FRAMING

- A. Canopy Framing: Manufacturer's standard structural-framing system, designed to withstand required loads, fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.
- B. Bracing: Provide lateral bracing as follows:

1. Fixed-Base Columns: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

2.5 ROOF PANELS

- A. 20 gauge x 16" wide x 3" smooth or embossed steel panels.
- B. Roof Panel Accessories: Provide components required for a complete roof panel assembly including trim, coping, corner units, clips, seam covers, battens, flashings, gutters, sealants, fillers, closure strips, and similar items. Match materials and finishes of roof panels, unless otherwise indicated.
- C. Panels shall have a finish side coated with a full coat of Silicone Modified Polyester (SMP) paint baked on over a polyester primer. Reverse side shall be protected by a whitewash coat baked on over a polyester primer.

PART 3 EXECUTION

3.1 REPARATION

- A. Clean substrates of substances, including oil, grease, rolling compounds, incompatible primers, and loose mill scale that impair bond of erection materials.
- B. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

3.2 ERECTION OF STRUCTURAL STEEL

- A. Erect metal canopy system according to manufacturer's written instructions and erection drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal canopy system manufacturer's professional engineer.
- C. Set structural framing in locations and to elevations indicated and according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base plates and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces before setting base plates and bearing plates. Clean bottom surface of base plates and bearing plates.
 1. Set base plates and bearing plates for structural members on leveling nuts.
 2. Tighten anchor bolts after supported members have been positioned and plumbed.
 3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure. Shrinkage-Resistant Grout to be provided and installed by the General Contractor.

- a. Comply with manufacturer's written instructions for proprietary grout materials.
- E. Align and adjust framing members before permanently fastening. Before assembly, clean bearing surfaces and other surfaces will be in permanent contact. Make adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
- F. Primary Framing: Erect framing true to line, level, plumb, rigid, and secure. Level base plates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation.
 - 1. Make field connections using high-strength bolts. Tighten bolts by turn-of-the-nut method.
- G. Secondary Framing: Erect framing true to line, level, plumb, rigid, and secure. Fasten secondary framing to primary framing using clips, non-high-strength bolts, and or screws as indicated on manufacturers erection drawings.
- H. Bracing: Install bracing in roof where indicated on manufacturers erection drawings.

3.3 ROOF PANEL INSTALLATION

- A. General: Provide roof panels of full length when possible.
 - 1. Field cutting by torch is not permitted.
 - 2. Rigidly fasten eave end of roof panels and allow ridge end free movement due to thermal expansion and contraction.
 - 3. Flash and seal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-drilling and tapping screws.
 - 4. Install screw fasteners with power tools having controlled torque adjusted to tighten without damaging screw threads, or panels.
 - 5. Use manufacturer supplied fasteners for exterior applications.
 - 6. Locate and space fastenings in true vertical and horizontal alignment.
- B. Deck Panels: Fasten roof panels to purlins with clip system that requires no “Thru Panel” fasteners.
 - 1. “Deck Clips” must be tested and rated to meet the most critical effects of load factors and load combinations.

3.4 ACCESSORY INSTALLATION

- A. General: Install gutters, downspouts, and other accessories according to manufacturer's written instructions, with positive anchorage and weather tight mounting. Coordinate installation with flashings and other components.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions. Provide for thermal expansion of metal units; conceal fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates resulting in waterproof and weather-resistant performance.
 - 2. Separations: Separate metal from incompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.

3.5 ERECTION AND LOCATION TOLERANCES

- A. Structural-Steel Erection Tolerances: Comply with erection tolerance limits of AISC 303-05, "Code of Standard Practice for Steel Buildings and Bridges."

3.6 CLEANING AND PROTECTION

- A. Touchup Painting: Immediately after erection, clean, prepare, and prime or re-prime welds, bolted connections, and abraded surfaces of prime-painted primary and secondary framing, accessories, and bearing plates.
 - 1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
 - 2. Apply compatible primer of same type as shop primer used on adjacent surfaces.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded surfaces of shop-painted primary and secondary framing, accessories, and bearing plates are included in Division 9 Section "Painting."
- C. Roof and Wall Panels: Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.
 - 1. Replace panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

**SECTION 22 05 00
PLUMBING**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Water piping, fittings, and valves
 - 2. Sanitary waste piping, fittings, and accessories.

1.2 SYSTEM DESCRIPTION

- A. Provide water piping, fittings, and valves for domestic water use. Provide sanitary waste piping, fittings, and accessories.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 – Submittal Procedures.
- B. Product Data:
 - 1. Include dimensions, finishes, construction information, capacities, operation instructions and accessories.
- C. Maintenance data for all products.
- D. Closeout Submittals:
 - 1. Coordinate provisions with Section 01 70 00 – Execution and Closeout Requirements.
- E. Submit operation and maintenance data and warranty information.

1.4 QUALITY ASSURANCE

- A. Coordinate with Section 01 40 00 - Quality Requirements.
- B. Manufacturer Qualifications:
 - 1. Minimum 5 years manufacturing similar products.
- C. Installer Qualifications:
 - 1. Minimum 2 years installing similar products.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
 - 1. Protect internal parts, valve ends, and specialties against corrosion, dirt, and damage.
 - 2. Store valves set in closed position.
 - 3. Storage:
 - a. Indoors: Higher than ambient dew point temperature.
 - b. Outdoors: Watertight enclosures off ground.
- B. Handling: Comply with manufacturer's recommendations.

1.6 WARRANTY

- A. Coordinate Section 01 70 00, Execution and Closeout Requirements.
- B. Provide One year warranty on all labor and materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Acceptable manufacturers are named in the following paragraphs.
- B. Alternates: The number and trade names given for any products are taken from various manufacturer catalogs as stated and shall be construed as being descriptive only of type, style, and quality of material required. Material from other reputable manufacturers of equal quality, type and style may be acceptable only if approved by the Engineer.

2.2 PRODUCTS

- A. Copper domestic water piping, fittings, and trim
 - 1. Provide Type “K” soft temper ASTM B 88 piping for piping underground or underground beneath the floor slab. Piping 1-inch and smaller shall be provided with no joints beneath floor slab. Piping greater than 1-inch underground or underground beneath the floor slab shall be provided with Type “K” hard copper piping and fittings joined with 15 percent silver solder. Piping underground beneath the floor slab shall be bedded in earth and shall not be in contact with concrete slab except at the slab penetration. The slab penetration shall be coated and wrapped. Solder and flux shall be lead free. Provide flux in accordance with ASTM B813 (flux shall be water flushable. Comply with ASTM B819, B 828, B32 and NSF 61.

2. Provide Type “L” hard copper ASTM B88 piping for above ground piping and for all indirect waste drain piping, including relief valve discharge piping. Provide wrought copper solder type fittings. Provide 95/5 tin/antimony solder. Solder and flux shall be lead free. Provide flux in accordance with ASTM B 813 (flux shall be water flushable). Comply with ASTM B819, B 828, B 32, and NSF 61.
 3. Provide dielectric fittings at all connections to water heaters, pumps, and equipment. Dielectric unions shall limit galvanic current 1% of the adjoining metal to metal contact. Rated for 150 psi. As manufactured by Epco, Victaulic, or Watts.
 4. Isolation valves 3-inch and smaller shall be ball valves; full port, malleable handle, brass stem, forged brass body, and hard chrome plated brass ball. Basis of design is Milwaukee BA 155 600 WOG, 150 SWP. Isolation valves 4-inch and larger shall be butterfly valves or lug type butterfly valves, bronze body, EPDM seat and stem seals, and bronze disk. Basis of design is Milwaukee “M” series. For valves 6-inch and smaller provide lever handle. For valves larger than 6-inch, provide gear operation. Lever handle shall be provided with 10 positions stop plate. Acceptable manufacturers are Apollo, Crane, DeZurik, Dover, Grinnell, Hammond, Jomar, Keystone, Kitz, Victaulic, Milwaukee, Mueller, Nibco, Powell, Resun, Stockham, SVF, Walworth, and Watts.
 5. Check valves shall be Watts Series LF007 Lead Free Double Check Valve Assemblies prevent the backflow of contaminated water into the potable water supply. It shall be constructed of lead-free cast copper silicon alloy (1/2 to 2 in), or fused epoxy coated cast iron (2 1/2 to 3 in) body construction. Maximum Working Pressure is 175psi.
 6. Pressure gauges and lever handle needle valves shall be by Trerice, Ashcroft, Marsh, Moeller, Weiss, Weksler, and American. Gauges shall be bourdon tube type. Bearing shall be bronze. Gauges shall be ANSI Grade A, dial indicating type, with 4-1/2” dial and stainless-steel case and ring.
- B. Cast iron and sanitary waste and vent piping and fittings.
1. Provide coated service weight cast iron no-hub soil piping and fittings, CISPI 301, for above ground piping 1 1/2” and larger. Comply with ASTM A-888 and C-564.
 2. Provide neoprene rubber sleeves, CISPI 301.
 3. Provide stainless steel compression, CISPI 301.
 4. Provide coated service weight cast iron hub and spigot piping CISPI HS-74 for underground piping 2” and larger. Comply with ASTM A-74 and C-564.
 5. All soil piping and fittings shall be installed in accordance with the CISPI Cast Iron Soil Pipe and Fittings Handbook.
- C. DWV copper piping and fittings
1. Provide drainage, waste, and vent copper manufactured in accordance with ASTM b-

306.

2. Provide wrought drainage fittings in accordance with ANSI B-16.29.
3. Provide solder and a compatible flux for joints.
4. Provide DWV copper for 2" and smaller concealed fixture branch arms. Provide red brass at urinals.

D. Equipment, Drains, and Accessories

1. Water Hammer Arrestors
 - a. Stainless steel housing, rubber bellows, size designations per Plumbing and Drainage Institute designate (PDI-WH-201).
 - b. Smith No. 5000 series all stainless steel "Hydrotrols" on both cold and hot water line or approved equal.
 - c. Install in an upright position at all quick closing valves, solenoids, and plumbing fixtures. Location and size as indicated on drawings. Where not shown on drawings, location and size in accordance with Plumbing & Drainage Institute Standard No. WH201.
2. Hose Bibb
 - a. Rough brass wall faucet with vacuum break, 3/4-inch hose thread, and wheel handle.
 - b. Woodford Model 24 or approved equal.
3. Fire Hose Ball Valve
 - a. Wye valve, 2 1/2-inch Inlet, 2x1 1/2 -inch outlets.
 - b. Application: Divides Single Flow to Double Flow.
 - c. Body Style: Wye
 - d. Inlet Type: Female NH
 - e. Outlet Type: Male NH x Male NH
 - f. Inlet Size: 2-1/2"
 - g. Outlet Size: 1-1/2" x 1-1/2"
 - h. Handle Type: Lever

- i. Handle Material: 304 Stainless Steel
 - j. Body Material: Brass
 - k. Ball Material: Brass Cast
 - l. Seal Material: Rubber
 - m. Seat Material: PTFE
 - n. Stem Material: Brass Bar
 - o. Max. Pressure: 300 psi
 - p. Manufacturer: Moon American or approved equal.
4. Water Pressure Reducing Valve: 1/2-inch – 2 1/2-inch.
- a. Design: Reduce incoming water pressure to a level to protecting plumbing system components and reducing water consumption.
 - b. Water Supply Pressures: up to 300psi.
 - c. Adjustable Reduced Pressure Range: 25 – 75psi.
 - d. Body: 1/2-inch – 2-inch Bronze; 2 1/2-inch Iron
 - e. Seat: Replaceable stainless steel
 - f. Diaphragm: Reinforced Buna-N
 - g. Disc: EPDM
 - h. Model Watts Series 223 or approved equal.
5. Eyewash: See Drawings schedule
6. Thermostatic Mixing Valve
- a. Cold water bypass flow (65% of rated tempered water flow) means continued protection under adverse conditions.
 - b. Flow range of 1 to 31 GPM provides service for one emergency combination shower or multiple eyewashes.
 - c. Haws Model 9201E.
7. Hot Water Recirculating System - Watts Model 500800 or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions
 - 1. Examine areas and conditions under which Work is to be performed and identify conditions that may be detrimental to proper or timely completion.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Demonstrate complete installation and operation before acceptance.

3.3 CLEANING

- A. Provide protective covering for installed units.
- B. Not to be used for temporary facilities without written approval by Owner.

3.4 DEMONSTRATION

- A. Demonstrate the operation and maintenance of equipment.

3.5 PROTECTION

- A. Protect work after installation until acceptance by the Owner.

END OF SECTION

**SECTION 22 05 29
HANGERS AND SUPPORTS**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Provide supports, hangers and anchors for piping, equipment, conduit, ductwork, valves, dampers, hardware, shims, and miscellaneous equipment.
- B. The Contractor is responsible for the design of all supports systems. Contractors shall provide all labor, materials, and equipment necessary to furnish, design and install an adequate system of hangers, supports, guidance, anchorage, and appurtenances.
- C. It shall be the Contractor's responsibility to select the appropriate type of support for each instance, in keeping with appropriate type related to the size and service of the pipe being supported. Adequate pipe supports shall be supplied for all systems to provide a rigid overall installation and additional support for pipe ends when equipment is disconnected.

1.2 SUBMITTALS

- A. Comply with Section 01 33 00. Include the following information:
 - 1. Make, model and design performance of each hanger and support and appurtenances.
 - 2. Details of methods for attachment of hangers and supports to building construction for equipment and piping.
 - 3. Manufacturer's catalog information that describes each type of hanger and support provided. Include:
 - a. Specifications.
 - b. A complete bill of materials that identifies all materials of construction.
 - 4. Sizing calculations prepared by a Registered Professional Engineer in the State of Georgia for each type of hanger and support provided.
 - a. Demonstrate acceptable performance for specified operating conditions.
 - b. Size each hanger and supports.
 - c. Include scaled drawings.
 - d. Shop drawing showing the location installation, loads and forces, and deflection of all hangers and supports and their reaction forces to the structure to which they are fastened.
 - e. Important details of construction,

- f. Equipment dimensions,
 - g. Size and location of anchor bolts, and
 - h. Locations of connections to other work.
- 5. Special shipping, storage, protection, and handling instructions.
- 6. Manufacturer's installation instructions.
- B. Maintenance data for all products.
- C. Closeout Submittals:
 - 1. Coordinate provisions with Section 01 70 00 – Execution and Closeout Requirements.
 - 2. Submit warranty information.

1.3 QUALITY ASSURANCE

- A. Coordinate with Section 01 40 00 - Quality Requirements.
- B. Manufacturer Qualifications:
 - 1. Minimum 5 years manufacturing similar products.
- C. Installer Qualifications:
 - 1. Minimum 2 years installing similar products.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Comply with Section 01 45 34, Storage Delivery and Handling.

1.5 GENERAL

- A. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.
 - 1. A single manufacturer shall provide all hangers and supports and appurtenances.
- B. Factor of Safety
 - 1. Hangers and supporting devices shall be designed to provide a minimum working safety factor of 12.

2. The safety factor for pipe hangers and supports shall be based on supporting ten linear feet of pipe filled with water.
3. The safety factor for ductwork supports shall be based on the weight of the ductwork and the duct containing a buildup of material equal to ten percent of the cross-sectional area with a material at 60 pounds per cubic foot.

1.6 WARRANTY

- A. The manufacturer shall warrant in writing all equipment against defects in materials and workmanship for a period of 12 months from the date of substantial completion. Within this 12-month period, any defective or malfunctioning equipment, component, or accessory shall be repaired or replaced upon notice at no additional cost to the Owner.
- B. Refer to Section 01 70 00 for additional information.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Acceptable manufacturers are named in the following paragraphs.
- B. Alternates: The number and trade names given for any products are taken from various manufacturer catalogs as stated and shall be construed as being descriptive only of type, style, and quality of material required. Material of other reputable manufacturers of equal quality, type and style may be acceptable only if approved by the Engineer.

2.2 PRODUCTS

- A. All supports, and hangers will meet the following material requirements.
 1. All structural steel will conform to ASTM A36.
 2. All structural stainless shall conform to ASTM A167, Type 304.
 3. All pipe support columns shall conform to ASTM 53, Grade and shall be minimum schedule 40.
 4. All embedded anchor bolt materials shall conform to ASTM A193, Grade B; ASTM A276, Type 304; or IFI-104, Grade 304. Nuts shall be heavy hex nuts conforming to ASTM A194, Grade 8 or IFI-104, Grade 304. Minimum anchor bolt size for pipe supports shall be 1/2 – inch diameter.
 5. All rod and bolting materials shall conform to ASTM A193, Type 304. Nuts shall be heavy hex nuts conforming to ASTM A193, Type 304.
 6. All carbon steel or malleable iron straps, hangers, clamps, U-bolts, and other hardware in contact with the pipe shall be shop primed, except where specified or shown on the Contract Drawings to be galvanized.

7. Expansion type anchor bolts shall be of stainless-steel construction and shall comply with federal Specification FF-S-325.
8. All interior and exterior concrete shall be Class A concrete meeting the requirements of these specifications.
9. Fiberglass channels and clamps for Unistrut pipe system are to be vinyl ester and must meet ASTM E84 Class I flame rating and self-extinguishing requirements of ASTM D635.

B. Supports

1. Long runs of pipe subject to expansion shall be hung by means of adjustable swivel pipe roll hangers, Grinnell Figure 174; Fee and Mason Figure 2729; or approved equal.
2. Short runs of uninsulated pipe subject to expansion up to and including 3 1/2 inches as well as pipe of those sizes not subject to expansion shall be hung by means of adjustable swivel, split pipe ring, Grinnell Figure 104; Fee and Mason Figure 199; or approved equal.
3. Insulated piping and tubing, short lengths of 4 inches and larger pipe subject to expansion, and pipes 4 inches and larger not subject to expansion shall be hung by means of adjustable steel clevis hanger, Grinnell Figure 260; Fee and Manson Figure 239; or approved equal.
4. Pipe 2 inches and less in diameter and not subject to expansion may, when paralleling walls, be supported by a single hook clamp hanger, Grinnell Figure 168; Fee and Mason Figure 327B; or approved equal.
5. Flat straphangers will not be permitted. Hangers relying on mastics or adhesives shall not be used.
6. Pipe supported from underneath and subject to expansion shall have adjustable roll stand supports, Grinnell Figure 274; Fee and Mason Figure 161; or approved equal. The pipe roll stand shall be supported by concrete piers, structural steel, or steel brackets as required.
7. Pipe supported underneath and not subject to expansion shall adjustable pipe roll stand supports. Supports shall be properly sized and properly grouted floor flanges. Adjustable pipe supports shall be Standon Model S89 Flange Support or approved equal.
8. Hangers suspended from structural steel shall be anchored on U.F.S. beam clamp, Grinnell Figure 228L or 2921; Fee and Mason Figure 252L or 253L; or approved equal.
9. Hangers from concrete work shall be secured by universal, galvanized metal inserts, Grinnell Figure 282; Fee and Mason 2570 or approved equal, placed in the concrete at the time of pouring.

10. Uninsulated copper tubing shall be hung by means of copper-plated, split ring hangers with copper-plated sockets, Grinnell Figure CT-109; Fee and Mason Figure 360; or approved equal.
11. Unistrut pipe supports shall be manufactured by B-Line or approved equal.

2.3 DUCTWORK HANGERS

- A. Sheet Metal Straps
 1. Galvanized straps shall conform to ASTM A 527 for lock-forming quality, and ASTM A 525 for coating designation G-90.
 2. Aluminum straps shall conform to ASTM B 209 for alloy MLA with H-14 temper.
 3. Stainless steel straps shall conform to ASTM A 167, Type 302, 304, or 316; and ASTM A 480, finish No. 1 or No. 4.
- B. Ductwork hangers and supports shall be 1/8-inch thick by one-inch-wide bands or one inch by one- inch channel or angle supports. Perforated bands shall not be acceptable.
- C. Hangers and supports shall be trapeze type.
- D. Fabricate ductwork hangers in accordance with SMACNA “HVAC Duct Construction Standards”.
- E. Sheet metal screws shall be the same material as the duct.
- F. Bolts and nuts shall be stainless steel unless otherwise noted.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 1. Examine areas and conditions under which Work is to be performed and identify conditions that may be detrimental to proper or timely completion.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Contact ferrous supports and non-ferrous piping materials shall not be permitted. Supports and clamps shall be rubber coated or copper plated as necessary to prevent such contact.
- B. Adequate supports shall be provided so that there is no movement or visible sagging between supports.

- C. Hangers shall permit a minimum of 1 1/2-inch vertical adjustment after installation.
- D. Hanger rods shall be stainless steel conforming to the following sizes:

Rod Diameter, Inches (MINIMUM)	Pipe Sizes, Inches
1/2 and under	1/4 - 2
5/8	2 1/2 - 4
3/4	5 -8
7/8	10 - 12

- E. Carbon steel, alloy steel, stainless steel, and hard-drawn copper pipe shall be supported on the maximum intervals as follows:

Pipe Size, Inches	Maximum Interval For Steel, Feet Liquid	Maximum Interval For Steel, Feet Gas	Maximum Interval For Copper, Feet
1/2	5	6	4
3/4	6	7	5
1	7	9	6
1 1/2	9	11	8
2	10	13	9
2 1/2	11	14	10
3	12	15	11
4	13	17	
6	17	21	
8	19	24	
10	22	27	
12	23	29	

- F. Annealed copper tubing, polyethylene tubing, and PVC piping shall be supported on the maximum intervals as follows:

Tube Size, Inches	Maximum Interval Feet
smaller	2
1/2	3
3/4-1	4
1 1/4-2	5
2 1/2 – 3 1/2	6
4	7
6	8

- G. Where indicated or directed by the Engineer, exposed piping and tubing carrying shall be sloped as necessary to permit complete drainage. Pipe deflection between supports shall be considered when determining the slope required to permit complete drainage. All underground piping shall be sloped uniformly for complete drainage.
- H. Cast iron and ductile iron shall be supported as recommended by manufacturer and at all valves and fittings larger than 4 inches. At least one support shall be provided per pipe section or at every other joint, whichever is closer. Supports shall be located next to hubs or bells.
- I. All threaded connections installed loose, such as hanger rods and U-bolts, shall have double nut installation.
- J. Vertical piping shall be supported as shown or required to prevent buckling or swaying utilizing special brackets. Unless otherwise shown, vertical piping shall be supported at the bottom and at each floor. Vertical copper tubing 1 inch and smaller shall be supported at 5-foot intervals.
- K. Provide a support within 18 inches of each elbow and within 24 inches of each equipment.
- L. Pipes passing through non-loading walls and partitions shall not bear on building construction. Pipes shall not be supported from roof decking, bar joists, or ceiling suspensions systems.
- M. No pipe supports shall be anchored to or supported from floor grating.
- N. All dimensions shall be field verified by Contractor. Size supports and hangers using actual field dimensions.
- O. The sizing of channels and clamps for Unistrut pipe support systems are to be based upon manufacturer's guidelines.
- P. Demonstrate complete installation and operation before acceptance.

3.3 FIELD PAINTING

- A. Field prepare and paint required surfaces as specified in Section 09 91 00.

END OF SECTION

**SECTION 22 05 33
HEAT TRACING FOR PIPING**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes pipe heat tracing and accessories.
- B. Refer to heat tracing schedule on the Drawings for additional information.

1.2 REFERENCES

- A. IEEE Standards:
 - 1. IEEE 515 - Standard for the Testing, Design, Installation and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications.

1.3 SUBMITTALS

- A. Comply with Section 01 33 00.
- B. Product Data: Submit product description, characteristics, and list of materials for each service and location, including heat tracing and accessories.
- C. Submit layout of each heat trace cable run, power supply end(s), location of thermostat(s), location of LED indicator light(s), location of splices, terminations, etc.
 - 1. Coordinate heat trace cable power requirements with the electrical work.
 - 2. Additional electrical circuits (conduit, fittings, connections, and conductors) may be required due to layout of heat trace cable requirements.
 - a. No additional costs will be paid for by the Owner for these circuits.
- D. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- F. Coordinate with plumbing insulation and jacketing materials.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- B. Applicator: Company shall be certified by the manufacturer of the heat tracing and shall have five (5) years written documented experience installing heat tracing/insulated/jacketed

systems.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 40 00 – Quality Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Install heat trace cable and accessories in accordance with manufacturer's written instructions.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers for Heat Trace Cable, Thermostat, Pilot Light, and Accessories:
 - 1. Raychem.
 - 2. Thermon.
 - 3. Or Equal

2.2 HEAT TRACING

- A. JBS-100 with LED Indicator Light.
 - 1. BTV Cable rated at 10 watts per foot for copper piping.
 - 2. BTV Cable rated at 5 watts per foot for PVC piping.
 - 3. AMC - F5 Fixed set point freeze protection thermostat.

4. AT-180 Aluminum tape.
5. When heat tracing PVC pipe, wrap the pipe in aluminum foil prior to installing the heat tracing as required by the heat tracing manufacturer.
6. E-100 -L-A end seal with red signal light.
7. Heating cables shall be self-regulating, capable of maintaining process temperatures up to 150°F and a continuous exposure to pipeline temperature of 185°F while de-energized.
8. Cable must be of parallel construction so that it can be cut to length without
9. changing its power output per unit length.
10. two parallel nickel-plated copper bus conductors with a semiconductive PTC polymer extruded over and between these parallel conductors.
 - a. A polyethylene dielectric insulating jacket is extruded over the heating element core.
11. The semiconductive heating matrix and primary insulating jacket shall be cross-linked by irradiation.
12. The basic cable will be covered by means of a metallic braid of tinned copper.
 - a. The braid will provide a nominal coverage of eighty percent (80%) and will exhibit a resistance not exceeding 0.0045 ohm/ft.
13. The cable shall be covered with a corrosion resistant over jacket of thermoplastic elastomer (for possible exposure to aqueous solutions, mild acids, or bases).
14. Long term stability shall be established by the service life performance test per IEEE 515 Std-current edition.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify piping has been tested before applying heat tracing materials.
- C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. Piping Systems:

1. Heat trace exposed system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

B. Heat Trace Cable Testing:

1. Factory inspections and tests for self-regulating, power limiting, series constant wattage and constant wattage (MI) heater cables shall include but are not limited to the following:
 - a. Testing shall be done per the latest IEEE Std. 515 test section and applicable manufacturer's standards.
2. In the field, all heater cables shall be meggered. The following separate field megger readings shall be taken on each self-regulating and each M.I. heater cable:
 - a. Heater cable shall be meggered when received at jobsite before installation.
 - b. Heater cable shall be meggered after installation, but before insulation is applied.
 - c. Heater cable shall be meggered after insulation has been installed.
 - d. All three of the above field megger readings shall be greater than 20 megohms. Otherwise, the heater cable is not acceptable and shall be replaced.
3. Field megger tests shall be recorded for each heater cable, and certified reports shall be submitted to the Owner and Engineer.

3.3 SCHEDULES

- A. See Drawings.

3.4 FIELD VERIFICATION

- A. A representative of the manufacturer shall visit the job site to verify the adequacy of each installation.
1. Provide written verification to the Engineer along with any deficiencies in the work.

END OF SECTION

**SECTION 23 05 00
COMMON WORK RESULTS FOR HVAC**

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Piping materials and installation instructions common to most piping systems.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Unless otherwise specified and in addition to provisions of the General Conditions, submit drawings having each sheet, and each page of a brochure, marked with identification and containing information described below. Submittals are to be complete, partial submittals will not be accepted. Refer to Section 01 33 00.

1.4 QUALITY ASSURANCE

- A. Application: HVAC work shall comply with applicable requirements and recommendations of standards published by listed agencies and trade associations, except to extent more detailed and stringent requirements are indicated or required by governing regulations.
- B. Listing of Associations, Standards and Abbreviations Specific to HVAC Work (in addition to standards specified in individual work sections), conform to following applicable standards:
 1. AABA - Associates Air Balance Council

2. AGA - American Gas Association
3. AMCA - Air Movement & Control Association
4. ARI - Air/Conditioning and Refrigeration Institute
5. ASC - Adhesive and Sealant Council
6. ASHRAE - American Society of Heating, Refrigeration & Air Conditioning Engineers
7. ASME - American Society of Mechanical Engineers
8. ASPE - American Society of Plumbing Engineers
9. ASSE - American Society of Sanitary Engineering
10. AWS - American Welding Society, Inc.
11. AWWA - American Water Works Association, Inc.
12. CAGI - Compressed Air and Gas Institute
13. CISPS - Cast Iron soil Pipe Institute
14. EPA - Environmental Protection Agency
15. FM - Factory Mutual System
16. MCA - Mechanical Contractor's Association of America
17. NIST - National Institute for Standards and Technology
18. (NBS) (formerly National Bureau of Standards)
19. NEC - National Electrical Code by NFPA
20. NEMA - National Electrical Manufacturer's Association
21. NFPA - National Fire Protection Association
22. NSF - National Sanitation Foundation
23. OSHA - Occupational Safety and Health Administration (U.S. Department of Labor)
24. PDI - Plumbing and Drainage Institute
25. SMACNA - Sheet Metal & Air Conditioning Contractors National Associations, Inc.
26. TIMA - Thermal Insulation Manufacturers Association

27. UL - Underwriter's Laboratories, Inc.
- C. Symbols: Except as otherwise indicated in drawing legends, refer to "ASHRAE Handbook of fundamentals" for definitions of symbols used on the drawings to show mechanical work.
- D. Manufacturers: Firms regularly engaged in the manufacture of products of quality, types and sizes required; and which have been in satisfactory use of not less than four years in similar service, except as otherwise noted in specific sections of this division.
- E. Installer's Qualifications: Firm with at least three years of successful installation experience on projects with work similar to this project and meet applicable regulatory agencies requirements.
- F. Compatibility: Provide products which are compatible with other products of the plumbing work, and with other work requiring interface with the plumbing work. Provide products with the proper or correct power characteristics, fuel-burning characteristics and similar adaptations for this project. Coordinate the selections from among options (if any) for compatibility of products.
- G. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
- H. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- I. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- J. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DESCRIPTIONS

- A. "Owner Purchased" and "Contractor Purchased" equipment is described in Division 00 Section General Conditions." Unless the Drawings indicate that it Owner purchased, the Contractor is responsible for purchasing the equipment as shown on Drawings.
- B. Section specifies provisions for HVAC work, including:
1. Certain adaptive expansions of requirements specified in Division 00 Section General

Conditions”, uniquely applicable to HVAC work.

2. General performance requirements within HVAC work (all Division 23 Sections) as a whole.
 3. General work to be performed as HVAC work, because of its close association with HVAC work.
- C. Examine all Drawings and visit site and become acquainted with all conditions which may affect execution of work.
 - D. Provide work in accordance with state and local codes, regulations and/or ordinances, and meet approval of authorities having jurisdiction. Provide only new material and as specified.
 - E. Furnish to Owner Representative, a Certificate of Final Approval from governing authority prior to Owner Representative’s final acceptance, where applicable.
 - F. Comply with all requirements for permits and licenses and pay all associated costs.
 - G. Provide piping specialties and condensate drain piping for air conditioning units.

1.6 COORDINATION OF HVAC WORK:

- A. Refer to Division 00 Section General Conditions” for general coordination requirements applicable to entire work. The Contract Documents are diagrammatic in showing certain physical relationships which must be established within HVAC work, and in its interface with other work, including utilities, control and electrical work, and that such establishment is Contractor’s exclusive responsibility.
- B. Arrange HVAC work in a neat, well-organized manner, with piping and similar services running parallel with primary lines of the building.
- C. Give right-of-way to piping as required for slope.
- D. Locate operating and control equipment properly to provide easy access and arrange entire HVAC work with adequate access for operation and maintenance.
- E. Advise other trades of openings required in their work for the subsequent move-in of large units of HVAC work (equipment).
- F. Coordination of Drawings: For locations where elements of HVAC (or combined HVAC, plumbing, fire protection and electrical) work must be sequenced and positioned with precision in order to fit into the available space, provide to Contractor coordination drawings (shop drawings) showing the actual physical dimensions (at accurate scale) required for the installation. Prepare and submit to the Contractor coordination drawings prior to purchase/fabrication/installation of any of the elements involved in the coordination.

PART 2 PRODUCTS

2.1 GENERAL

- A. Compatibility: Provide products which are compatible with other products of the HVAC work, and with other work requiring interface with the HVAC work. Provide products with the proper or correct power characteristics, fuel-burning characteristics and similar adaptations for this project. Coordinate the selections from among options (if any) for compatibility of products.

2.2 SUBSTITUTIONS AND EQUIPMENT SELECTION:

- A. First listed manufacturer shown in Specifications and Drawings was used for design basis, layout, performance and indication of style and appearance.
- B. Equipment selected from this list of manufacturers, other than design basis, must be compatible with the facility and meet requirements of the Contract Documents.
- C. If any changes are required to the Work scope, due to the selected equipment being different from the design basis equipment, Contractor is responsible for coordinating increases or decreases in Work scope, paying Contractor's cost increases and any consultant fees.

2.3 CONDENSATE PIPING

- A. Drain Piping: Provide condensate drain piping from HVAC units as required to complete the system. Provide piping of Schedule 40 PVC. Trap and pipe as required.

2.4 PIPING SPECIALTIES

- A. Provide factory fabricated drainage piping, fittings and specialties recommended by manufacturer.
- B. Pipe Escutcheons: Provide pipe escutcheons with inside diameter close to outside diameter of pipe or outside diameter of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Unless other indicated, furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

2.5 FABRICATED PIPING SPECIALTIES:

- A. Pipe Sleeves: Provide pipe sleeves of one of the following:
 - 1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams or welded longitudinal joint.
 - 2. PVC Pipe: Fabricate from Schedule 40, PVC

2.6 BASIC SUPPORTS AND ANCHORS:

- A. General: Provide supports and anchors in accordance with the following listing:
 - 1. Adjustable steel clevises, for horizontal piping hangers and supports.
 - 2. Two bolt-riser clamps, for vertical-piping clamps.
 - 3. Concrete inserts, c-clamps, malleable beam clamps and steel brackets for building attachments.

2.7 HVAC SYSTEM IDENTIFICATION:

- A. Provide identification for HVAC equipment including but not limited to:
 - 1. RTU's
 - 2. Exhaust Fans
 - 3. Supply Fans
 - 4. Hoods
 - 5. Air Handlers
- B. Text: Description, unit number, and location.
 - 1. Example: "RTU-5 PHARMACY".
- C. Interior Identification: Provide either of the following interior identification methods:
 - 1. For open structure, provide stencil-painted identification with lettering size not less than 1-1/2-inches (38-mm) located in an easily visible location such as on the ductwork entering building from the roof.
 - 2. Where ceilings conceal the unit from sight, identify location with an engraved hard black plastic tag, 1 inch by 2-inch (25 mm by 50 mm) plate with 3/4 inch (19 mm) white lettering, pop riveted to the ceiling suspension grid directly below the location of the RTU or other piece of equipment.
- D. Exterior Identification (For equipment that does not have identification applied at the factory)
 - 1. Stencil-Painted Identification: Lettering size not less than 1-1/2-inches (38-mm).
 - 2. Engraved Plastic-Laminate Signs: Sufficient size to convey adequate information at each location. Comply with recognized industry standards for color and design.
 - 3. Operational Tags: Plasticized card stock, with pre-painted or hand printed, to convey the message; example: "DO NOT CLOSE THIS VALVE EXCEPT WHEN BURNER

IS OFF”. Provide proper and adequate information on operation and maintenance of HVAC systems.

PART 3 EXECUTION

3.1 PIPING SYSTEMS – COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
 - 1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
 - 2. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
 - 3. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
 - 4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and clearance for light fixtures.
 - 5. Install piping to permit valve servicing.
 - 6. Install piping at indicated slopes.
 - 7. Install piping free of sags and bends.
 - 8. Install fittings for changes in direction and branch connections.
 - 9. Install piping to allow application of insulation.
 - 10. Select system components with pressure rating equal to or greater than system operating pressure.
 - 11. Install escutcheons for penetrations of walls, ceilings, and floors.
 - 12. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - a. Pipe Sleeves:
 - (1) For pipes passing through brick or concrete walls, or concrete floor slabs, provide steel pipe sleeves, two sizes larger than the pipe for which they are intended. Coordinate setting of sleeves as construction progresses. Set sleeves flush with finished line of walls and floors.

- (2) Caulk sleeves through foundation walls to make them watertight.
13. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and HVAC sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing HVAC sleeve seals.
- a. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - b. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - c. HVAC Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble HVAC sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
14. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using HVAC sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing HVAC sleeve seals.
- a. HVAC Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble HVAC sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
15. Verify final equipment locations for roughing-in.
16. Refer to equipment specifications in other Sections for roughing-in requirements.
17. Where a pipe slot is indicated for a group of pipes passing through a wall, set a rectangular frame of structural angles, welded in the slot, at each side of wall. Close each side of opening with two No. 16 USG galvanized steel plates cut to fit the pipes and/or pipe insulation closely and fasten to angle frame. For slots in exterior walls, slip flanged ferrules of sheet metal on pipes when they are installed, with flanges inside the closure plates at exterior wall face, caulk ferrules and plates to make weathertight joint, and pack space between closure plates with rock wool or glass fiber. At slots in fire walls, pack as specified above, but omit ferrules and caulking.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems:
- 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before

assembly.

3. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
6. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
7. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
8. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators.
9. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
10. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - b. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - c. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - d. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - e. PVC Non pressure Piping: Join according to ASTM D 2855.
 - f. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.
11. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.
12. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean

cloth or paper towels. Join according to ASTM D 2657.

- a. Plain-End Pipe and Fittings: Use butt fusion.
 - b. Plain-End Pipe and Socket Fittings: Use socket fusion.
13. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Follow manufacturer's suggested procedure for protection of equipment which will be idle for an extended period of time prior to start-up.
- F. Mount and align equipment in strict accordance with manufacturer's recommendations and in accordance with procedures described below. In case of conflict, these procedures govern. Where structural or miscellaneous steel is not drilled, drill in field as directed.
- G. Lubricate all equipment as required and in accordance with manufacturer's recommendations. Furnish required lubricants.
- H. Neatly cut all openings in roof decks as needed for equipment, duct and pipe penetrations.
- I. Suspend Equipment, Piping and Ductwork:
1. Provide structural steel and steel rod hangers, rigid in appearance. Weld (with approval of Architect where attaching to building steel) structural steel hangers or bolt with hex

head machine bolts and with spring lock washers under nuts.

2. For suspension from concrete, provide steel or malleable iron inserts in poured concrete construction, as specified for pipe hangers and supports, and expansion shields, toggle bolts or lag screws, in other construction. Use electric drill with carbide bit for drilling concrete blocks.
 3. For suspension from structural steel, use beam or channel clamps with locking clips.
 4. Do not support HVAC components from ceiling grids.
 5. Do not suspend hangers from roof decks.
 6. Suspend from roof trusses and joists/joist girders only at panel points, at top cord only, unless otherwise indicated.
 7. Provide additional supports wherever needed, and structural steel members attached to building frame to provide additional points of support where required. Do no drilling of building structural and miscellaneous steel, except as directed or indicated.
- J. Hanger Rods and Hanger Spacing: 8-feet to 10-feet (2.4-m to 3-m) spacing maximum, provide auxiliary angles spanning between joints, as required. Comply with current A.S.M.E. code for pressure piping. Piping 5-inches (127-mm) size and larger to be supported by a minimum of two joists, with pipe center between joists.
- K. Insulated Pipe: Fit pipe hangers over outside diameter of insulation; provide sheet metal saddles 16 gage, 6-inches (152-mm) long by 1/3 of the circumference.
1. Select supports for a minimum safety factor of five.
- L. Rooftop Mounted Equipment Set on Structure:
1. Weld or bolt equipment to roof curbs or structural supports. For bolting equipment directly to structural supports, provide machine bolts, lock washers and nuts.
- M. Floor-Mounted Equipment:
1. Set and level equipment on foundation. Grout in place, using non-ferrous grout. Provide wedges and shims for leveling.
 2. Accurately align equipment prior to operation.
- N. Maintain daily log of operational data on HVAC equipment and systems through the close-out period; record hours of operation, assigned personnel, fuel consumption and similar information; submit copy to Owner Representative.
- O. Turn Over of Operation: Upon substantial Completion, turn over prime responsibility for operation of HVAC equipment and systems to Owner's personnel. However, until time of final acceptance, respond promptly with consultation and services, as required. Provide one

operating engineer, who is completely familiar with the work, to consult with and continue training Owner personnel.

3.5 INSTALLATION OF CONDENSATE PIPING:

- A. Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leakproof piping systems. Install piping with a minimum of offsets.
- B. Accurately cut pipe to measurements established at the site and work into place without springing or forcing. Install piping with sufficient flexibility to adequately provide for expansion and contraction due to temperature fluctuation inherent in its work operation.
- C. Do not conceal piping in walls or partitions nor underground or under the floor. Where pipe passes through building structure, pipe joints are not to be concealed, but located where they may be readily inspected.
- D. Discharge condensate water to comply with requirements of local jurisdiction.
- E. Run pipes to be insulated as shown as required with sufficient clearance to permit application of insulation.
- F. Use cadmium plated or galvanized nuts and bolts with self-locking type nut or double nut on pipe clamps. Use double nuts or self-locking nuts on hanger rods for piping support.
- G. Connect condensate drain piping to HVAC equipment in manner shown and comply with equipment manufacturer's instructions where not otherwise indicated.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete Slabs."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Sections "Structural Steel" and "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 HVAC SYSTEM IDENTIFICATION

- A. Provide stencil-painted identification on rooftop equipment when not provided by manufacturer.
- B. Provide engraved plastic-laminate signs at locations of major equipment units, primary control devices, emergency equipment, dangerous elements of HVAC work and similar places. Mount permanently in an appropriate and effective location.
- C. Operational Tags: Provide proper and adequate information on operation and maintenance of mechanical systems.

3.10 INSPECTION

- A. Installer must examine areas and conditions under which products are to be installed. Notify Owner Representative, in writing, of conditions detrimental to proper completion of work. Starting of installation constitutes acceptance.

3.11 CUTTING AND PATCHING

- A. Comply with Division 00 Section "General Conditions" for cutting and patching of other work, to accommodate the installation of HVAC work. Except as individually authorized by the Architect, cutting and patching of HVAC work to accommodate the installation of other work is not permitted, other than necessary penetrations of HVAC sheet metal work for electrical conduit and similar purposes.

3.12 TRIMMING

- A. Inspect ductwork, pipe supports, in occupied and equipment spaces for sharp angles which protrude into path of occupants and may cause injury. Trim such protrusions or cover with suitable spongy material to prevent such injuries.

3.13 TOUCH-UP

- A. Touch-up with zinc dust-zinc oxide primer galvanized or steel equipment which has been welded or otherwise scarred. Provide additional finished equipment with paint type and color to match original.

3.14 AIR FILTER MEDIA

- A. Provide necessary filter changes for equipment operated during building construction. Replace each set of filters with clean filters at time of project close-out.

3.15 SYSTEM TESTS

- A. Perform system tests in the presence of Owner Representative. Notify Owner Representative of system's tests at least 48 hours in advance.

3.16 SYSTEM INSPECTION

- A. Systems are to be inspected by Owner Representative before covering, enclosing, or concealing of work. Notify Owner Representative of systems which are to be covered, enclosed, or concealed at least 48 hours in advance.

END OF SECTION

**SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Basic requirements for factory and field-installed motors.
- B. See individual Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.2 SUBMITTALS:

- A. Submit product data for motors, starters and other electrical components, with submittal data required for the equipment which it serves, as required by the individual equipment specification sections.

1.3 QUALITY ASSURANCE:

- A. Provide all factory assembled and wired equipment listed and labeled in accordance with the National Electrical Code (NEC) and by an organization acceptable to the authorities having jurisdiction.
- B. References:
 - 1. NEMA Standard MG 1: Motors and Generators.
 - 2. NEMA Standard ICS 2: Industrial Control Devices, Controllers and Assemblies.
 - 3. NEMA Standard 250: Enclosure for Electrical Equipment.
 - 4. NEMA Standard KS 1: Enclosed Switches.
- C. Standards: Where not otherwise indicated, comply with applicable provisions of the National Electrical Code (NFPA 70), NEMA Standards and Division 26 Sections.

1.4 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:
 - 1. Compatible with the following:
 - a. Magnetic controllers.
 - b. Multispeed controllers.

- c. Reduced-voltage controllers.
- 2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
- 3. Matched to torque and horsepower requirements of the load.
- 4. Matched to ratings and characteristics of supply circuit and required control sequence.
- B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.
- C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section “Cast-In-Place Concrete Slabs.”

1.5 DESCRIPTION OF WORK:

- A. This section specifies the basic requirements for electrical components which are an integral part of packaged HVAC equipment. These components include, but are not limited to, factory installed motors, starters and disconnect switches furnished as an integral part of packaged HVAC equipment; wiring from HVAC equipment to electrical work termination (junction box or disconnect switch); control switch, pilot lights, interlocks and similar devices; electrical work specified as HVAC work in temperature control systems; and drip pans to protect electrical work.
- B. Specific electrical requirements (i.e., horsepower and electrical characteristics) for HVAC equipment are scheduled on the Drawings.

PART 2 PRODUCTS

2.1 MOTOR REQUIREMENTS

- A. Motor requirements apply to factory- and field-installed motors except as follows:
 - 1. Different ratings, performance, or characteristics for motors are specified in other Sections.
 - 2. Motorized-equipment manufacturer requires ratings, performance, or characteristics, other than those specified, to meet performance specified.

2.2 MOTORS

- A. Manufacturers
 - 1. Emerson Electric Company, U.S. Motors
 - 2. A. O. Smith Electrical Products Company, Century Motors

3. General Electric Company, GE Motors
 4. The Louis Allis Company, A Division of Alliance Specialty Motors
 5. Marathon Electric, Inc.
 6. Rockwell Automation, Reliance Electric
 7. TECO-Westinghouse Motor Company
- B. Where motor manufacturer selection is independent of HVAC equipment selection, provide motors produced by single manufacturer to greatest extent possible.
- C. Standards: Comply with applicable provisions of NEMA MG 1, NEC Article 430, ANSI C50, ANSI C6.1. Provide equipment listed and labeled, in accordance with the National Electric Code, by an organization acceptable to the authorities having jurisdiction (i.e., UL).
- D. Temperature Rating: Class A insulation, except where otherwise indicated or required for service indicated.
- E. Starting Capability: As required for service indicated, but not less than five starts per hour.
- F. Provide 2-speed motors as 2-speed - one winding, with consequent pole starters.
- G. Motor Size: Provide motor size as indicated or, if not indicated, large enough so that driven load will not require the motor to operate in the service factor range.
- H. Service Factor: Unless otherwise indicated on drawings or in specifications, 1.15 for polyphase; 1.35 for single-phase.
- I. Construction: General purpose, continuous duty; Design "B", except "C" for high starting torque applications.
- J. Bearings: Ball or roller, and designed for thrust, where applicable; shaft seals and regreasable, except provide permanently sealed where not accessible for greasing. Sleeve type bearings permitted only where indicated for light-duty fractional horsepower motors.
- K. Enclosure Type: Open drip-proof for normal concealed indoor use, guarded where exposed to employees or occupants. Type II for outdoor use, except where weather-protected; Type I where adequately housed. Totally enclosed fan cooled (TEFC) where specified or indicated on drawings.
- L. Overload Protection: Built-in thermal for all single-phase motors, with internal sensing device for stopping motor.
- M. Noise Rating: Provide "quiet" rating on motors located in occupied spaces of building.

2.3 MOTOR CHARACTERISTICS

- A. Motors 1/2 HP and Larger: Squirrel-Cage induction polyphase.
- B. Motors Smaller Than 1/3 HP: Single phase.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- E. Duty: Continuous duty at ambient temperature of 105 deg F (40 deg C) and at altitude of 3300 feet (1005 m) above sea level.
- F. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.4 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium, as defined in NEMA MG 1.
- C. Stator: Copper windings, unless otherwise indicated.
 - 1. Multispeed motors shall have separate winding for each speed.
- D. Rotor: Squirrel cage, unless otherwise indicated.
- E. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating, unless otherwise indicated.
- G. Insulation: Class F, unless otherwise indicated.
- H. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- I. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.
 - 1. Finish: Gray enamel.

2.5 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Designed with critical vibration frequencies outside operating range of controller output.
 - 2. Temperature Rise: Matched to rating for Class B insulation.
 - 3. Insulation: Class H.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Rugged-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with non-hygroscopic material.
 - 1. Finish: Chemical-resistant paint over corrosion-resistant primer.
- D. Source Quality Control for Field-Installed Motors: Perform the following tests on each motor according to NEMA MG 1:
 - 1. Measure winding resistance.
 - 2. Read no-load current and speed at rated voltage and frequency.
 - 3. Measure locked rotor current at rated frequency.
 - 4. Perform high-potential test.

2.6 STARTERS, SWITCHES:

- A. Manufacturers: Comply with Division 26 Sections.
- B. Starters Characteristics: Type I general purpose enclosure for indoor use and Type II for outdoor use, with padlock ears and supports of mounting, as indicated or required. Starter type and size as recommended by motor manufacturer. Locate disconnect switch within sight of motor.
- C. Manual Switches: Where indicated on drawings or specifications, provide on motors 1/3 horsepower and smaller, except where automatic control or interlock is indicated; include pilot light. Provide overload protection by panelboard circuit breaker or fused disconnect switch.

- D. Magnetic Starters: Where indicated on drawings or specifications, provide for 1/2 horsepower and larger motors on automatic control or with interlock switch. Include push-buttons, pilot lights, reset, trip-free relay on each phase, undervoltage release, and devices for coordination with control system (including 120-volt transformer for control circuit where service exceeds 120 volts).

2.7 WIRING, CONNECTIONS:

- A. Motors: Wired connections in rigid and flexible metal conduit, except where plug-in electrical cords are indicated and permitted by governing regulations.
- B. General Wiring: Comply with applicable provisions of Division 26 Sections.
- C. Piping, General: Do not run mechanical piping directly above electrical (or electronic) work.

2.8 DISCONNECT SWITCHES:

- A. Fusible Switches: Fused, each phase; general duty; horsepower rated; nontearable quick-mate, quick-break mechanism, dead front-line shield; solderless lugs suitable for copper conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "OPEN" position; arc quenchers; capacity and characteristic as indicated.
- B. Non-Fusible Switches: For equipment 2 horsepower and smaller, shall be horsepower rated; toggle switch type; quantity of poles and voltage rating as indicated. For equipment larger than 2 horsepower, switches shall be the same as fusible type.

2.9 SINGLE-PHASE MOTORS

- A. Type: One of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split-phase start, capacitor run.
 - 3. Capacitor start, capacitor run.
- B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
- C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
- D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.
- E. Source Quality Control for Field-Installed Motors: Perform the following tests on each motor

according to NEMA MG 1:

1. Measure winding resistance.
 2. Read no-load current and speed at rated voltage and frequency.
 3. Measure locked rotor current at rated frequency.
- (1) Perform high-potential test.

PART 3 EXECUTION

3.1 FIELD-INSTALLED MOTOR INSTALLATION

- A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align with load transfer link.
- B. Install motors on concrete bases complying with Division 03 Section "Cast-In-Place Concrete Slabs."
- C. Comply with mounting and anchoring requirements specified in Division 23 Section "Vibration and Seismic Controls for Facility Services."

3.2 FIELD QUALITY CONTROL FOR FIELD-INSTALLED MOTORS

- A. Prepare for acceptance tests.
 1. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer's written instructions.
 2. Verify bearing lubrication.
 3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
 4. Test interlocks and control and safety features for proper operation.
 5. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.
- B. Perform the following field tests and inspections and prepare test reports:
 1. Perform electrical tests and visual and mechanical inspections including optional tests and inspections stated in NETA ATS on field installed motors. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION

**SECTION 23 07 00
HVAC INSULATION**

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ductwork and equipment insulation materials

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. CertainTeed Corp.
2. Knauf Fiberglass
3. Owens-Corning Fiberglass Corp.

2.2 DUCTWORK INSULATION MATERIALS

A. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type II, Class B-6, 1 lb./cu.ft. with integral foil vapor barrier.

1. R-Value (Installed): 3.0 per inch.

PART 3 EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 APPLICATION REQUIREMENTS:

- A. Insulate all metal ductwork with the following exceptions:
 - 1. Return and supply ductwork exposed in air-conditioned spaces without ceilings.
 - 2. Exposed HVAC supply and return ductwork extending through air-conditioned spaces.
- B. Insulate each ductwork system with flexible fiberglass insulation in thickness and R-value as indicated on Drawings.
- C. Insulate exhaust hood duct with fire resistive grease ductwork material. Provide material and installation to meet local and state requirements. Provide clearances as required per manufacturers requirements and local and state requirements.
 - 1. Install a minimum of 2 layers.

3.3 INSTALLATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.

3.4 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

**SECTION 23 31 13
METAL DUCTS**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Metal, rectangular ducts and fittings with or without duct liner for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2500 Pa).
 - 2. Sealants and gaskets.
 - 3. Hangers and supports.
 - 4. Seismic-restraint devices.
- B. See Division 20 Section "Vibration and Seismic Control for Facility Services" for seismic-restraint devices.
- C. See Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounted access doors and panels, turning vanes, and flexible ducts.

1.2 SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
 - 3. Seismic-restraint devices.
- B. Shop Drawings: Show fabrication and installation details for metal ducts.
 - 1. Penetrations through fire-rated and other partitions.
 - 2. Duct accessories, including access doors and panels.
 - 3. Hangers and supports, including calculations for selecting hangers and supports and methods for duct and building attachment, seismic restraints, and vibration isolation.

1.3 QUALITY ASSURANCE

- A. Compliance Standards: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with the following:

1. SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.
2. ASHRAE Handbook, Equipment Volume, Chapter 1, "Duct Construction", for fabrication and installation of metal ductwork.
3. ANSI/NFPA 90A "Standard for the Installation of Air-Conditioning and Ventilating Systems" and ANSI/NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".

1.4 DELIVERY, STORAGE AND HANDLING

- A. Internally Lined Ductwork: Store up off of the floor. Protect internally lined ductwork from water and dust. Protect the leading edge of internal duct lining with the manufacturer's recommended adhesive.

PART 2 PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 (Z180) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).
- E. Carbon Steel: Deli/Bakery hoods shall meet the requirements NFPA 96. Materials shall be a minimum .054" (16 gage) and welded liquid tight.

2.2 DUCT LINER

- A. Fibrous-Glass Matt-Faced Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 1. Manufacturers
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.

- c. Knauf Insulation.
 - d. Owens Corning.
 - 2. Thickness: 1 inch (25 mm) unless indicated otherwise.
 - 3. Minimum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
 - 4. Fungi And Bacteria Resistance: Comply with ASTM G21 and G22.
 - 5. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 6. Solvent or Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Insulation Pins and Washers:
- 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
- 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 - 2. Protect upstream edge of duct liner preceded by unlined duct with zee or channel metal nosing.
 - 3. Butt transverse joints without gaps, and coat joint with adhesive.
 - 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 - 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of

ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. In addition to adhesive, secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally. Ensure mechanical fasteners do not compress duct liner/wrap more than 10 percent.

2.3 SEALANT MATERIALS

- A. Joint and Seam Tape: 2 inches (50 mm) wide; glass-fiber-reinforced fabric.
- B. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
- C. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- D. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- E. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
- B. Hanger Materials: Galvanized sheet steel, threaded steel rod, or steel cable.
 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
 2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct" for steel sheet width and thickness and for steel rod diameters.
 3. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

- 4. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Galvanized-steel shapes and plates complying with ASTM A 36/A 36M.

2.5 SEISMIC-RESTRAINT DEVICES

- A. As specified in Division 20 Section "Vibration and Seismic Control for Facility Services."

2.6 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 - 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Nexus Inc.
 - c. Ward Industries, Inc.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Lockformer.
 - 2. Duct Size: Maximum 30 inches (750 mm) wide and up to 2-inch wg (500-Pa) pressure

class.

3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.030 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of nonbraced panel area unless ducts are lined.
- E. Minimum duct sheet metal gages to be:
 1. Through 30-inches (762-mm): 24 gage
 2. 31-inches (787-mm) through 54-inches (1372-mm): 22 gage
 3. 55-inches (1397-mm) through 84-inches (2134-mm): 20 gage
 4. 85-inches (2159-mm) through 120-inches (3048-mm): 18 gage

2.7 ROUND DUCTS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.
- F. Elbows: Fabricate in die-formed, gored, pleated or mitered construction. Fabricate the bend radius of die-formed, gored, pleated elbows 1.5 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements:

- G. Round Mitered Elbows: Solid welded metal thickness listed below for pressure classes 2-inches (51-mm) to 10-inches (254-mm):
 - 1. 3-inches (76-mm) to 14 inches (356-mm): 24 gage.
 - 2. 15-inches (381-mm) to 26 inches (660-mm): 22 gage.
 - 3. 27-inches (686-mm) to 50 inches (1270-mm): 20 gage.

2.8 FLEXIBLE DUCT

- A. Basis of Design Manufacturer: Geneflex
- B. Flexible duct shall conform to SMACNA "HVAC Duct Construction Standards" and UL 181. Flexible duct can be used for branch drops to air devices. Connection to main trunk shall be made with a bellmouth fitting and an adjustable metal clamp ring.
- C. Maximum length allowable shall be determined by the length of branch drop, but in no case shall exceed 14-feet (4.3-m).
- D. Construction of flexible duct to consist of a full interior liner bonded to a zinc coated, high carbon spring steel helix wire. Bonded to this wire shall be 1-inch (25.4-mm) by 1-lb/cf (16-kg/cu.m) density fiberglass and an outer jacket comprised of seamless copolymer.

PART 3 EXECUTION

3.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
 - 1. Supply Ducts: 2-inch wg (500 Pa).
 - 2. Supply Ducts (in Mechanical Equipment Rooms): 2-inch wg (500 Pa).
 - 3. Return Ducts (Negative Pressure): 1/2-inch wg (125 Pa).
 - 4. Exhaust Ducts (Negative Pressure): 1-inch wg (250 Pa).

3.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install ducts with fewest possible joints.
- C. Install fabricated fittings for changes in directions, size, and shape and for connections.
- D. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure

couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of 3 screws in each coupling.

- E. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- H. Ducts with Duct Liner:
 - 1. Inspect and repair damaged lining prior to installation of ductwork. Repair cuts or gouges in surface of duct liner with adhesive in accordance with manufacturer's instructions.
 - 2. Protect upstream edge of duct liner preceded by unlined duct with zee or channel metal nosing.
 - 3. Line the following ductwork with flexible duct liner:
 - a. In spaces without ceilings, supply and return ductwork from the roof penetration to the first 10 feet (3 m) past the first elbow below the roof line, i.e. ductwork in mezzanines without ceilings and the main sales area unit. Do not line branch ducts.
 - b. Supply and return ductwork of units with drop box diffusers. Do not line branch ducts.
 - c. Provide additional insulation where required for thermal purposes as specified in Division 23 Section "HVAC Insulation."
- I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap

openings on 4 sides by at least 1-1/2 inches (38 mm).

- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."
- O. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

3.3 SEAM AND JOINT SEALING

- A. Seal ductwork after installation to seal class recommended, and method prescribed in SMACNA "HVAC Duct Construction Standards".
- B. Welded Joints: Weld all seams and joints where ductwork is indicated to be watertight.
- C. All metal longitudinal seams to be Pittsburgh Lock or other SMACNA listed seams. Button punch nap lock not acceptable.
- D. Round Metal Ductwork: Connect sections of duct by using beaded sleeve joint couplings, joint Type RT-1, with noncorroding, self-tapping, sheet metal screws, installed in accordance with duct manufacturer's recommendations.

3.4 HANGING AND SUPPORTING

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- C. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.
- D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- E. Install concrete inserts before placing concrete.
- F. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
- G. Do not support metal ducts directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

- H. When steel framing does not permit installation of hanger at spacing required, install carrying channels or other supplemental support for attachment of hangers.
- I. Do not attach hangers to steel deck tabs.
- J. Do not attach hangers to steel roof deck. Attach hangers to structural members.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with Division 20 Section "Vibration and Seismic Control for Facility Services" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 BALANCING:

- A. Test balancing will be conducted by Owner. Any deficiencies or corrections required by testing will be the responsibility of the Contractor.
- B. Seal leaks in ductwork that are discovered during balancing.

END OF SECTION

**SECTION 23 33 00
AIR DUCT ACCESSORIES**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Backdraft dampers.
 - 2. Volume dampers.
 - 3. Turning vanes.
 - 4. Duct-mounting access doors.
 - 5. Flexible connectors.
 - 6. Duct accessory hardware.
- B. See Division 28 Section "Fire Alarm/Security System" for duct-mounting fire and smoke detectors.
- C. See Division 23 Section "Instrumentation and Control Devices for HVAC" for electric and pneumatic damper actuators.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Backdraft dampers.
 - 2. Volume dampers.
 - 3. Turning vanes.
 - 4. Duct-mounting access doors.
 - 5. Flexible connectors.
 - 6. Flexible ducts.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Special fittings.

2. Manual-volume damper installations.
3. Wiring Diagrams: Power, signal, and control wiring.

1.3 QUALITY ASSURANCE

- A. SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) "HVAC Duct Const. Standards, Metal & Flexible".
- B. Industry Standards: Comply with American Society of Heating Refrigeration, and Air Conditioning Engineers, Inc. (ASHRAE) recommendations pertaining to construction of duct accessories except as otherwise indicated.
- C. NFPA Compliance: Comply with applicable provisions of ANSI/NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of duct accessories.

PART 2 PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 (Z180) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M.
- D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT DAMPERS

- A. Manufacturers:
 1. Air Balance, Inc.
 2. American Warming and Ventilating.

3. Greenheck.
4. Penn Ventilation Company, Inc.
5. Ruskin Company.
- B. Description: Multiple-blade, parallel action gravity balanced, with center-pivoted blades of maximum 6-inch (150-mm) width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.
- C. Frame: 0.052-inch (1.3-mm) thick, galvanized sheet steel, with welded corners and mounting flange.
- D. Blades: 0.050-inch (1.2-mm-) thick aluminum sheet.
- E. Blade Seals: Vinyl.
- F. Blade Axles: Galvanized steel.
- G. Tie Bars and Brackets: Galvanized steel.
- H. Return Spring: Adjustable tension.

2.3 VOLUME DAMPERS

- A. Manufacturers:
 1. Air Balance, Inc.
 2. American Warming and Ventilating.
 3. METALAIRE, Inc.
 4. Penn Ventilation Company, Inc.
 5. Ruskin Company.
 6. Vent Products Company, Inc.
 7. Air Balance, Inc.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
- C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal

or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 2. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized sheet steel.
 3. Blade Axles: Galvanized steel.
 4. Bearings: Oil-impregnated bronze.
 5. Tie Bars and Brackets: Galvanized steel.
- D. Jackshaft: 1-inch- (25-mm-) diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
- B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- (38-mm-) wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch (19 mm) o.c.; support with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into vane runners suitable for duct mounting.
1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Duro Dyne Corp.
 - c. METALAIRE, Inc.
 - d. Ward Industries, Inc.

2.5 DUCT-MOUNTING ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class.

- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
 - 1. Manufacturers:
 - a. American Warming and Ventilating.
 - b. Ductmate Industries, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. Greenheck.
 - e. McGill AirFlow Corporation.
 - f. Ventfabrics, Inc.
 - g. Ward Industries, Inc.
 - 1. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 2. Provide number of hinges and locks as follows:
 - a. Less Than 12 Inches (300 mm) Square: Secure with two sash locks.
 - b. Up to 18 Inches (450 mm) Square: Two hinges and two sash locks.
 - c. Up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches.
 - d. Sizes 24 by 48 Inches (600 by 1200 mm) and Larger: One additional hinge.
- C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch (25-mm) thickness. Include cam latches.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Flexmaster U.S.A., Inc.
 - 2. Frame: Galvanized sheet steel, with spin-in notched frame.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.6 FLEXIBLE CONNECTORS

- A. Manufacturers:
 - 1. Ductmate Industries, Inc.

2. Duro Dyne Corp.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- C. Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

2.7 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.
- E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- F. Provide test holes at fan inlets and outlets and elsewhere as indicated.

- G. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 - 1. On both sides of duct coils.
 - 2. Downstream from volume dampers, turning vanes, and equipment.
 - 3. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot (15-m) spacing.
 - 4. On sides of ducts where adequate clearance is available.
- H. Install the following sizes for duct-mounting, rectangular access doors:
 - 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
 - 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
 - 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 - 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 - 5. Body Access: 25 by 14 inches (635 by 355 mm).
 - 6. Body Plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- I. Install the following sizes for duct-mounting, round access doors:
 - 1. One-Hand or Inspection Access: 8 inches (200 mm) in diameter.
 - 2. Two-Hand Access: 10 inches (250 mm) in diameter.
 - 3. Head and Hand Access: 12 inches (300 mm) in diameter.
 - 3. Head and Shoulders Access: 18 inches (460 mm) in diameter.
 - 4. Body Access: 24 inches (600 mm) in diameter.
- J. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- K. For fans developing static pressures of 5-inch wg (1250 Pa) and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- L. Connect terminal units to supply ducts directly or with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.
- M. Connect diffusers or light troffer boots to low pressure ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

- N. Install duct test holes where indicated and required for testing and balancing purposes.

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION

**SECTION 23 37 00
AIR OUTLETS AND INLETS**

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Ceiling- and wall-mounted diffusers, registers, and grilles.
2. Additional items supplied and installed by Contractor.
 - a. Ceiling- and wall-mounted diffusers, registers, and grilles.
 - b. Items not provided by Owner necessary for a complete installation.

1.2 SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

1.3 WARRANTY

A. Warranty information for drop box diffusers is specified in Division 01 Section "Product Warranties."

PART 2 PRODUCTS

2.1 GRILLES AND REGISTERS

A. Adjustable Bar Register:

1. Products:
 - a. Anemostat, a Mestek Company.
 - b. Carnes Company.
 - c. Price Industries; 500 Series
 - d. Titus, a division of Air System Components, Inc.; 272-RLS.
2. Material: Steel.

3. Finish: Baked enamel.
4. Color: White
5. Face Blade Arrangement: Fixed horizontal spaced 1-1/2 inches apart.
6. Rear Blade Arrangement: Fixed vertical spaced 3/4 inch apart.
7. Frame: 1-1/4 inches wide.
8. Mounting Frame: Filter.
9. Mounting: Lay in.
10. Damper Type: Adjustable opposed-blade assembly.

2.2 DIFFUSER OUTLETS

A. Rectangular and Square Diffusers:

1. Products:
 - a. Anemostat, a Mestek Company; DA.
 - b. Carnes Company; Model K with safety chain.
 - c. Krueger.
 - d. Price Industries; AMDSR
 - e. Titus, a division of Air System Components, Inc.; TDCA.
2. Material: Steel.
3. Finish: Baked enamel.
4. Color: White
5. Face Size: As listed in diffuser schedule.
6. Face Style: Three cone or four cone.
7. Mounting: Duct, surface, or T-bar.
8. Pattern: Fixed.
9. Dampers: Radial opposed blade or butterfly.
10. Accessories:

- a. Equaling grid.
- b. Plaster ring.
- c. Safety chain.
- d. Wire guard.
- e. Sectorizing baffles.
- f. Operating rod extension.

B. Round Diffusers:

- 1. Products:
 - a. Carnes Company; Model SSMA.
 - b. Krueger, Model RM2.
 - c. Price Industries; RCD Series
 - d. Titus, a division of Air System Components, Inc.; TMRA.
- 2. Material: Steel.
- 3. Finish: Baked enamel.
- 4. Color: White
- 5. Face Size: As listed in diffuser schedule.
- 6. Face Style: Three cone or four cone.
- 7. Mounting: Duct or surface.
- 8. Pattern: Fixed.
- 9. Dampers: Radial opposed blade or butterfly.
- 10. Accessories:
 - a. Equaling grid.
 - b. Plaster ring.
 - c. Safety chain.
 - d. Wire guard.

- e. Sectorizing baffles.
- f. Operating rod extension.

2.3 EXHAUST AND RETURN AIR REGISTERS AND GRILLES:

- A. Provide registers similar to the model numbers indicated on the drawings. Provide registers with an aluminum opposed blade damper. Color of registers to match adjoining surface color.
- B. Gypsum wall board and CMU installation
 - 1. Exhaust Grille Manufacturers, (steel):
 - a. Price Industries; 500 Series.
 - b. Titus, a division of Air System Components, Inc.; 23RL0A25 w/ 45degree angle blades.

2.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install drop box diffusers, diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

**SECTION 25 00 00
PROCESS INSTRUMENTATION AND CONTROL SUPPLIER**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. A Process Instrumentation and Control Supplier (PICS) shall furnish all services and equipment specified herein and in other specification sections as listed in Article 1.2 – Related Work. Sub-suppliers and/or manufacturers may provide components, and/or services to the PICS, but the final product shall conform to this specification and shall be the sole responsibility of the PICS.
- B. The Process Instrumentation and Control Supplier (PICS) shall be Aqua Aerobics.
- C. The PICS shall provide on-site supervision during material and equipment installation performed by the General Contractor . All equipment, materials and installation labor shall be provided by the General Contractor. The PICS shall design and coordinate the process 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.
- D. PICS shall furnish all networking equipment shown on P&IDs, including, but not limited to control panels, network switches, sonic wall, printer, HIM package, computer, two 24” monitors, etc.
- E. Application software programming for the Programmable Logic Controllers (PLC) and Human Machine Interface (HMI) computers shall be provided by the PICS. All programming, configuration, and integration, including but not limited to loading of software on computers, operating system software configuration, servers and PLCs shall be provided by the PICS. The fiber optic system shall be provided by the General Contractor.
- F. Auxiliary and accessory devices necessary for complete system operation or performance to interface with existing equipment or equipment provided by other suppliers under other sections of these specifications, shall be included whether or not they are shown on the drawings. These devices include but are not limited to, transducers, current isolators, signal conditioners or interposing relays.
- G. Substitution of functions or type of equipment specified shall not be acceptable, but the PICS is encouraged to recommend changes in the design that will improve the overall process control system subject to approval by the Engineer. In order to ensure interchangeability of parts, maintain quality, interface between other subsystems, and establish minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained. System design shall allow removing devices from service without disrupting other devices in the process control system.
- H. Equipment shall be fabricated, assembled, installed, and placed in proper operating conditions in full conformity with detail drawings, specifications, engineering data,

instructions and recommendations by the equipment manufacturers as approved by the Engineer.

- I. To facilitate the Owner's future operation and maintenance efforts, similar products shall be by the same manufacturer, as much as possible.
- J. All equipment and installations shall be in accordance with Federal, State and Local codes, regulations, and laws.
- K. Where applicable, the PICS shall coordinate with other suppliers under other sections of these specifications on the following:
 - 1. Interface requirements.
 - 2. PLC input and output (I/O) requirements.
 - 3. Consistency of instrumentation.
 - 4. PLC communication requirements.
 - 5. Transfer of data.
 - 6. HMI graphic screen design.
 - 7. Control requirements.
- L. All materials, equipment, labor and services necessary to achieve the monitoring, control and reporting functions described herein shall be provided in a timely manner so that the monitoring, control and reporting functions are available when the equipment or process is ready to be placed in service.
- M. The PICS shall coordinate, and schedule all required testing and training with the General Contractor, Engineer and Owner in a timely manner.
- N. The PICS shall submit a monthly status report and updated project schedule to the General Contractor so that the General Contractor can integrate the PICS work into the overall project schedule.

1.2 RELATED WORK

- A. The PICS shall furnish all materials, labor and services specified in Division 25 and the drawings, as required to ensure a complete coordinated process control system. Division 25 specifications include:
 - 1. Section 25 00 20 – Panels
 - 2. Section 46 53 53 Sequential Batch Reactor System

3. Appendix A and B of these specifications.
- B. The PICS shall coordinate with all equipment suppliers, subcontractors including mechanical and electrical and the General Contractor.

1.3 SUBMITTALS

- A. Submittals shall fully demonstrate that the equipment and services to be furnished comply with the provisions of these specifications and provide a true and complete record of the equipment as manufactured and delivered. Each submittal shall be securely bound with an index and sectional dividers. All submittal drawings shall be legible and a maximum size of 11-inches by 17-inches.
- B. The Engineer shall determine whether a product is an “Approved Equal” based upon the information specified herein and the manufacturer’s data sheets regarding the models specified. Substitute or alternate equipment must meet the criteria listed herein and any additional information in the manufacturer’s data sheets in order to be accepted as an “Approved Equal”. The supplier must furnish at the Engineer’s request five (5) working installation references for any substitute or alternative equipment along with reference Owner, contact and telephone number.
- C. Submittals listed below shall be provided as a minimum. Each submittal must be complete in order to be reviewed by the Engineer. A total of ten (10) submittals of each type is required.
 1. Field instruments
 2. SCADA system hardware and software
 3. Control panels, panel mounted equipment and wiring
 4. Instrument loop diagrams
 5. Ladder logic for Proportional/Integral Derivative (PID) control
 6. Spares and test equipment
 7. Operation and maintenance manuals (O&M)
 8. As-built documentation
- D. Submittal Descriptions.
 1. Field Instruments
 - a. This submittal shall provide complete documentation of all field instruments. A complete Bill of Materials (BOM) listing all field instrumentation equipment shall be provided.
 - b. Provide data sheets for each instrument listing model numbers, options and

ancillary devices that are being provided. Data sheets shall be provided with an index, proper identification, and appropriate cross-referencing. Data sheets shall include, but not be limited to, the following information:

- (1) ISA instrument tag number
 - (2) Item name used herein and, on the Drawings,
 - (3) Manufacturer's complete model number
 - (4) Physical installation location
 - (5) Input or output characteristics
 - (6) Range, units, size and graduations
 - (7) Physical dimensions
 - (8) Enclosure dimensions
 - (9) NEMA classification
 - (10) Mounting details
 - (11) Materials of construction
 - (12) Instrument sizing calculations, where applicable
 - (13) Calibration data (Certified for all flow metering devices)
- c. Provide manufacturer's equipment specifications, which shall fully describe each device, the intended function, how it operates, and its physical environment and performance characteristics. As a minimum, the specification sheets shall include the following:
- (1) Complete information regarding the instrument.
 - (2) Description of operation
 - (3) Performance characteristics
 - (4) Calibration standards
 - (5) Environmental characteristics
 - (6) Electrical requirements
 - (7) Process requirements
 - (8) Materials of construction
 - (9) Physical dimensions and clearance requirements
 - (10) Installation details
 - (11) Maintenance and calibration requirements
 - (12) Spare parts, special tools and test equipment requirements
2. SCADA System Hardware and Software

- a. This submittal shall provide complete documentation of all SCADA system hardware and software. A complete Bill of Materials (BOM) listing all SCADA system hardware and software shall be provided.
- b. This submittal shall include all computer workstations, servers, printers, and data highway network, network switches, fiber-optic cable, fiber-optic connectors, PLCs, UPSs and related equipment. This submittal shall also include all related software for the SCADA system including the computer operating system, communications network, management, operations, HMI, report, PLC, diagnostic, etc.
- c. Provide a complete set of SCADA System Block Diagrams showing interconnections between all major components of the SCADA system. The block diagrams shall reflect the total integration of all digital devices in the SCADA system and any human machine interface (HMI) locations. Locations of all components shall be clearly identified with appropriate cross-references. The diagrams shall also show all interconnecting cabling requirements for digital components of the system including the complete data highway network. The diagrams shall include, but not be limited to:
 - (1) Computers and peripheral devices
 - (2) Control centers
 - (3) PLCs
 - (4) Panels and Consoles
 - (5) Data highway
 - (6) Interfaces to other systems
- d. Provide data sheets for each component of the SCADA system hardware and software listing model numbers, options and ancillary devices that are being provided. Data sheets shall be provided with an index, proper identification, and appropriate cross-referencing. Data sheets shall include, but not be limited to, the following information:
 - (1) ISA instrument tag number, if applicable
 - (2) Item name used herein and, on the Drawings,
 - (3) Manufacturer's complete model number
 - (4) Physical installation location
 - (5) Functional characteristics
 - (6) Physical dimensions
 - (7) Enclosure dimensions, if applicable
 - (8) NEMA classification
 - (9) Mounting details

- (10) Materials of construction
- (11) UPS sizing calculations
- e. Provide manufacturer's equipment specifications, which shall fully describe each device, the intended function, how it operates, and its physical environment and performance characteristics. As a minimum, the specification sheets shall include the following:
 - (1) Complete information regarding the equipment as required by ISA-S5.4 standards.
 - (2) Description of operation
 - (3) Performance characteristics
 - (4) Calibration standards
 - (5) Environmental characteristics
 - (6) Electrical requirements
 - (7) Process requirements
 - (8) Materials of construction
 - (9) Physical dimensions and clearance requirements
 - (10) Installation details
 - (11) Maintenance and calibration requirements
 - (12) Spare parts, special tools and test equipment requirements
- f. Provide a complete SCADA System Input/Output (I/O) List for all equipment connected to the SCADA system under this Contract. The I/O List shall fully identify and describe each I/O point in the SCADA system, the intended function, how it operates, and its physical location and performance characteristics. As a minimum, the I/O List shall include the following:
 - (1) I/O Point Address (PLC name, PLC address and point address)
 - (2) I/O Physical Address (Panel name, rack, slot, etc.)
 - (3) I/O Alarms, limits and tag names
 - (4) Identify Instruments for 2-wire or 4-wire configuration
 - (5) Any other applicable data
- g. See P&IDs and Electrical Schematic Diagrams on Electrical Drawings for I/O requirements. All I/O on electrical schematic diagrams shall be accounted for even if not shown on P&IDs.
- h. The submittal shall contain planning information, when panels will ship, how to store the panels and any special instructions. All cables, grounding systems,

power supply and site preparation shall be the responsibility of the General Contractor.

3. Control Panels, Panel Mounted Equipment and Wiring

- a. This submittal shall provide complete documentation of all control panels, panel mounted equipment and related wiring. A complete Bill of Materials (BOM) listing all panels and panel-mounted equipment shall be provided.
- b. Provide data sheets for each panel, equipment or instrument listing model numbers, options and ancillary devices that are being provided. Data sheets shall be provided with an index, proper identification and appropriate cross-referencing. Data sheets shall include, but not be limited to, the following information:
 - (1) ISA instrument tag number
 - (2) Item name used herein and, on the Drawings,
 - (3) Manufacturer's complete model number
 - (4) Physical installation location
 - (5) Input or output characteristics
 - (6) Range, units, size, and graduations
 - (7) Physical dimensions
 - (8) Enclosure dimensions
 - (9) NEMA classification
 - (10) Mounting details
 - (11) Materials of construction
 - (12) Instrument sizing calculations, where applicable
 - (13) Calibration data
- c. Provide manufacturer's equipment specifications, which shall fully describe each device, the intended function, how it operates, and its physical environment and performance characteristics. As a minimum, the specification sheets shall include the following:
 - (1) Complete information regarding the panel, equipment or instrument as required by ISA-S5.4 standards.
 - (2) Description of operation
 - (3) Performance characteristics
 - (4) Calibration standards
 - (5) Environmental characteristics

- (6) Electrical requirements
 - (7) Process requirements
 - (8) Materials of construction
 - (9) Physical dimensions and clearance requirements
 - (10) Installation details
 - (11) Maintenance and calibration requirements
 - (12) Spare parts, special tools and test equipment requirements
 - d. Provide detailed drawings for all control panels, PLC panels, consoles, etc. which shall include, as a minimum, the following:
 - (1) Panel assembly and physical layout drawings to scale. Drawings shall include exterior front and side views, as required to show the physical dimensions of the panel and all exterior mounted equipment. Drawings shall also include interior views of all sub-panels mounted within the enclosure.
 - (2) Material and paint specifications.
 - (3) Fabrication details.
 - (4) Panel wiring diagrams showing all power connections to equipment within and mounted on the panel, panel power requirements, breaker sizes, fuse sizes and grounding requirements. The diagram shall be in ladder logic format and shall cross-reference all appropriate loop drawings for continuation or detail where required. The diagram shall include wire numbers and terminal block designations as required to complete the drawing.
 - e. The submittal shall also contain all planning information, site preparation instructions, power supply and grounding procedures, cabling diagrams, system identification, safety precautions and equipment layouts in order to enable the General Contractor to proceed with detailed site preparation for all equipment.
 - f. The submittal shall also include power calculations for UPS sizing and heat dissipation calculations for each enclosure.
4. Spares, Tools and Test Equipment
- a. Provide a comprehensive and complete list of specified and PICS recommended spare parts, tools, expendables and test equipment along with descriptive literature for each of the following sections:
 - (1) Section 13430 – Panels
 - b. Provide recommended quantities for each item on each composite list for a period of three years starting when the warranty period begins.

- c. Provide unit pricing for each item on each composite list using the associated manufacturers nationally published list price. Provide copies of all manufacturers' nationally published price lists.
- d. Provide a summary document listing all recommended items, grouped by sections, showing recommended quantities with unit prices and extended item totals, section totals and an overall total.
- e. All spare parts, expendables and test equipment shall be packed in appropriate storage containers for warehouse storage conditions and shall be clearly labeled and identified.
- f. All spare parts shall be delivered to the job site prior to the first startup phase of the project.

1.4 REFERENCE STANDARDS

- A. Instrument Society of America (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. Display Instrumentation Logic and Computer Systems
- B. American National Standards Institute (ANSI)
 - 1. ANSI X3.5 – Flowchart Symbols and Their Usage in Information Processing
- C. National Electrical Manufacturers Association (NEMA)
- D. National Electric Code (NEC)
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid shall apply.

1.5 PROJECT / SITE REQUIREMENTS

- A. Environmental Requirements. Air-conditioned areas require NEMA Type 1A or 12 ventilated enclosures. Equipment located below grade shall be rated or enclosed for NEMA Type 4X. All other areas require NEMA Type 4X stainless steel enclosures unless otherwise specified. Equipment located outdoors require sun shields.
- B. Elevation. Equipment shall be suitable to operate at a ground elevation of approximately 1000 feet above mean sea level.

- C. Temperature. Equipment mounted indoors shall be suitable to operate from 10 to 35⁰ C ambient. Equipment mounted outdoors shall be suitable to operate from -30 to 50⁰ C ambient. Equipment stored shall be suitable to operate from 0 to 50⁰ C ambient. Additional cooling or heating shall be furnished, if required, for stored equipment.
- D. Relative Humidity. Equipment mounted in air-conditioned areas shall be suitable for 20 to 95 % relative, non-condensing humidity. Equipment mounted in all other areas shall be suitable for 0 to 100 % relative, condensing humidity.
- E. Power Supply. Equipment shall be suitable for 120 VAC electric power supply from unregulated industrial panel boards.

1.6 WARRANTY

- A. Provide warranties per Division 1 requirements and Operation and Maintenance Manuals and as specified herein.

1.7 O & M MANUALS

- A. Prior to final acceptance of the system and owner training, operating and maintenance manuals (O&M) covering instruction and maintenance on each type of equipment shall be furnished.
- B. The manuals shall be bound in three-ring binders with Drawings reduced or folded for inclusion and shall provide the following as a minimum:
 - 1. A comprehensive index.
 - 2. A complete “As Built” set of approved shop drawings.
 - 3. A complete list of equipment supplied, including model numbers, serial numbers, ranges and pertinent data.
 - 4. Detailed service, maintenance and operating instructions for each item.
 - 5. Special maintenance requirements for each specified system clearly defined, along with special calibration and test procedures.
 - 6. Operating instructions and control strategies for each specified system, which incorporate a functional description of the entire system, with references to the shop drawings.
 - 7. A complete parts list with stock numbers, name, address and telephone number of the local supplier.
- C. The final documentation shall be new documentation written specifically for this project but may include standard or modified standard documentation. Modifications to existing hardware or software manuals shall be made on the respective pages or inserted adjacently

to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.

- D. The manuals shall contain all illustrations, detailed drawings, wiring diagrams and instructions necessary for installing, operating and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.
- E. If the PICS transmits any documentation or other technical information, which he considers proprietary, such information shall be designated. Documentation or technical information, which is designated as proprietary will be used only for the design, construction, operation or maintenance of the system and, to the extent permitted by law, will not be published or other wise disclosed.
- F. The final documentation requirements are as follows:
 - 1. As-built documentation shall include all previous submittals, as described in this Specification, updated to reflect the as-built system. Any errors in or modifications to the system resulting from the Factory or Field Acceptance Tests shall be incorporated in this documentation.
 - 2. The Hardware Maintenance documentation shall describe the detailed preventive and corrective procedures required to keep the system in good operating condition. Within the complete Hardware Maintenance documentation, all hardware maintenance manuals shall make reference to appropriate diagnostics, where applicable, and all necessary timing diagrams shall be included. A maintenance manual or set of manuals shall be furnished for all delivered hardware, including peripherals. The Hardware Maintenance documentation shall include, as a minimum, the following information:
 - a. Operation Information. This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
 - b. Preventative Maintenance Instructions. These instructions shall include all applicable visual examinations, hardware testing, diagnostic routines and the adjustments necessary for periodic preventive maintenance of the system.
 - c. Corrective Maintenance Instructions. These instructions shall include guidelines for locating malfunctions down to the card-replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source (s) of trouble, the symptoms, probable cause and instructions for remedying the malfunction.
 - d. Parts Information. This information shall include the identification of each replaceable or field-repairable module. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring

any repairable or replaceable part. Cross-references between the PICS part number and manufacturer's part number shall be provided.

- e. System Backup / Restore. This information shall include a detailed description of the procedure for backing up the SCADA system including the computer workstations, servers and PLCs; reloading using a backup; and completely restoring from a backup.

PART 2 PRODUCTS

2.1 GENERAL

A. Process Control System

1. All equipment and instrumentation supplied shall be of the manufacturer's latest design and shall produce or be activated by signals, which are established standards for the water and wastewater industry.
2. All electronic instrumentation shall be of the solid-state type and shall utilize linear transmission signals of 4 to 20 mA DC (milliampere direct current), however, signals between instruments within the same panel or cabinet may be 1 to 5 VDC (volts direct current), or the like.
3. Output of equipment, not of the standard signals as outlined above, shall have the output immediately raised and / or converted to compatible standard signals for remote transmission. Zero based signals shall not be allowed.
4. Unless otherwise supplied by others, the General Contractor to provide all instruments. Mounting, floor stand and wall brackets for all instruments shown on the drawings are to be provided and installed by the General Contractor.
5. Equipment installed in a hazardous area shall meet Class, Group and Division as shown on the Drawings to comply with the National Electric Code.
6. All indicators and recorder readouts shall be linear in process units, unless otherwise noted.
7. All transmitters shall be provided with either integral indicators or conduit mounted indicators in process units, accurate to two percent (2%).
8. Electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture or fungus. Solid-state components shall be conservatively rated for their purpose to assure optimum long-term performance and dependability over ambient atmosphere fluctuations and 0 to 95 % relative humidity. Field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.

9. All equipment, cabinets, consoles and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models, which are currently in production. All equipment provided shall be modular construction and shall be capable of field expansion.
10. Field-mounted digital system equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.
11. All electronic and digital equipment shall be provided with radio frequency interference protections and shall be FCC approved.

B. Electrical

1. All equipment shall be designed to operate on a 60-hertz alternating current power source at a nominal 120 volts, +/- 10%, except where specifically noted. All 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. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.
3. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The SCADA system, instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms, and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. All information relevant to the placing of SCADA work shall be obtained in the field. In case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.
- B. The instrumentation loop diagrams indicate the intent of the interconnections between the individual instruments. Any exceptions shall be noted. Two (2) complete sets of approved shop drawings shall be kept at the jobsite during all on-site construction work. Both sets shall be marked up identically to reflect any modifications made during field installation or start-up. All markings shall be verified and initialed by the Engineer or his designated representative.
- C. Following completion of installation, one (1) set of the marked-up drawings shall be provided to the Engineer; the other set shall be retained by the PICS for incorporation of the mark-ups

into final as-built documentation.

- D. The instrumentation installation details in the Drawings indicate the designed installation for the instrument specified.
- E. All work shall be executed in full compliance with codes, ordinances, regulations, and local rulings. Should any work be performed contrary to said codes, ordinances, regulations or local rulings, the General Contractor shall bear full responsibility for such violations and assume all costs arising therefrom.
- F. All equipment used in areas designated as hazardous shall be designed for the Class, Group and Division as required on the Drawings for the specific locations.
- G. Unless specifically shown in the Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the installation detail drawings. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifold for calibration, testing and blowdown services shall also be provided. For slurries, chemical or corrosive fluids inline diaphragm seals shall be provided.
- H. Unless noted otherwise, the General Contractor to provide all piping to and from field instrumentation shall be provided with necessary unions, test tees, couplings, adaptors and shut-off valves.
- I. Field instruments requiring power supplies shall be provided with local electrical shutoffs and fuses as required by the National Electric Code or as shown on the Drawings.
- J. Brackets and hangars required for equipment mounting shall be provided and shall be installed by the General Contractor in a workmanlike manner and shall not interfere with any other equipment.
- K. The General Contractor shall investigate each space in the building through which equipment must pass to reach its final destination. If necessary, the PICS shall be required to ship material in sections sized to permit passing through restricted areas in the building. The PICS shall also investigate and make any field modifications to the allocated space for each panel, enclosure and console to assure proper space and area around it (front, rear, side).
- L. The shield on each process instrumentation cable shall be continuous from source to destination and shall be grounded as directed by the manufacturer of the instrumentation equipment, but in no case shall more than one ground point be employed for each shield.
- M. Lifting rings shall be removed from panels, enclosures and consoles and the remaining holes plugged using the same color as the panel.
- N. The PICS, acting through the General Contractor, shall coordinate the installation, the placing and location of system components, and their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. The PICS shall be responsible for

ensuring that all field wiring for power and signal circuits is done correctly in accordance with best industry practice and provide for all necessary system grounding to ensure a satisfactory functioning installation. The General Contractor, hereunder, shall schedule and coordinate his work under this Section with that of the electrical work specified under applicable Sections of Division 16.

3.2 TESTS (GENERAL)

- A. The PICS shall test all equipment at the factory prior to shipment. Unless otherwise specified in the individual specification sections, all equipment provided by the PICS shall be tested at the factory as a single fully integrated system.

3.3 14-DAY SITE ACCEPTANCE TEST (SAT)

- A. The PICS shall be responsible for operation of the entire system for a period of 14 consecutive days, under conditions of full plant process operation, without a single non-field repairable malfunction.
- B. During the test, plant operating, and PICS personnel shall be present as required. For this test, the PICS is expected to provide personnel who have intimate knowledge of the system hardware and software.
- C. While the test is proceeding, the Owner shall have full use of the system. Only certified plant operating personnel shall be allowed to operate equipment associated with the actual water production process.
- D. Any malfunction during the tests shall be analyzed and corrected by the PICS. The Engineer/Owner will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.
- E. During the 30 consecutive day test period, any malfunction which cannot be corrected within 24 hours of occurrence by PICS personnel, or more than two similar failures of any duration, will be considered a non-field-repairable malfunction.
- F. Upon completion of a non-field-repairable malfunction by the PICS, the test shall be repeated as specified herein.
- G. Down times due to power outages or other factors outside the normal protection devices or back-up power supplies provided shall not contribute to the availability test time above.
- H. Down times due to plant process equipment failures or other factors beyond the control of PICS shall not contribute to the availability test time above.
- I. Upon successful completion of the SAT and subsequent review and approval by the Engineer of the complete system final documentation, the system shall be considered substantially complete, and a one-year warranty period shall commence.

3.4 TRAINING

A. General

1. The cost of training programs for the Owner's personnel shall be included in the Contract price. Where practical, the training and instruction shall be directly related to the system being applied.
2. Training shall be conducted at the PICS facility or the Owner's facility.
3. All Technicians, Operators, Engineers and Managers of the facility shall require training on the system. The training courses shall address operation, maintenance and troubleshooting of the system provided. The courses shall be designed specifically for the type of personnel attending, such as Operators, Engineers, etc.
4. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training shall be used where required by the Owner's operations schedule.
5. Provide detailed training manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.
6. The trainer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, all training materials shall be delivered to the Owner.
7. The Owner reserves the right to videotape all training sessions. All training tapes shall become the sole property of the Owner.

B. HMI Training

1. PICS On-Site Training
 - a. The PICS shall provide one or two days of on-site training for the plant operators. Training shall focus on the following:
 - (1) Manipulating the HMI Screens
 - (2) Alarms / Alarm Acknowledging
 - (3) Trending
 - (4) Historical
 - (5) Time Stamping
 - (6) Security
 - (7) Changing Set Points

C. Field Training

1. Field and Panel Instruments

- a. Provide training course for two (2) of Owner's personnel in the operation, configuration, programming, installation and maintenance of the field and panel-mounted instrumentation system supplied.
- b. Training shall consist of classroom and hands-on instruction utilizing the Owner's system.
- c. The following training shall be provided, as a minimum:
 - (1) Training in standard hardware maintenance.
 - (2) 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.
 - (3) Test, adjustment and calibration procedures
 - (4) Troubleshooting and diagnostics
 - (5) Periodic maintenance
 - (6) A walk-through of the installed system explaining each major component of the system.

3.5 CONTROL SYSTEM DIAGRAMS AND DETAILS

- A. To assist the PICS in determining the scope of work, a series of schematic diagram drawings and details are provided. Unless specifically stated otherwise, the PICS shall be responsible for providing all instrumentation, control equipment and auxiliary devices necessary to perform the functions specified herein and as shown and described on the Drawings. Any auxiliary devices such as lightning/surge protectors, relays, timers, signal isolators, signal boosters, etc., which are necessary for complete operation of the system, or to perform the functions specified, shall be included whether or not they are specifically shown or tabulated on the loop drawings.
- B. The intent of the loop drawings (as shown in the Drawings) are to describe in as much detail as possible, the hardware, software and functional requirements of a process measurement and control system. They are not intended to convey requirements for conduit and wiring between panels or system components. This information is included in appropriate electrical Specifications and Drawings. Any additional wiring or raceway required for a fully operational system shall be provided at no additional cost to the Owner.

END OF SECTION

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**SECTION 25 00 20
PANELS**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The General Provisions of Section 25 00 00 shall apply to this section.
- B. Furnish all labor, materials, equipment, and incidentals required to fabricate, complete and ready for operation, the panels depicted on the Drawings and in the Panel List below.
- C. All work in this Section shall be the product of the Process Instrumentation and Control Supplier (PICS). Sub-suppliers and/or manufacturers may provide components, enclosures and/or fabrication services to the PICS, but the final product shall conform to this specification and shall be the sole responsibility of the PICS.

1.2 RELATED WORK

- A. Refer to Section 25 00 00.

1.3 SUBMITTALS

- A. Submittals shall be prepared and transmitted to the Engineer for approval in compliance with Section 25 00 00 of these specifications. In addition, shop drawings shall include the following information:
 - 1. Materials for all panels and enclosures.
 - 2. Drawings shall be prepared on 11” by 17” paper, shall be to scale and shall show the location of panel mounted devices as well as doors, louvers and sub-panels.
 - 3. Drawings shall include a panel legend and a bill of materials.
 - 4. The panel legend shall list and identify front of panel devices by their assigned tag numbers, nameplate inscriptions, service legends and annunciator inscriptions.
 - 5. The bill of materials shall list devices mounted within the panel that are not listed in the panel legend and shall include the tag number, description, manufacturer, and model number for each item.
- B. Interconnecting Wiring Diagrams
 - 1. Provide interconnecting wiring diagrams showing electrical connections between panels, consoles, terminal junction boxes and field mounted components.
 - 2. Diagrams shall show component and panel terminal identification numbers and external wire and cable numbers.

3. Circuit names corresponding to the Conduit Schedule shall be shown.
4. These diagrams shall be coordinated with the Electrical Subcontractor and shall bear his mark showing that this has been done.

1.4 SYSTEM DESCRIPTION

- A. Refer to Section 25 00 00.
- B. The following PLC based panels shall be furnished by the PICS as specified under this Section. Refer to the Drawings for size, location and contents of each panel.

LCP No.	Location	Notes
SCADA LCP-A	Post Equilization PS	Nema 4X Stainless Steel
SCADA LCP-B	Proposed SBR Blower Area	Nema 4X Stainless Steel
SCADA LCP-C	Proposed Digester Blower Area	Nema 4X Stainless Steel

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 25 00 00.
- B. The panels and consoles shall be mounted on wood skids four inches high. Adequate crating shall be provided to protect the panels or consoles from damage during shipping.
- C. Instruments and components shall be blocked and tied down to prevent damage during shipping. Front-panel mounted instruments or components shall be removed or securely protected from damage during shipment. Items removed from the panels shall be repacked in their original containers and shipped with the panel.
- D. Accessories, drawings, instruction bulletins, etc. shall be packed and shipped with the associated panel.

1.6 SPARE PARTS AND TEST EQUIPMENT

- A. Provide spare parts and test equipment as specified in Section 25 00 00 and as indicated below.
 1. Fuses: 20 percent of each size and type used, but no less than ten of each size and type.
 2. Relays: 10 percent of each type used, but no less than five of each type.
 3. Indicating Light Bulbs: 25 of each size and type used.
 4. DC Power Supplies: 20 percent of each size and type used, but no less than two of each size and type.
 5. Five spare pilot indicating lights, rotary hand switches, pushbuttons of each type used.

- 6. One spare analog indicator of each type used.
- 7. Corrosion Inhibiting Vapor Capsules: Provide 20 of each type and size used.
- B. B. All spare parts shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity, and temperature.

PART 2 PRODUCTS

2.1 CONTROL PANEL GENERAL REQUIREMENTS

- A. Furnish and install the panels per the Specifications and Drawings.
- B. The construction and wiring for the panels shall be in accordance with this Specification and applicable panel drawings. The panel drawings will specify the arrangement of instruments to be mounted on the front, rear and sides of the panels.
- C. All panels shall be fully enclosed for use with high-density instrumentation mounting.
- D. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.
- E. The instruments and equipment designated for rear-of-panel mounting shall be arranged within the panel according to associated panel drawings in a manner to allow for functionality, ease of maintenance and adjustment.
- F. Conductors running from the field to the panels shall be continuous without splices, except at approved junction boxes. All junction boxes and panels shall have 20 percent spare terminals.
- G. Conduits and cables entering panels shall be sealed to prevent the intrusion of gas and moisture.
- H. All components shall be mounted in a manner that shall permit servicing, adjustment, testing and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates, in such a manner that the component may be removed without removing the plate and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required by the manufacturer to protect equipment from vibration. Mounting orientation shall be in accordance with the requirements of each component.
- I. Components shall be identified with suitable plastic or metal engraved tags attached adjacent to (not on) each component identifying the component in accordance with the Drawings, Specification and PICS data.
- J. The internal framework of each panel shall permit panel lifting without distortion. Provide removable lifting rings designed to facilitate simple, safe rigging and lifting of the panel during installation. Plugs shall be provided and shall unobtrusively fill the panel lifting ring

holes when substituted for the lifting rings after installation is complete.

- K. All panels, consoles and exterior mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.
- L. All panels shall be supplied with suitable nameplates, which identify the panel and individual devices as required. Nameplates shall be provided for all flush mounted equipment in the interior and exterior of each panel. Nameplates shall be constructed of white and black laminated phenolic material having engraved letters extending through the white face into the black layer. Nameplate shall be beveled and attached to panels by adhesive or glue.
- M. Provide a sun / rain shield over enclosure.

2.2 PANEL MATERIALS AND CONSTRUCTION

A. General

- 1. All panels located in indoor areas, unless otherwise specified, shall be NEMA 12 construction.
 - a. Freestanding panels shall be constructed of 12 gauge or thicker steel, suitably braced internally for structural rigidity and strength. All exposed welds, seams or edges shall be ground smooth.
 - b. Wall or Unistrut mounted panels shall be constructed of 14 gauge or thicker steel. All exposed welds, seams or edges shall be ground smooth.
 - c. Front panels or panels containing instruments or components shall be 10 gauge or thicker sheet steel reinforced to prevent warping or distortion.
 - d. Interior panels of 10-gauge steel construction shall be provided where necessary for instrument or component mounting.
 - e. All doors shall be lockable, mounted with strong, continuous, piano type hinges and shall be provided with door handles and three-point latches or screw clamps.
- 2. All panels located in outdoor areas, or in indoor areas where otherwise specified, shall be NEMA 4X Type 316 stainless steel construction.
 - a. Freestanding panels shall be constructed of 12 gauge or thicker Type 316 stainless steel, suitably braced internally for structural rigidity and strength. All exposed welds, seams or edges shall be ground smooth.
 - b. Wall or Unistrut mounted panels shall be constructed of 14 gauge or thicker Type 316 stainless steel. All exposed welds, seams or edges shall be ground smooth.
 - c. Front panels or panels containing instruments or components shall be 10 gauge

or thicker Type 316 stainless steel reinforced to prevent warping or distortion.

- d. Interior panels of 10-gauge steel construction shall be provided where necessary for instrument or component mounting.
 - e. All doors shall be lockable, mounted with strong, continuous, piano type hinges and shall be provided with door handles and three-point latches or screw clamps.
- 3. Panels shall be provided with full length, fully gasketed rear doors or front access doors as shown on the panel drawings. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments or control devices.
 - 4. The panel shall be suitable for top or bottom conduit entry as required by the Electrical Drawings.
 - 5. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts or other accessories as required to maintain the NEMA rating of the panel and the electrical rating of the conduit system.

B. Finish Requirements

- 1. All panel sections shall be descaled, degreased, filled, ground and finished. The enclosure, when fabricated of carbon steel, shall be furnished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane or lacquer finish, which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel and fiberglass-reinforced polyester panels will not require a paint finish.
- 2. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with solvent. Surface voids shall be filled and ground smooth.
- 3. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sanding shall be applied to the intermediate exterior coat before the final topcoat is applied.
- 4. The panel interior shall have a minimum of two coats of flat white lacquer after priming.
- 5. Unless otherwise noted, the finish exterior colors shall be selected by the Owner from color chips supplied by the PICS.

C. Manufacturers

- 1. The panels shall be manufactured by Hoffman or Engineer approved equal.

2.3 CONSOLE MATERIALS AND CONSTRUCTION

A. General

1. All consoles located in outdoor areas, unless otherwise specified, shall be NEMA 4X construction.
 - a. Freestanding consoles shall be constructed of a one-piece molded fiberglass-reinforced polyester material, suitably braced internally for structural rigidity and strength with a minimum wall thickness of 0.125 inch thick.
 - b. Surfaces containing instruments or components shall be a minimum of 0.25 inch thick and reinforced to prevent warping or distortion.
 - c. Interior panels of 10-gauge steel construction shall be provided where necessary for instrument or component mounting.
2. Consoles shall be provided with front and rear access lift off doors with Southco Type 44 latches as shown on the panel drawings.
3. The console shall be suitable for bottom conduit entry as required by the Electrical Drawings.
4. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts or other accessories as required to maintain the NEMA rating of the panel and the electrical rating of the conduit system.

B. Finish Requirements

1. Consoles shall be maintenance free using molded-in colors that never require painting, fade or wear off. The finish shall be satin gloss and gel coated.
2. The consoles shall have all edges rounded and ground smooth for safety and appearance.
3. Unless otherwise noted, the finish exterior colors shall be selected by the Owner from color chips supplied by the PICS.

C. Manufacturers

1. The consoles shall be manufactured by Warminster Fiberglass or Engineer approved equal.

2.4 TEMPERATURE CONTROL

- A. Freestanding panels shall be provided with louvers, forced air ventilation or air conditioning as required to prevent temperature buildup due to ambient temperature conditions and/or electrical devices mounted in or on the panel.
- B. Panels that require louvers shall have them mounted on the rear at the top and bottom of the

panel unless the panel is located against a wall, then they shall be mounted on the sides.

- C. Panels that require forced air ventilation fans shall provide a positive internal pressure within the panel and shall be provided with washable or replaceable filters. Fan motors shall operate on 115 VAC, 60 Hz power.
- D. Panels that require air conditioning shall use side-mount air conditioners manufactured by Hoffman Proair or Engineer approved equal. Air conditioners shall operate on 115 VAC, 60 Hz power.
- E. The internal temperature of all panels shall be regulated so as not to exceed 100⁰ F.
- F. The panel cooling equipment shall not compromise the NEMA rating of the panel.

2.5 CORROSION CONTROL

- A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Hoffman or Engineer approved equal.

2.6 INTERNAL CONSTRUCTION

- A. Internal Electrical Wiring
 - 1. Panel equipment and components shall be mounted and wired on or within the panel or console. Wiring shall comply with the National Electric Code. Wiring within the panel shall be grouped together with wire ducts and secured to the structure. Wiring shall be numbered in compliance with the numbering system used on the wiring / connection diagrams. Wiring and connection diagrams shall comply with ISA S5.4 Instrument Loop Diagrams and shall be as part of the Shop Drawings for review by the Engineer.
 - 2. Power wires shall be 14 AWG Type THWN stranded and shall be insulated for not less than 600 volts. Conductors shall be of tinned copper construction. All interconnecting wiring, except for electronic circuits, shall be rated for not less than 90⁰ C.
 - 3. Control wires shall be 16 AWG Type THWN stranded and shall be insulated for not less than 600 volts. Conductors shall be of tinned copper construction. All interconnecting wiring, except for electronic circuits, shall be rated for not less than 90⁰ C.
 - 4. Analog signal cables shall be single pair 16 AWG shielded cable with a ground wire. Conductors shall be of tinned copper construction.
 - 5. All wiring leaving or entering the panel shall be terminated on terminal blocks that are rigid, numbered and located for ease of access and troubleshooting.
 - 6. Terminal strips shall be separated into groups for power, control and analog signals.
 - 7. Terminal strips and/or block systems shall be manufactured by Phoenix, Allen Bradley

or Weidmuller and shall be rated for a minimum of 600 volts.

8. Wire ducts for supporting internal wiring shall be a plastic type with snap on covers.
9. Each wire shall be provided with a numbered and typed heat shrink tubing identification marker at both ends. Handwritten markers or paper markers will not be permitted. Each individual wire shall be assigned a number that corresponds to the number shown on the Drawings.
10. Each freestanding panel shall have a switched single-tube 20-Watt fluorescent light fixture mounted internally in the ceiling of the panel manufactured by Hoffman.
11. Each panel shall have a duplex convenience receptacle mounted internally within the panel in an appropriate steel box and cover.
12. A single lamp test button shall be provided on a panel, where appropriate, to test all of the indicator lamps in the panel at the same time.
13. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Grounding shall be in accordance with the instrumentation manufacturer's recommendations.
14. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the National Electric Code.
15. Each panel shall be provided with analog signal isolation (I/I) when analog signals are sent from one panel or console to another.
16. Each panel shall be provided with surge suppression protection (electrical transients) for connections between AC power systems and electrical or electronic equipment. Surge suppressor grounding shall be in accordance with the manufacturer's recommendations.
17. Each panel shall be provided with a circuit breaker power disconnect switch.
18. Each digital output shall be wired to an interposing relay and one normally open contact from each relay shall be wired to the terminal strip. The contact shall be rated for 115 VAC, 10 Amp or 24 VDC, 10 Amp.

B. Print Storage Pockets

1. Print storage pockets shall be provided on the inside of each panel or console. Its size shall be sufficient to hold all of the prints and documentation necessary to service the equipment attached to it or within it.

C. Equipment Shelves

1. Equipment shelves shall be provided as necessary to support miscellaneous equipment that is normally not mounted or fastened directly to a panel.
 - a. SCADA System Data Highway Fiber-Optic Ethernet Switches
2. Shelves shall be fabricated out of aluminum sheet metal and shall be fastened securely to the equipment panel within the enclosure.

2.7 MISCELLANEOUS PANEL COMPONENTS

A. Panel Meter - Digital Readout

1. Type
 - a. Numerical digital process meter.
2. Functional Performance
 - a. The meter shall be a 3-½ digit minimum resolution LED indicator and shall display the value of the analog input signal in engineering units with a scaled range, as noted. The decimal point shall be field selectable and the meter shall provide an over range indication.
 - b. Accuracy shall be 99.9 percent.
 - c. Power requirements shall be 120 VAC or 24 VDC, as required.
 - d. The operating temperature limits shall be 0 to 60° C.
3. Physical
 - a. The meter shall be housed in a NEMA 4X high impact plastic enclosure with a splash proof lens.
 - b. The meter shall provide a permanent service legend to display the engineering units of the process variable.
 - c. The meter dimensions shall not exceed 4" wide x 2" high x 5" deep.
4. Manufacturers
 - a. The digital readout panel meter shall be Model PD690 as manufactured by Precision Digital or Engineer approved equal.

B. Pilot Indicating Lights

1. Type
 - a. Heavy-duty oil tight type utilizing low voltage lamps with integral lamp test.

2. Functional Performance

- a. Units shall be provided with low voltage lamps suitable for 24 VDC power.
- b. Units shall provide for a remote lamp test function.
- c. Lamps shall be replaceable from the front of the unit.

3. Physical

- a. Lens colors shall be as indicated on the Drawings and shall be approximately 1 ¼ inch in diameter.
- b. Provide legend nameplates engraved to indicate the required function of each device.
- c. Units shall be rated NEMA 4X for outdoor weatherproof conditions.

4. Manufacturers

- a. The pilot indicating lights shall be Model 800T as manufactured by Allen Bradley or Engineer approved equal.

C. Rotary Hand Switches and Pushbuttons

1. Type

- a. Control devices shall be heavy-duty oil tight type with stackable contact blocks.

2. Functional Performance

- a. Provide control devices, switch configurations as required for the control system specified and as shown on the Drawings.

3. Physical

- a. For 115 VAC service, provide contacts rated 10 Amps at 115 VAC, for 24 VDC service provide contacts rated 5 Amps at 125 VDC, for electronic (millivolt / milliamp) switching provide gold plated contacts rated at 28 VDC.
- b. Pushbuttons shall have flush type operators and selector switches shall have knob or wing lever operators.
- c. Provide legend nameplates engraved to indicate the required function of each device.
- d. Units shall be rated NEMA 4X for outdoor weatherproof conditions.

4. Options / Accessories Required

- a. Provide lockout pushbuttons, key-operators, etc. as indicated on the Drawings.
 - b. Provide make-before-break bridging contacts as required for the control system specified.
 5. Manufacturers
 - a. The rotary hand switches and pushbuttons shall be Model 800T as manufactured by Allen Bradley or Engineer approved equal.
- D. General Purpose Relays and Time Delay Relays
 1. Type
 - a. Units shall be general-purpose plug-in type.
 2. Functional Performance
 - a. Provide general-purpose control relay and time delay relay configurations as required for the control system specified and as shown on the Drawings.
 - b. Mechanical life expectancy shall be in excess of 10 million operations and the duty cycle shall be rated for continuous operation.
 - c. Relays shall be provided with an integral indicating light to display when a relay is energized.
 - d. Solid-state time delay relay periods shall be 0.1 second to 4.5 hours and shall be adjustable, provided with polarity protection and transient protection.
 3. Physical
 - a. For 115 VAC service, provide contacts rated 10 Amps at 115 VAC, for 24 VDC service provide contacts rated 5 Amps at 125 VDC, for electronic (millivolt / milliamp) switching provide gold plated contacts rated at 28 VDC.
 - b. Relays shall be provided with dust and moisture resistant covers.
 4. Options / Accessories Required
 - a. Provide all mounting rails, mounting sockets, etc. that are required.
 5. Manufacturers
 - a. The general-purpose relays and time delay relays shall be Model 700HF as manufactured by Allen Bradley or Engineer approved equal.
- E. Signal Isolators / Boosters / Converters

1. Type
 - a. Solid-state electronic type.
2. Functional Performance
 - a. Provide signal isolators, boosters or converters as required for the control system specified and as shown on the Drawings.
 - b. Accuracy shall be 0.15 percent or better.
 - c. Inputs shall be current, voltage, frequency, temperature or resistance as required.
 - d. Outputs shall be current, or voltage as required.
 - e. Isolation shall be complete between input circuitry, output circuitry and the power supply.
 - f. Zero and span adjustments shall be provided.
 - g. RFI protection shall be provided.
3. Physical
 - a. Units shall be suitable for mounting in a rack or an enclosure.
 - b. Units shall be provided with dust and moisture resistant covers.
4. Options / Accessories Required
 - a. Provide all mounting rails, racks, etc. that are required.
5. Manufacturers
 - a. The signal isolators / boosters / converters shall be Series 4000 as manufactured by AGM or Engineer approved equal.

F. Surge Protection

1. See Section 13660

2.8 UNINTERRUPTIBLE POWER SUPPLY

- A. An Uninterruptible Power Supply (UPS) shall be provided for each new panel or console. The UPS shall protect all PLC equipment, including remote I/O, instrumentation, power supplies, etc.
- B. The UPS shall be based on ferroresonant technology, preventing spikes, sags, surges, noise and harmonics from adversely affecting equipment. Input power shall be 120/208/ 240 VAC

as indicated on the drawings, 60 Hz. Output power shall be 120 VAC, 60 Hz.

- C. The UPS shall contain hot-swappable internal backup batteries sufficient to allow all connected equipment to run continuously after a normal power failure for one or four hours as stated below in the UPS Schedule. PICS shall submit power calculations for each UPS system to be reviewed by the Engineer.
- D. The UPS shall automatically switch to battery power upon loss of normal power and back to normal power upon return to normal conditions, using a continuous no-break connection to ensure that there are no momentary power interruptions.
- E. The UPS shall be housed in a NEMA 1 enclosure and shall be securely mounted within a NEMA 12 panel, console or battery cabinet as shown on the Drawings.
- F. Additional batteries, where required to meet the specified runtime, shall be housed in a NEMA 12 enclosure located adjacent to the PLC panel as shown on the Drawings.
- G. The UPS shall include auto-diagnostics and communications capabilities, accessible through a RS-232 port.
- H. The UPS shall be Best Power, Ferrups Model FE or Engineer approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Refer to Section 25 00 00.
- B. The panels and consoles shall be factory tested and approved by the Engineer prior to shipment.
- C. The panels and consoles shall be installed at locations as shown on the Drawings.

3.2 FACTORY ACCEPTANCE TEST (FAT)

- A. Refer to Section 25 00 00.
- B. All panels and consoles shall be tested for proper operation and approved by the Engineer at the PICS factory, or other selected site, prior to shipment to the Jobsite.
- C. Tests shall demonstrate all specified control functions by simulating inputs and outputs to the panels, communication to and from the SCADA and HMI systems, etc.
- D. Acceptance of factory tests by Owner or Engineer shall not constitute a waiver of requirements to meet field tests under specified operating conditions, nor does inspection relieve the PICS of his responsibility in any way.

END OF SECTION

**SECTION 26 00 00
GENERAL ELECTRICAL PROVISIONS**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Furnish and install all materials, equipment, labor, supervision, and services necessary to complete all electrical work specified herein and shown on the Drawings.
- B. Contractor shall coordinate service to each site (Raw Sewage Pump Station & Wastewater Treatment Plant) with the local utility company.
- C. Principal Features
 - 1. Main Breaker
 - 2. Generator and ATS
 - 3. Panelboards – 480V and 208/120V
 - 4. Complete system of conduits, cables and conductors to supply electrical energy throughout the facility.
 - 5. Motor Control Center with integral VFDs
 - 6. Installation of Control Panels and instruments
 - 7. All field terminations, including instruments, vendor panels, etc.

1.2 APPLICABLE STANDARDS AND CODES

- A. Local, State, and National Electrical Codes.
- B. National Electrical Code, 2020.
- C. Rules of the Electrical Utility and the National Electrical Safety Code.
- D. Life Safety Code 101.
- E. NECA Standard of Installation.
- F. NFPA (National Fire Protection Association).

1.3 FEES AND TESTS

- A. Contractor shall be responsible for all fees for permits, inspections, and tests necessary to complete this work. Contractor shall demonstrate to the Owner and the Engineer that all

items of equipment installed are completely operational and free of defects in all modes.

1.4 COORDINATION WITH OTHER TRADES

- A. Furnish and locate all anchor bolts, inserts and supports for installation by the other trades as required. Coordinate the location of all fixtures, outlets, equipment, and devices with other trades to avoid conflicts.

1.5 LIST OF PROPOSED MANUFACTURERS

- A. List of Proposed Materials: The Contractor shall submit a complete list of the proposed manufacturers for each proposed item as required to complete the work. Additional submittal data, sufficient to determine equality, shall be required if the Contractor proposes to substitute another manufacturer's equipment.

1. Intent of Drawings

- a. Electrical plan drawings show only general locations of equipment, devices and raceways, unless specifically dimensioned. The Contractor shall be responsible for the proper routing of raceway, subject to the review of the Engineer.

2. Departures from Contract Documents

- a. Submit to the Engineer in writing details of any necessary, proposed departures from these Contract Documents, and the reasons, therefore. Submit such requests as soon as practicable and within 30 days after award of the Contract. Make no such departures without written approval of the Engineer.

PART 2 PRODUCTS

2.1 REFERENCE TO DRAWINGS

- A. Reference shall be made to Drawing Schedules, Details, Notes, and Specifications for: Manufacturer, model, catalog number, size, capacity, performance, ratings and installation of equipment and material.

2.2 CHOICE OF MATERIALS AND EQUIPMENT

- A. In submitting substitutions, bidders should note the following minimum considerations: (1) capacities shown are absolute minimal and must be equaled, (2) physical size limitations for space allotted, (3) structural properties, (4) noise level, (5) interchangeability, (6) compatibility with other materials and assemblies, (7) similar items shall be same manufacture and style wherever possible.
- B. All material and equipment, for which a UL, ANSI, or a NEMA Standard is established, shall be so approved and labeled or stamped.
- C. Adhesives are not acceptable as a mounting, supporting, or assembling technique, unless

noted otherwise.

2.3 ELECTRICAL EQUIPMENT

- A. NEMA Standards shall be taken as minimum requirements for electrical equipment.
- B. Equipment shall operate properly under a plus or minus 10 percent of the system voltage.

2.4 SUBMITTALS DURING CONSTRUCTION

- A. Provide complete manufacturers' descriptive information and shop drawings for all permanently installed equipment, material and devices furnished under Division 26, Electrical, including certified outline drawings, arrangement drawings, elementary (schematic) diagrams, interconnection and connection diagrams, in accordance with provisions elsewhere in these Contract Documents. Provide the number of copies specified in Section 01 33 00. Operation and Maintenance Manuals shall be submitted in accordance with Section 01 70 00.
- B. Provide certified shop drawings, literature and requested samples showing items proposed for use, size, dimensions, capacity, special features required, schematic (elementary) control diagrams, equipment schedules, rough-in, etc., as required by the Engineer for complete review and for use during installation. Use NEMA device designations and symbols for all electric circuit diagrams submitted. Make content of the schematic (elementary) connection or interconnection diagrams in accordance with the latest edition of NEMA ICS 1.
- C. Manufacturer's standardized elementary diagrams will not be acceptable unless applicable portions of the diagram have been clearly identified and non-applicable portions deleted or crossed out.
- D. Certified arrangement drawings, outline dimensions, and weights for all major (engineered) equipment including, but not limited to:
 - 1. Low voltage switchgear.
 - 2. Transformers.
 - 3. Variable frequency drives.
- E. Functional description or logic diagrams for all control systems furnished under Division 26, Electrical.
- F. Characteristic curves for all protective devices.
- G. Certified drawings and descriptive literature for all equipment and devices furnished under Division 26, Electrical, and not listed above.
- H. Schematic (elementary drawings for any electrical control and bills of material for equipment including, but not limited to:

1. Motor control
 2. Control systems furnished under Division 26, Electrical.
 3. Switchgear, Breakers, and Automatic Controllers
 4. Variable Frequency Drives
- I. Connection diagrams showing all internal wiring and all required field connections for the following:
1. Low voltage switchboard
 2. Breakers
 3. Variable Frequency Drives
- J. The interconnection diagrams shall show terminal points, intermediate connections, device designation, terminal numbers, polarity of dc circuits, conductor identification, and any other information necessary to show which conductor connects to which point; the Contractor shall review and sign off on the control interconnection diagrams.
- K. In addition to submittals for specific items mentioned above, furnish shop drawing information on the following items:
1. Conduit, tubing, and fittings.
 2. Wireway.
 3. Outlet and device boxes.
 4. Pull boxes and junction boxes.
 5. Terminal junction boxes.
 6. 600-volt conductors.
 7. Control cable.
 8. Receptacles.
 9. Surge suppressors

PART 3 EXECUTION

3.1 WIRING ELECTRICALLY OPERATED EQUIPMENT

- A. The Contractor shall be responsible for electrical connections to all equipment requiring electrical power. This responsibility applies to equipment furnished under this and other

Divisions and by the Owner.

3.2 RECORD AND AS-BUILT DOCUMENTS

- A. Maintain at the job site a set of Contract Documents kept current by indicating thereon all changes, revisions and substitutions, between work as specified and as installed.
- B. Furnish Owner with complete set of Operation and Maintenance Manuals.

3.3 EQUIPMENT OPERATION

- A. This Division is responsible for: (1) proper rotation, (2) observing that lubrication has been properly performed, (3) that motors operate within nameplate limits, and (4) adjustment of circuit breaker and MCP trip settings.

3.4 CLEANING AND PAINTING

- A. Fixtures, panels, and equipment shall be thoroughly cleaned. All equipment shall be touched up or repainted as required to present a clean professional appearance. Paint all ferrous metal that is not otherwise protected against corrosion. Paint exposed pipe threads with Bitumastic No. 50.

3.5 IDENTIFICATION

- A. Identify all major items of equipment including controls, panels, switches, contactors, motor starters, junction boxes and metering by permanent nameplates, with wording approved by Engineer. Secure metal nameplate frame with screws or brads. Adhesives are acceptable on components within NEMA 1 enclosures.
- B. Nameplates after installation shall be easily visible and shall bear notations corresponding to those shown on record drawings.
- C. Each instrument shall be identified with a stamped stainless-steel tag system (Brady or approved equal). Instrument tags shall be permanently attached to each individual instrument and stamped with the appropriate number per instrument specification section.
- D. Each cable shall be identified with a permanent labeling system (Brady Catalog Number B-292 with printed legends or approved equal). Instrumentation cables shall be labeled with the appropriate instrument number of the originating signal (Ex. FT-2020-1). Multiplex cables, power and control cables shall be labeled with the appropriate cable number per the conduit and cable schedules. Refer to PICS shop drawings for instrument cable identification.
- E. All switchgears, MCC's, MCC compartments, power panels, lighting panels, control panels, control cabinets, etc. shall be identified with permanently mounted phenolic labels.
- F. All power and lighting panels shall have typed schedules mounted on panel doors.

- G. All terminals and associated wires shall be numbered and labeled respectively and wiring diagrams shall be installed in the MCC or electrical panel doors.

3.6 TEST PERIOD

- A. Each piece of equipment shall continue to meet performance specifications throughout the first year of operation. Contractor shall replace or repair any defect due to faulty workmanship or material which shall develop within 1 year from date of acceptance.
- B. For first year after final acceptance, Contractor shall provide, at no cost to Owner, any required maintenance and service necessary to assure the proper operation of the system. Date of acceptance shall be certified by Engineer as that date on which the Contract Work has been satisfactorily completed, as a whole, in accordance with the Contract Documents.

3.7 GROUNDING

- A. See Specification 26 05 26.

3.8 ELECTRICAL TESTING AND START-UP

A. General

- 1. Prior to energizing any equipment, the electrical contractor shall thoroughly vacuum clean the equipment with an industrial type vacuum cleaner. The outside of all electrical equipment shall be cleaned, and paint touched up as required to leave equipment in an “as purchased” condition.
- 2. During start-up of new equipment, the electrical contractor shall provide sufficient personnel to aid with start-up of the electrical equipment to remove any faults, and to make the necessary adjustment for proper operation of electrical equipment and installation. This includes sufficient personnel to aid equipment service personnel in their check-out of the electrical equipment and service.
- 3. All testing equipment shall be furnished by the Contractor.
- 4. All failures under tests due to defective material or poor workmanship shall be corrected by the Contractor at no expense to the Owner.
- 5. The electrical contractor shall not, under any circumstances, energize any electrical equipment covered by these Specifications without first obtaining permission from the Engineer.

B. Grounding

- 1. After all connections have been made to the ground, ground tests shall be made to verify its adequacy. See specification 26 05 26.

- C. Typewritten directories shall be inserted in all panels showing the designation of each circuit.

All power and replacement fuses necessary for testing shall be furnished and paid for under this item.

D. Circuit Continuity

1. Complete installation shall be free of short circuits, open circuits, and other defects. Insulation Resistance and Continuity Tests shall be performed in accordance with Section 26 01 26-3.2 to prove that all parts of the installation are intact.

3.9 INSTALLATION OF EQUIPMENT

- A. The electrical contractor shall coordinate with the Local Utility Company, Contractor and Owner in order to have electric power available when required.

3.10 TEMPORARY ELECTRIC POWER

- A. The contractor shall coordinate, furnish, pay for, and provide any necessary provisions for electric power used during construction.

END OF SECTION

**SECTION 26 05 19
WIRE AND CABLE**

PART 1 GENERAL

1.1 SCOPE

- A. Work covered by this section includes furnishing all labor, equipment, and materials required to install, connect, and test all wire and cable, including splices, terminations, connectors, and accessories for a complete installation as shown on the Drawings and/or specified herein.
- B. The Contractor's attention is directed to the fact that all wires and cables are not necessarily shown on the Drawings, which are more or less schematic. However, the Contractor shall be responsible for furnishing and installing all wire and cable indicated or required to properly connect and place into operation all equipment and services requiring such wiring and/or cable.

1.2 QUALITY ASSURANCE

- A. Samples of all wire and cable, clearly marked and long enough to show complete identification, shall be submitted to the office of the Engineer for approval prior to wiring installation.
- B. No defective or damaged wire and cable shall be incorporated into the work.

1.3 SIZING OF CONDUCTORS

- A. Unless otherwise required or directed by the Engineer, conductors shall be furnished in the sizes shown on the Drawings. No wire for lighting, power, or motor control circuits shall be smaller than No. 12 AWG. Motor control circuits carrying less than 8 amps may be No. 14 AWG. No wire for instrumentation and low-level signal transmission pairs shall be smaller than No. 16 AWG for single pairs or No. 20 AWG for bundled cable.
- B. All wires and cables shall be of such size as to conform to the regulations of the current edition of the National Electrical Code for current carrying capacity.
- C. Where the size of lighting wiring is not given on the Drawings, it shall be of such size that the voltage drop from the main panel to the lighting panel is not more than 1 percent, and the drop in the branch circuit is not more than 2 percent. The voltage drops in motor feeder, when the wire size is not specified, shall not be more than 3 percent at full load from the Motor Control Center to the motor terminal.

1.4 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data shall be submitted in accordance with requirements of the Section 01 33 00 of these Specifications.

1.5 STORAGE AND PROTECTION

- A. Store and protect all wire and cable in accordance with the manufacturer's recommendations and requirements of the Section 01 60 00 of these Specifications.
- B. Wire and cable shall be stored indoors in a dry and warm location and in its original packaging.

1.6 GUARANTEE

- A. Provide a guarantee against defective materials and workmanship in accordance with requirements of the Section 00 72 14 Article 23 of these Specifications.

PART 2 PRODUCTS

2.1 CONDUCTORS - GENERAL

- A. Conductors shall be solid or Class B concentric stranded, soft, or annealed, uncoated copper free from kinks and defects in accordance with ASTM B 3 or B 8.
- B. Copper conductors should have a conductivity not less than 97 percent.
- C. The wire and cable shall have size, grade of insulation, voltage, and manufacturer's "E-Number" permanently marked on the outer covering at not more than 2-foot intervals.
- D. All wires shall conform to the latest Standards of the ASTM and ICEA and shall be tested for their full length by these Standards.
- E. All control circuit wiring and all wiring No. 8 AWG and larger shall be stranded. Lighting branch circuits No. 12 and No. 10 AWG may be solid. Wiring shall be stranded as follows:
 - 1. No. 14 thru No. 2 AWG shall have a minimum of 7 strands.
 - 2. No. 1 thru No. 4/0 AWG shall have a minimum of 19 strands.
 - 3. No. 250 MCM thru No. 500 MCM shall have a minimum of 37 strands.
 - 4. All circuits except control and instrumentation circuits shall have a separate grounding conductor carried in the conduit.

2.2 CONDUCTORS FOR WIRE AND CABLE

- A. XHHW - For service entrance, motor branch, and feeder circuits operating at 208, 240, and 480 volts, the conductors shall be single-conductor, cable rated, 600 volts. The single-conductor cable shall consist of uncoated annealed copper, Class B stranded per ASTM B 8 and insulated with corona, ozone, heat and moisture resisting cross-linked polyethylene insulation rated to withstand a copper temperature of 90 degrees C, Underwriter's approved Type XHHW and shall be as manufactured by Southwire, General Cable Corporation, Okonite Company or equal.

- B. THWN-2 - For general lighting and receptacle branch circuits operating at 120 volts, the conductor shall be single-conductor cable rated 600 volts. The single-conductor cable shall be uncoated annealed copper. No. 12 and No. 10 AWG may be solid or stranded; larger cables shall be stranded per ASTM B 8 or B 3 and insulated with polyvinyl chloride insulation rated to withstand a copper temperature of 75 degrees C, Underwriter's approved Type THWN-2, and shall be as manufactured by Southwire, General Cable Corporation, Okonite Company, or equal.
- C. VFD Cables – For VFD cables, use 3/C with ground, bare copper XLPE insulation overall dual copper tapes helically applied shield, block PVC outer jacket, 600/1000V TC-ER 90C dry/wet 1000V CSA AWM, Sunlight resistant, dry wet. Cable shall be equal to Belden 29526C (#4), Belden 29525C (#6), Belden 29524C (#8), Belden 29523C (#10), Belden 29522C (#12) or approved equals that have equivalent or less overall diameters.
- D. For lighting fixture drop wire or for running in fluorescent units, the conductors shall be single-conductor cable rated 600 volts. The single-conductor cable shall be stranded tinned copper with a 31-mil-thick wall silicone insulation and a glass braid jacket overall rated to withstand a copper temperature of 150 degrees C, Underwriter's approved silicone insulated fixture wire type SFF-2, and shall be as manufactured by General Cable Corporation, General Electric Company, or equal.
- E. For control circuits the conductors may be single or multi-conductor cable rated 600 volts. The conductors shall consist of uncoated annealed copper Class B stranded per ASTM B 3 or B 8 and shall be No. 14 or No. 12 AWG, 7-strand, identified at each end using Brady wire markers B-500 vinyl cloth, Thomas and Betts "E-Z Code" wire markers, or equal.
 - 1. Single-conductor cable shall have 45-mil-thick wall of cross-linked polyethylene or polyvinyl chloride insulation, color red, to withstand a copper temperature of 90 degrees C, Underwriter's Laboratories approved Type RHH-RHW, and shall be as manufactured by General Electric Company, Phelps Dodge, General Cable, Okonite, or equal.
 - 2. Multi-conductor cable shall consist of single-conductor cables rated 600 volts and insulated to withstand a copper temperature of 90 °C cabled together to form a cable assembly which is Underwriter's Laboratories approved for installation in conduit. The core shall be color coded in accordance with ICEA, Method 1, with a plastic tape cover and a PVC or neoprene jacket overall.
- F. Bare grounding conductor shall be Class A or B medium hard drawn, high conductivity bare copper, sized as shown on the Drawings. Conductors No. 6 AWG and smaller may be solid. Conductors No. 4 AWG and larger shall be stranded.
- G. Flexible power cords shall be moisture-resistant, oil-resistant, neoprene-sheathed service cable designed for extra hard usage, Type SO, rated 600 volts at 90 degrees C continuous conductor temperature. Flexible heater cords shall be moisture-resistant, oil-resistant, neoprene and cotton sheathed service cable designed for extra hard usage, Type HSO, rated 600 volts at 90 degrees C continuous. Insulation shall be thermoplastic ethylene-propylene

conforming to ICEA S-68-516. Neoprene shall conform to ASTM D 752. All flexible cords shall be UL listed.

2.3 INSTRUMENTATION AND THERMOCOUPLE EXTENSION WIRING

- A. Instrumentation and low-level DC signal wiring shall be shielded, twisted pair conductors. Single twisted pairs shall consist of 2, Class B stranded, No. 16 AWG annealed copper conductors, 1 white and 1 black, with 15 mils of PVC insulation rated for 600 volts and 90 degrees C minimum continuous conductor temperature. Pairs shall be twisted to a lay of 1.5 to 2.5 inches. A 0.35 mil by 0.50 mil aluminum-mylar tape shield with stranded, bare No. 18 AWG, tinned copper drain wire in contact with the aluminum side of the shield shall be applied helically around the twisted pair. An overall jacket of 90 degrees C black PVC at least 30 mils in thickness shall be applied to the outside. Shield coverage shall be full 100 percent. All instrumentation wiring shall be UL listed.
- B. Twisted, Shielded Triad Instrumentation Cable for RTD circuits: Stranded copper conductors, size #16 AWG. Insulate conductors individually with color-coded PVC. Provide shield for each triad and tinned-copper drain wire. Provide flame-retardant PVC outer jacket. Cable shall be rated 600 volts and 90 degrees C. Cable shall be designed for noise rejection for use in process control signals.

2.4 AUDIO SIGNAL WIRING

- A. Audio signal wiring for public address and sound systems shall be shielded, twisted pair instrumentation cable with 2 No. 16 AWG conductors constructed in accordance with the requirements of Part 2.3 of this section.

2.5 ETHERNET CABLES

- A. Ethernet cables routed in conduit shall be Cat 7a enhanced cable suitable for outdoor use and in conduits. Outer shield shall be braided. Conductor shall be 22 AWG.

2.6 FIBER CABLE

- A. See P&ID drawing for fiber type. Coordinate fiber type with PICS / System Integrator prior to purchase.

2.7 TELEPHONE AND COMMUNICATION WIRING

- A. Indoor telephone and communication cable shall consist of solid, minimum No. 22 AWG, annealed copper conductors insulated, and standard telephone color coded with polyethylene and twisted together in pairs. Pairs shall be cabled together and protected with a metal tape shield and a polyethylene or PVC jacket overall. Cable shall be suitable for installation in ducts.
- B. Buried telephone cable shall be REA approved for aerial installation on messenger wire, installation in underground ducts, and direct burial. Cable shall consist of solid, minimum No. 22 AWG annealed copper conductors insulated and standard telephone color coded with

polypropylene or polyethylene and twisted together in pairs. Each pair shall be twisted to a different lay length. Cable with more than 25 pairs shall be assembled from oscillated, bundled, 25-pair subunits. Bundled pairs shall be covered by a nonhygroscopic tape, an inner jacket of polyethylene, a shield of aluminum or tinned copper, and an outer jacket of black, high-molecular weight polyethylene copolymer. Cable core shall be completely filled with a nontoxic, petrolatum-polyethylene weatherproofing compound. Jacket shall be sequentially marked to indicate footage.

2.8 SPLICES AND TERMINATIONS

- A. Splices, taps and attachment of fittings and lugs shall be electrically and mechanically secure, and approved solderless lugs and connectors shall be used. Lugs and connectors shall be top quality product of Burndy, O-Z, Thomas and Betts, or equal manufacturer. Conductors shall not bind at bushings. Lugs shall be of the correct sizes for the conductors joined and strands shall not be cut from a conductor.
- B. Splices, taps, and terminations of cable rated 600 volts and less requiring tape shall be half lap and at least 3 layers. Taping shall be neatly done and form a permanent insulation equal in mechanical and electrical strength to the insulation of the conductor. Taping shall be as follows:
 - 1. Rubber Insulation
 - a. Inner Layer: Okonite Rubber Tape, 3M “Scotchfil” Electrical Insulation Putty, Plymouth “Plysafe” Tape, or equal.
 - b. Outer Layer: 3M “Scotch No. 88” Tape, Permacel No. 295 Tape, Slipknot Grey Tape, or equal.
 - c. Thermoplastic Insulation: 3M “Scotch No. 88” Tape, Permacel No. 295 Tape, Slipknot Grey Tape, or equal.
 - 2. Terminations at motor junction boxes shall be sealed with 3M “Scotchkote” Electrical Coating over the outer layer of tape. All splices 600 volts and less in No. 8 AWG and larger sizes shall be made using approved bolted connectors properly taped as specified herein.
- C. For No. 10 AWG and smaller branch circuit and fixture conductors operating at 277 volts or less, live spring pressure connectors rated for 600 volts may be used for splices and junctions. When installed in a fixture, connectors shall be rated for 1,000 volts.

2.9 GROUND RODS

- A. Ground rods shall be Copperweld, sectional type. Ground rods shall be UL listed and REA approved and shall conform to ANSI C33.8.
- B. Connections between grounding conductors and grounding rods shall be mechanical if above ground, thermal if underground.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All interconnecting wiring shall be installed in approved conduit or cable trays and connected as shown on the Drawings and/or specified herein. Unless otherwise shown or specified, all wiring shall be run in conduit.
- B. Unless otherwise shown on the Drawings, wiring shall be run by the most direct route keeping overall circuit length to a minimum.
- C. Instrumentation and low-level signal wiring shall not be located in the same conduit as motor wiring, feeder wiring, branch circuit wiring, or control wiring. Control wiring shall not be located in the same conduit as feeder wiring, or instrumentation wiring.
- D. All control and circuit wiring in cabinets, boxes, gutters, etc. shall be neatly tied and held using nylon cable ties and mounting brackets.
- E. After installation, conductors shall not have dents, scars, cuts, pressure indentations, abraded areas, etc.
- F. Conductors 600 volts and below shall not be bent to a radius less than 12 times the cable diameter. Conductors above 600 volts shall not be bent to a radius of not less than 24 times the cable diameter.
- G. Wiring run in metallic conduits shall be arranged such that there are an equal number of conductors of each phase in each conduit. Under no circumstances shall metallic conduits contain one single conductor or several conductors of only one phase. This requirement shall not apply to single, bare grounding conductors run in conduit to grounding rods or grids.
- H. Conductors may be coated with talc, soapstone, Ideal “Yellow 77” or “Wire Lube”, Electro-Compound “Y-ER EAS,” or equal, to facilitate pulling into raceways, but in no case may they be greased or coated with any substance injurious to conductor insulation and jacket. Pulling tension shall be exerted primarily on the strongest component of conductors, normally the metallic conductors themselves and not on the insulation jacket. When installing cable in conduit with pulling eye attached to copper conductor, the tension shall not exceed 0.008 pound per circular mil area of the conductor nor 5,000 pounds, whichever is smaller. When a basket grip is used over the outer jacket of the cable, the maximum pulling tension shall not exceed 0.008 pound per circular mil area of the conductor nor 1,000 pounds, whichever is smaller. In no case shall pulling tensions recommended by the wire manufacturer be exceeded. The maximum sidewall pressure exerted on the insulation and sheath at a cable bend shall not exceed 300 pounds per foot of conduit bending radius. Conductors shall not be pulled “through” any outlet, conduit or box. Separate “pulls” shall be made on each side of such point.
- I. Unless otherwise specified, splices shall be made at outlet or conduit boxes, pull or junction boxes, manholes, or vaults. No splice shall be drawn into a conduit. Splices in wiring rated 600 volts and below shall be made with enough spare wire for 2 splices to be remade with

the wire at the same location.

- J. All instrumentation and thermocouple extension wire shields shall be grounded. Shields on individual circuits shall be electrically continuous and shall be grounded at only 1 point in the circuit. Shields on thermocouple extension wire shall be grounded at the thermocouple only.
- K. Surge suppressors shall be installed with the shortest line lead possible, but in no case longer than 18 inches unless otherwise shown on the drawings.
- L. Inside manholes, all cables are to have racks with insulator supports. Supports are to be within 6 inches of each side of a splice and spaced not farther than 3 feet apart.
- M. All conductors are to be identified. Branch circuits, motor feeders, and lightning wiring shall be identified by color coding consistent with the existing facility. If the facility is new, the color code shall be as follows:

	277/480V	120/208/240V
Phase A	Brown	Black
Phase B	Orange	Red
Phase C	Yellow	Blue
Neutral	Grey	White
Ground	Green w/ Stripe	Green

- N. The color coding on No. 8 AWG and smaller conductors shall be continuous in length. No taping, painting or other means of coding will be acceptable. Conductors No. 6 AWG and larger and conductors operating above 600 volts shall be black with color coded tape visible at each point of access or view.
- O. All circuits shall be identified at each termination and at all accessible locations such as manholes, hand holes, and pull-boxes. A circuit name shall be assigned based on the equipment at the load end of the circuit. Add a suffix letter if necessary to make the circuit number unique. Utilize sleeves for conductor sizes #2 AWG and smaller, and marker plates attached with nylon tie cords for larger conductor sizes. Taped-on markers or markers relying on adhesives shall not be allowed.
- P. Conductors used for temporary construction power shall not be used for the permanent installation, and the permanent conductor system shall not be used for construction power unless authorized in writing by the Engineer. Circuit protective devices shall never be temporarily bypassed.
- Q. Cables shall be pulled and installed without splices. Splices shall only be made with the Engineer's approval.
- R. Apply fireproofing tape to cables in hand holes and manholes, and in other locations such as

vaults, throughout their exposed length. Follow the tape manufacturer's installation instructions closely.

3.2 TESTING

- A. Perform visual and mechanical inspection of each individual exposed power cable #6 AWG and larger for physical damage, correct terminations in accordance with the Drawings, cable bends in accordance with bending radius requirements, proper circuit identification, proper lug type, tightness of bolted connections with proper torque level per NETA ATS, Table 10.12 or manufacturer's specifications, and proper grounding.
- B. Perform Insulation Resistance Testing of all conductors #6 AWG and larger with respect to ground and each adjacent conductor. Apply 1,000 volts dc for one minute on 600 volts insulated conductors in accordance with NETA. Minimum insulation resistance values shall not be less than 50 meg-ohms. Investigate all deviations between adjacent phases.
- C. Perform Continuity test by ohmmeter method to ensure proper cable connections of all conductors #6 AWG and larger.

END OF SECTION

**SECTION 26 05 26
GROUNDING**

PART 1 GENERAL

1.1 STANDARDS

- A. All electrical systems shall be grounded in accordance with the National Electrical Code, Local Codes, these Specifications and the contract drawings.

PART 2 PRODUCTS

2.1 CABLE AND EQUIPMENT

- A. Use green colored and bare stranded copper conductors.
- B. Use approved ground clamp manufactured for such purpose.
- C. Use approved grounding electrodes and ground rod.
- D. Make permanent ground connection with exothermic weld method.

PART 3 EXECUTION

3.1 GENERAL

- A. In general, alternating current circuits of 600 volts and below, surge suppressors, conductor raceway systems, and platform steel framework shall be effectively and permanently connected to a grounding system by means of copper conductors having cross section as required by the National Electrical Code and of capacity sufficient to ensure continuity and continued effectiveness of the ground connections under conditions of excess current. If some of the equipment to be grounded is not covered herein by detailed instructions or is not shown completely and clearly on the Drawings, such provisions of the National Electrical Code as may apply are to be considered minimum requirements for the work.
- B. All metallic conduit systems, whether used for power or lighting wiring, shall be installed in such a manner as to produce electrical continuity and shall be bound together at one or more points and connected to the building system ground, except that isolated sections of conduit not exceeding 4 feet in length are not to be grounded or bonded unless specifically called for.
- C. Rigid metal conduit systems made up with fittings, boxes, and apparatus housings having fully threaded hubs need no additional provisions for continuity of ground. If the conduit system contains cutouts, pull boxes, junction boxes, switchboxes, etc., to which the conduit is fastened by means of locknuts and bushings, such interruptions in the grounding continuity shall be eliminated by bonding the conduit to the housings or by separately grounding each box and conduit sections, etc., that are so isolated. Grounding wedge lugs shall be used between all bushing and metal boxes. Paint and other nonconducting material shall be removed from the surface of conduit, fittings, and metal housings prior to connecting

grounding clamps, straps, or other devices.

- D. Equipment Grounding: Panel, starters, lighting fixtures, motor control center, etc., for power and lighting constitute the fundamental center of the associated distribution systems. As such, the metallic enclosures, frames, and other noncurrent carrying metal parts of this equipment shall be connected by one or more grounding conductors to the grounding system. Install a ground connection from the ground bus of switchgears, MCCs, and other electrical panels with ground bus to the ground grid.
- E. All motor frames shall be grounded. The ground conductor shall be run inside the conduit containing the power conductors. In the case of most 3-phase circuits, this means a fourth conductor in each branch circuit. The grounding conductor may be as large as the power conductor or as small as allowed by Section 250 of the NEC but shall not be smaller than No. 12 AWG. The grounding conductor shall be stranded, with green insulation through No. 4 AWG; larger sizes may be bare stranded. Ground connection at the motor shall be terminal lug or servit post inside motor conduit box and the other end connected to the ground bus in the motor control center.
- F. Transformer Grounding: Bond the neutrals of outdoor substation transformers and distribution transformers within buildings to system ground network, and any additional grounding electrodes shown near the transformers. Connect the case of the transformer to the grounding system as well.
- G. In making ground connections, the surfaces to all parts that will touch shall be thoroughly cleaned to ensure making good electrical contacts.
- H. All clamped joints shall be made up firmly. Thermal joints shall be equal to CadWeld Type TA. Where exposed to mechanical injury, the grounding conductor shall be suitably protected by pipe or other substantial guard. If guards are iron pipe or other magnetic material, the grounding conductor shall be electrically connected to both ends of the guard to reduce impedance of the circuit.
- I. Grounding conductors shall be without splice or joint if applicable and shall be straight and short except that when laid underground they shall be laid slack to prevent their being readily broken unless otherwise mechanically protected.
- J. No fuse, switch, circuit breaker, or similar disconnecting devices shall be inserted in the grounding conductor or connection throughout the entire installation.
- K. Grounding conductors shall be medium hard drawn, stranded bare copper wire sized as required by the National Electrical Code Article 250. Conductors Size No. 6 and smaller may be solid; Size No. 4 and larger shall be stranded. Ground wire shall be carried in conduit to the grounding point.
- L. Ground rods where required, shall be of copper-clad steel not less than 3/4-inch in diameter, 10 feet long or as shown on the Contract Drawings, and driven full length into the earth. The maximum resistance of a single driven ground shall not exceed 5 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, a minimum of 2 additional

rods shall be installed not less than 10 feet on center. Connections between grounding conductors and ground rods shall be mechanical if exposed, thermal if buried.

- M. Except where specifically indicated otherwise, all exposed noncurrent-carrying metallic parts of electrical equipment, raceway systems, and neutral conductor of the wiring system shall be grounded. The ground connection shall be made at the main service equipment and shall be extended to driven rods on the exterior of the building.
- N. All neutral conductors shall be continuous throughout the system and shall be grounded only at the point of origin of the service neutral.
- O. All receptacles shall have provision for grounding conductor connection and shall be grounded to the grounding conductor and outlet box.
- P. All exposed steel columns, tanks, ladders, towers, and elevated platform shall be effectively grounded using No. 4/0 or larger bare copper grounding conductors and driven ground rods. Where multiple columns or tanks must be grounded, ground points shall be interconnected by minimum No. 4/0 bare copper grounding conductors buried approximately 18 inches below finished grade.
- Q. Anchor bolts securing exposed electrical equipment, structures, metal enclosures, and tanks located outdoors shall be electrically connected to the steel reinforcement in the concrete foundation or footing. Connection shall consist of minimum No. 2/0 bare copper conductors and mechanical grounding clamps.
- R. Surge arrestor ground terminals shall be connected to the equipment ground bus. Ground paths for lightning and surge arresters and capacitors shall be kept as short and direct as practical. If possible, arresters shall be connected in direct shunt relationship to the equipment terminals. Supporting brackets shall be connected directly to the equipment frame.
- S. Grounding resistors, where specified, shall have a resistance within the boundary limits specified in IEEE Standard 142 in order to minimize transient overvoltages during ground faults. Ground fault current shall not be less than that required to operate protective devices or 25 amps, whichever is greater.
- T. Lightning and surge arresters used with grounded-wye systems which do not have effectively grounded neutrals as defined by IEEE Standard 100 shall have a voltage rating not less than the maximum phase-to-phase voltage of the system.
- U. The grounding system equivalent resistance shall not exceed 5 ohms for the entire system under normally dry conditions unless otherwise specified. After the grounding system has been installed and all connections made, tests shall be made by the Electrical Contractor to determine the resistance to earth. If the resistance of the entire system exceeds the specified maximum, additional ground rods shall be driven to reduce the resistance to this value.
- V. Gas piping or piping conveying flammable liquids shall not be used as grounding electrodes.

- W. The use of salts or electrolytes to reduce earth resistance shall not be permitted.
- X. Permanently connect the green ground conductor to each receptacle junction box (self-tapping screw).
- Y. Install a ground rod inside each manhole. Connect any metallic raceway and all noncurrent-carrying metal parts to the ground rod with a No. 6 AWG (min.) copper conductor. Similarly, provide a ground rod for every pole-mounted site lighting and make grounding connections.
- Z. Bond the standby generator neutral to the grounding system with a properly sized grounding conductor. Ground the generator frame to the ground grid.
- AA. Ground metallic fences when used to enclose electrical equipment.
- BB. Bond all metallic pipe systems, ducts, etc as per the NEC.

3.2 TESTING

- A. Ground resistance testing shall be done in accordance with IEEE standard 81-1993 to confirm that the resistance of the grounding system is 5 ohms or less (test shall not be run within 72 hours of last rain fall). Ground resistance testing shall be done with the power off and the grounding electrode conductor isolated from the utility, and the service to prevent coupling. The testing equipment shall use the fall of potential method of earth resistance measurement. The test equipment must be designed to reject the effects of stray ac and dc currents on readings.
- B. A test report shall be submitted to the engineer and included in the O & M manual for the project. The report shall include but not be limited to:
 - 1. Date of test
 - 2. Time of day
 - 3. Weather condition (ex. 82°F, 82% RH, cloudy)
 - 4. Date of last rain fall $\geq \frac{1}{2}$ " in a 24-hour period
 - 5. Soil type
 - 6. Minimum of five (5) readings
 - 7. A plot of all readings indicating a level spot in the curve at the system resistance.
- C. All ground resistance testing shall be done in the presence of the Engineer. If test measurements indicate a grounding system resistance of greater than 5 ohms, additional grounding cable shall be buried in locations and at the direction of the Engineer. Ground resistance testing as described herein shall be repeated after the additional ground cable has been installed. The installation of grounding cable and repeat testing shall be done until the 5-ohm grounding system resistance has been achieved.

- D. Test equipment for ground resistance measurement shall be Vibroground by Associated Research, Megger null balance by Biddle, or alternate approved by the Engineer.

END OF SECTION

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**SECTION 26 05 33
BOXES**

PART 1 GENERAL

1.1 SCOPE

- A. All boxes required throughout the electrical raceway system shall be furnished and installed in accordance with the requirements which follow.

1.2 SECTION INCLUDES

- A. Outlet boxes.
- B. Pull and junction boxes.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Boxes shall be equal to Appleton, Crouse Hinds, Raco, or Steel City.

2.2 MATERIAL

- A. Outlet Boxes
 - 1. Sheet Metal Outlet Boxes: NEMA OS-1, UL 514; galvanized steel, with ½ inch male fixture studs where required.
 - 2. Cast Boxes: Cast fer alloy with galvanized or cadmium finish, deep type, gasketed cover, threaded hubs for use with steel conduit, UL 514.
 - 3. Floor Boxes: Full adjustable, steel, water and concrete tight equal to T&B model number 68 D.
 - 4. Except as indicated otherwise on the drawings or in these specifications, all junction boxes or pull boxes 4-inch trade size or smaller in any dimension shall be galvanized malleable iron or acceptable equal cast ferrous metal for use with steel conduit.
- B. Pull and Junction Boxes
 - 1. Junction boxes and pull boxes shall be as indicated on the drawings and as specified in these specifications. Where no type or size is indicated elsewhere for junction boxes or pull boxes, they shall be in accordance with the requirements of the NEC, Article 314, Paragraphs 28, 29, 40 and 41 for use on systems with a nominal rating of 600 volts and less, and Section IV for use on systems with a nominal rating of over 600 volts.
 - a. Sheet Metal Boxes: NEMA OS-1; galvanized steel. Boxes larger than 12-inches in any dimension are hinged enclosure. Equal to Hoffman Bulletin A-51.

- b. Cast Metal Boxes: NEMA 250; Type 4, galvanized cast iron box and cover, neoprene gasket, stainless steel cover screws, UL listed as raintight. Provide flat-flanged type for surface mounting and outside flange recessed cover type for underground use. Boxes for sidewalk or other traffic areas to have appropriate duty cover with non-skid finish.
 - c. Corrosion Resistant Boxes: UL 508 Type 4X, gasketed screw cover. For boxes larger than 12-inches in any dimension provide hinge on one side and stainless-steel toggle latches (equal to Hoffman A-FC412SS) on the other three sides. Equal to Type 304 stainless steel equal to Hoffman Bulletin A-51.
 - d. Floor Boxes: Floor boxes shall be cast iron with bolted covers. The boxes shall be approximately 12 inches square and 10 inches deep and shall be located as shown on the drawings with the lid flush with the finished floor. Floor boxes shall be Neenah No. R-7517-DB or alternate acceptable to the Engineer.
2. Electrical enclosures, except junction boxes and pull boxes 4-inch trade size and smaller and other enclosures of cast metal, shall be constructed from steel plate reinforced as required to provide true surfaces and adequate support for devices mounted thereon.
 3. Except as indicated otherwise in these specifications or on the drawings, all junction boxes and pull boxes larger than 4-inch trade size for use in indoor locations shall be sheet steel hot-dip galvanized after fabrication and those for use in outdoor or wet corrosive indoor locations shall be 316 stainless steel.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordination of Box Locations

1. Provide boxes as shown on Drawings, and as required for splices, taps, wire pulling and equipment connections.
2. Box locations shown on the Drawings are approximate unless dimensioned. Verify box locations prior to rough-in. Coordinate mounting heights and locations of outlet mounted above counters, benches, backsplashes, and other furnishings. Any outlet may be relocated by up to 10 feet before it is permanently installed without incurring additional cost.

3.2 INSTALLATION

A. Box Installation

1. Do not install boxes back-to-back in walls. Provide minimum 6-inch separation, except provide minimum 24-inch separation in acoustic-rated walls.
2. Locate boxes in masonry walls to require cutting of masonry unit corner only.

Coordinate masonry cutting to achieve neat openings for boxes.

3. Support boxes independently of conduits openings.
4. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
5. In inaccessible ceiling areas, position outlets and junction boxes within 6-inches of recessed luminaires to be accessible through luminaire ceiling opening.
6. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
7. Align wall-mounted outlet boxes for switches, thermostats, and similar devices. Align adjacent devices at different elevations in one vertical line. Set floor boxes level and flush with finish flooring material.
8. Unless otherwise noted, use only cast outlet boxes. Galvanized steel boxes shall be used only in finished areas where they are completely concealed within walls or ceiling.
9. Conduit openings in boxes shall be made with a hole saw or shall be punched. Field locate holes in junction and pull boxes so as to afford the maximum bending radius for the conductors.
10. Boxes mounted on concrete shall be secured by self-drilling anchors. Mounting on steel shall be by drilled and tapped screw holes, or by special support channels welded to the steel, or by both. Boxes larger than 4-inch trade size shall be leveled and fastened to the mounting surface with not less than 1/4-inch air space between the enclosure and mounting surface. All mounting holes in the enclosure shall be used.
11. Except as prevented by the location of other work, all junction boxes and outlet boxes shall be centered on structures.
12. Label cover of junction boxes with circuit numbers of conductors in the box.
13. Medium voltage boxes and low voltage boxes shall be kept separate. Provide physical partitions where required.
14. Unless indicated otherwise on the drawings or in these specifications, electrical enclosures except junction boxes and pull boxes 4-inch trade size and smaller, shall be as follows:

<u>Location</u>	<u>Enclosure Type</u>
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Indoor (Nonhazardous) Dry Areas	NEMA 1
Areas where moisture conditions are more severe than those for which NEMA 1 enclosures are intended	NEMA 4
Wet, corrosive indoor areas	NEMA 4X SS
Outdoor (Nonhazardous)	NEMA 4X SS
Class 1, Division 2	NEMA 7

END OF SECTION

**SECTION 26 05 34
CONDUIT**

PART 1 GENERAL

1.1 SCOPE

- A. Work covered by this section includes furnishing all labor, equipment, and materials required to install electrical conduit and fittings as specified herein and/or shown on the Drawings.
- B. The Contractor's attention is called to the fact that all conduits and conduit fittings are not necessarily shown completely on the Drawings, as the Drawings are schematic. However, the Contractor shall furnish and install all conduits and conduit fittings indicated or required for the proper connection and operation of the equipment.

1.2 SHOP DRAWINGS AND ENGINEERING DATA

- A. Shop drawings and engineering data shall be submitted in accordance with requirements of the Section 01 33 23 of these Specifications.

1.3 STORAGE AND PROTECTION

- A. Store and protect conduit and fittings in accordance with the manufacturer's recommendations and requirements of the Section 01 66 00 of these Specifications. Conduit shall be stored aboveground and adequately supported.

1.4 GUARANTEE

- A. Provide a guarantee against defective equipment and workmanship in accordance with requirements of the Section 00 72 43 Article 23 of these Specifications.

PART 2 PRODUCTS

2.1 GENERAL

- A. Unless otherwise shown or specified, all conduits shall be rigid metal. See the paragraph on Conduit Application for additional information.
- B. Conduit terminations at electrical equipment such as electric motors, dry type transformers and heaters shall be made using liquid-tight, flexible metal conduit.
- C. Damaged, dented, flattened, or kinked conduit shall not be used.

2.2 RIGID METAL CONDUIT

- A. Rigid metal conduit shall be heavy wall, mild steel conduit conforming to ANSI C80.1 and Federal Specification WW-C-581, hot dip galvanized both inside and out. All conduits shall bear the approved stamp of the Underwriters Laboratories.

- B. Rigid metal conduit shall be by Allied Tube & Conduit, Republic, or equal.

2.3 RIGID NONMETALLIC CONDUIT

- A. Rigid nonmetallic conduit for voltages 600V and less shall be Schedule 40 heavy wall polyvinyl chloride (PVC) electrical conduit rated for 90 degrees C conductors and conforming to NEMA TC-2, Type EPC-40-PVC. It shall be listed by Underwriters Laboratories in conformance with the National Electrical Code. Conduit fittings, elbows, and joint cement shall be produced by the same manufacturer as the conduit. Conduits shall be as manufactured by Carlon, Allied Tube and Conduit, Borg-Warner, or equal.
- B. Rigid nonmetallic conduit for voltages higher than 600V shall be polyvinyl chloride (PVC) power duct rated for 90 degrees C conductors and conforming to NEMA TC-6, Type EB. Conduit fittings, elbows, and joint cement shall be produced by the same manufacturer as the conduit. Conduit shall be as manufactured by Carlon, Olin, or equal.

2.4 PLASTIC-COATED RIGID METAL CONDUIT

- A. Rigid metal conduit prior to application of plastic coating shall conform to Part 2.02, Rigid Metal Conduit, of this section.
- B. Plastic coating shall be polyvinyl chloride (PVC) bonded to the metal a uniform thickness of 40 mils the full length of the conduit except the threads. The bond between the metal and PVC coating shall be equal or greater than the tensile strength of the PVC coating.
- C. A coupling shall be furnished loose with each length of conduit and shall have a PVC sleeve extending 1 pipe diameter, or 2-inches, whichever is least, beyond the end of the coupling. Elbows shall have the same thickness of PVC coating as on the conduit. All threaded conduit and elbow ends shall have plastic thread protectors.
- D. The rigid steel galvanized PVC coated conduit and fittings shall be KorKap as manufactured by Plastic Applicators, Houston, Texas; Plasti-Bond as manufactured by Pittsburgh Std. Div. of Robroy Industries, Verone, Pa.; or equal.
- E. PVC-coated rigid conduit shall meet the ASTM D870 Boil Test.

2.5 RIGID ALUMINUM CONDUIT

- A. Rigid aluminum conduit shall be manufactured of 6063 alloy in temper designation T-1. The fittings shall be of the same alloy.
- B. All conduits shall bear the approved stamp of the Underwriters Laboratories and be manufactured to ANSI C80.5 and Federal Specification WW-C-540c.
- C. Rigid Aluminum conduit shall be by Republic, Allied Tube and Conduit, or equal.

2.6 LIQUID-TIGHT FLEXIBLE METAL CONDUIT

- A. Flexible conduit shall have an oil-resistant, liquid-tight jacket in combination with flexible metal reinforcing tubing and shall be designed for use with waterproof fittings. An integral ground wire shall be pulled. Flexible conduit shall be American Brass Sealtite Type UA as manufactured by Electric-Flex Company; Flexible Metallic Conduit as manufactured by Ideal Industries, Inc; or equal. Only Underwriter's Laboratories approved fittings shall be used.

2.7 CONDUIT FITTINGS AND BUSHINGS

- A. Wherever conduits terminate in sheet steel boxes, double bonding type locknuts and bushings shall be used except when terminating in cast hubs. All bushings shall be insulated metallic type, equal to O. Z. Electrical Manufacturing Company, Type B; T & B Company, 1200 Series; Appleton Electric Company, Type BU-I; or equal.
- B. Where conduits terminate in steel or cast NEMA 4 enclosures with no factory-installed threaded hubs, a threaded hub shall be installed equal to Myers Electric Products, Inc., Type ST or STG; Appleton Electric Company, Type HUB; Crouse-Hinds, Type HUB; or equal.
- C. All conduits terminating at motor control centers shall be suitably grounded to the motor control center ground bus using grounded type insulated bushings equal to O. Z. Electrical Manufacturing Company, BLB or IGB; Appleton, Type BIB; Thomas and Betts, 3800 Series; or equal.
- D. Conduit expansion fittings shall be O. Z. Electrical Manufacturing Company, Type EX with Bonding Jumper, Type XJ; Appleton, Type SJ with Type XJB4 Bonding Jumpers; Crouse-Hinds, Type XJ with GC100 Bonding Jumper; or equal.
- E. All outdoor conduit penetrations shall enter the enclosures, panels, junction boxes from the bottom side. Top and side penetrations are not permitted without the Engineer's approval.
- F. All outdoor conduit hubs shall be watertight Myer's hubs.

2.8 CONDUIT BOXES

- A. Exposed conduit boxes and pulling elbows shall be of diecast, copper-free aluminum with threaded body and removable neoprene- gasketed cover. Conduit boxes shall conform to Federal Specification W-C-586a and shall be Crouse-Hinds "Condulet," Appleton "Unilet Form 85," or equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Minimum size conduit shall be 3/4 inch aboveground and 1 inch below ground except where noted otherwise, and no conduit shall have more than 40 percent of its internal area occupied by conductors.

- B. During construction all installed conduits shall be temporarily plugged, capped, or otherwise protected from the entrance of dust, trash, moisture, etc., and any conduits that may become clogged shall be replaced. No conductor shall be pulled in until all work that might cause damage to the conduit or conductors has been completed.
- C. Conduit connections to sheet metal enclosures shall be securely fastened by double lock nuts inside and outside and shall have grounding bushings.
- D. Conduit straps or brackets secured to concrete, brick, or masonry shall be by means of expansion bolts, toggle bolts, or approved drill anchors. No wood plugs will be permitted.
- E. Conduits supported from building walls shall be installed with at least 1/4-inch clearance from the wall using pipe spacers equal to Appleton Electric Company, T & B Company, Steel City, or equal. Clamp back to prevent the accumulation of dirt and moisture behind the conduit.
- F. Unless otherwise shown or specified, exposed rigid conduit shall be installed parallel or at right angles to structural members, surfaces, and building walls.
- G. Two or more conduits in the same general routing shall be parallel with symmetrical bends.
- H. Conduits shall be at least 12 inches from high temperature piping, ducts, and flues.
- I. Conduit installed horizontally shall allow headroom of at least 7 feet, except where it may be installed along structures, piping, equipment, or in other areas where headroom cannot be maintained because of other considerations.
- J. Wherever necessary conduit boxes and pulling elbows shall be inserted in the lines. Gaskets shall be used to ensure a dust and watertight installation on all conduit boxes and fittings.
- K. All bends and turns in conduits shall have a bend radius of not less than 6 times the internal diameter of the conduit. Bends shall be made using an approved bender to provide smooth bends with no kinks, dents, or flattening.
- L. All concealed conduits shall be placed in walls, floors, ceilings, or slabs at the proper time in accordance with the progress of the work. The Contractor shall cooperate in every respect in meeting schedules and shall not delay the structural work unnecessarily. Conduits embedded in concrete shall be blocked and braced in place by use of adequate conduit separators to prevent displacement during pouring of the concrete. Where conduit interferes with structural steel, steel reinforcement, or in the opinion of the Engineer occupies too much space in the slab, the conduits shall be rearranged or installed exposed as directed by the Engineer. No additional payment will be made for such rearrangement of conduit whether or not additional conduit or fittings might be required.
- M. Conduit wall seals with water stops shall be installed in outside walls below grade for all incoming or outgoing underground conduit emerging directly into the building area. The conduit wall seals shall have a pressure ring and sealing grommet to ensure a watertight installation.

- N. Conduit expansion fittings and ground bonding jumpers shall be installed on all conduits passing through building expansion joints to provide movement in the conduit system.
- O. Where groups of conduits terminate together or pass-through floors, provide template to hold conduits in proper relation to each other and to building.
- P. Conduits shall be plugged or capped with plastic caps during construction to protect threads and prevent entrance of dirt and water.
- Q. Conduits shall be adequately supported at intervals as required by the National Electrical Code. One to two exposed conduits running parallel to each other may be supported by strap anchors, or 1-hole clamps (walls only). Exposed conduits larger than 2 inches or groups of more than 2 conduits run parallel shall be supported by means of minimum 12-gauge, slotted steel channels fitted with 2-piece, bolted pipe clamps. All conduit supports, clamps, straps and brackets shall be stainless steel for corrosion resistance.
- R. Runs of conduit shall not contain more than four 90-degree bends (360-degrees total) between conduit boxes panelboards, or terminations. In general, and to the extent practical length of conduit runs between conduit boxes or similar means of access shall not exceed 100 feet.
- S. Exposed service entrance conduits and main feeder conduits shall be identified using stenciled letters at intervals not to exceed 20 feet. Size of letters shall be equal to one-half the diameter of the conduit or 2 inches, whichever is less.
- T. In Class 1, Division 2 areas, the contractor is responsible for installing seal-off fittings as required by Articles 500, 501, and 502 of the National Electric Code. The drawings do not show seal off fittings and it is the contractor's responsibility to locate and install the seal-offs based on field routing of the conduit.

3.2 INSTALLATION OF RIGID METAL CONDUIT

- A. Terminations and connections of rigid metal conduit shall be threaded. Conduits shall be reamed free of burrs and terminated with insulated metallic conduit bushings.
- B. Conduit threads shall be coated with a petroleum base corrosion-inhibitor with low electrical contact resistance before assembly equal to Burndy Engineering Company, Inc., Penetrax "A" or equal screw thread lubricant (zinc-petroleum or zinc-chromate compounds are permissible).
- C. All conduits shall be suitably grounded to the plant ground grid using grounded type insulated bushings, O. Z. Electrical Manufacturing Company, Type BLG or IGB, T & B Company, Appleton Electric Company, or equal.
- D. Conduit across structural joints where structural movement is allowed shall have bonded, weathertight expansion and deflection fitting the same size as the conduit.

- E. Support spacing for conduits 1 inch and smaller shall not exceed 6 feet, and conduits 1¼ inches and larger shall not exceed 10 feet. Supports shall be as specified under basic electrical materials and methods. Conduits 1½-inch and smaller may be supported by 1-hole conduit straps and 2 inches and larger shall be supported by 2-hole conduit straps. Conduit racks shall be as manufactured by Unistrut, Kindorf, or equal. Conduit racks shall be 316 stainless steel.
- F. Conduit joints shall be made up tight using a pipe wrench. Channel lock pliers will not be permitted, and unions shall be used as necessary to aid in the installation. Conduits shall be cut square and the ends reamed smooth after threading to prevent injury to conductors. Conduit joints in concrete or exposed to weather or damp locations shall be drawn up tight and coated with insulating paint before casting in concrete or painting exposed conduit system.
- G. Plastic-coated rigid metal conduit and fittings shall be installed in accordance with the manufacturer's specifications and recommendations. Any damage to the plastic coating shall be repaired in accordance with the manufacturer's requirements. The manufacturer shall certify the installers before installation can be started.

3.3 INSTALLATION OF RIGID NONMETALLIC CONDUIT

- A. Field bending of polyvinyl chloride conduit shall be made with appropriate equipment. No torches or flame-type devices shall be used.
- B. When joints are to be made with polyvinyl chloride conduit, the conduit shall be cut with a fine-tooth saw and deburred. Conduit ends shall be wiped clean of dust, dirt, and shavings and shall be dry. Solvent cement shall be applied to bond the joint. The joint should be watertight.
- C. Polyvinyl chloride conduit shall be installed in accordance with the manufacturers' specifications and recommendations.

3.4 INSTALLATION OF LIQUID-TIGHT FLEXIBLE METAL CONDUIT

- A. Terminations at motors shall be made with flexible liquid-tight metal conduit from conduit stub to terminal box; flexible connection shall be made as short as possible. Flexible conduit shall be Type UA, black. Underwriter's Laboratories approved flexible liquid-tight conduit connectors shall be as manufactured by Thomas and Betts Company, Appleton Electric Company, or equal.
- B. Uncoated flexible metal conduit may be used for short connections between junction boxes and lighting fixtures or speakers installed in suspending ceiling systems. Flexible metal conduit shall be connected using Underwriters Laboratories approved grounding connectors.

3.5 INSTALLATION OF UNDERGROUND CONDUIT

- A. All underground conduits shall be concrete-encased unless otherwise noted on the Drawings or directed by the Engineer. No conduit shall be concealed or encased until the Engineer has

inspected the conduit for proper installation and accurate placement.

- B. The Contractor shall be responsible for all excavating, draining trenches, forming of duct assembly and protective concrete envelope, backfilling, and removal of excess earth.
- C. Underground conduit shall be installed with a minimum 3-inch per 100-foot downward slope for drainage. Drains shall be provided at all low points.
- D. Bends and turns shall be made using long sweeps. Ninety-degree bends will be used only where required and shall be kept at a minimum. Field coordinate conduit bends with minimum bending radius of conductor prior to installation of conduits.
- E. Where rigid nonmetallic conduits emerge from underground, an adapter from rigid nonmetallic conduit to rigid metal conduit shall be installed and all exposed conduits shall be rigid metal conduit. The last bend shall be rigid galvanized steel.
- F. All rigid metal conduit risers shall be protected with 2 coats of a Bitumastic compound before concrete is poured from a point 12 inches below grade to a point not less than 6 inches above grade or surface of concrete. All stub-ups shall extend upward with one length of rigid metal conduit until after concrete is poured to assure vertical alignment.
- G. Conduits shall be encased in concrete with 3-inch minimum concrete cover all around.
- H. Concrete for concrete encasement shall be Class B concrete conforming to requirements of the section entitled “Cast-In-Place Concrete,” of these Specifications. Longitudinal and lateral steel reinforcement shall be provided as shown on the Drawings.
- I. All underground conduit runs for voltages less than 600 volts shall be at least 24 inches below grade and shall have a minimum conduit separation of 4 inches. Provide a magnetic warning tape 12” below finished grade.
- J. All underground conduit runs for voltages over 600 volts shall be at least 36 inches below grade and shall have a minimum conduit separation of 4 inches. Conduit shall have a minimum 4-inch concrete cover on all sides. Provide a magnetic warning tape 12” below finished grade.
- K. All underground conduit runs shall be rodded, and a mandrel drawn through followed by a swab to clean out any obstructions that may cause cable abrasions. The mandrel shall be 12 inches in length and the diameter ½ inch less than the inside diameter of the conduit.
- L. All underground conduit runs shall be marked by a strip of permanently colored red polyethylene tape, 0.004-inch-thick and 6 inches wide, buried above the conduit and 6 inches below finished grade. Provide a magnetic warning tape 12” below finished grade.
- M. All spare conduits shall be provided with permanent waterproof caps at stub-ups and shall be furnished with a 500# fiber tape pulling wire. Waterproof raceway tags shall be attached to the pulling cords, at each end and at each intermediate pulling point. The raceway tags shall identify the origin and destination of the conduit.

3.6 conduit application

- A. Install the following conduit types, unless otherwise shown on the drawings.
 - 1. Outdoors, exposed (Not Buried): Aluminum Rigid Conduit
 - 2. Indoors
 - a. Dry Areas Aluminum Rigid
 - b. Wet Areas Aluminum Rigid
 - 3. Underground (Under Slabs-on-Grade, Encased or Embedded in Concrete)
 - a. PVC Schedule 40
 - 4. Conduits in Wetwell
 - a. Aluminum Rigid
 - 5. Chemical Feed Areas
 - a. PVC Schedule 80
 - 6. Transition Areas and Final Connections to Equipment
 - a. Motor Connections – Flexible metal, liquid-tight conduit.
 - b. Light Fixture Connections – Flexible metal non-metallic liquid-tight conduit in dry areas and liquid-tight in wet areas.

END OF SECTION

**SECTION 26 24 16
PANELBOARDS**

PART 1 GENERAL

1.1 SCOPE

- A. Panelboards shall be furnished in the quantities and with components, devices, and materials meeting the requirements indicated in the panelboard list on the drawings.
- B. Panelboards shall be designed and fabricated in accordance with NEMA standards for panelboards. Each panelboard, or all current controlling devices in each panelboard, shall bear the UL label.

1.2 SECTION INCLUDES

- A. Panelboards.

1.3 REFERENCE STANDARDS

- A. Design, manufacturing and assembly of elements of panelboards and devices herein specified shall be in accordance with the standards of the below listed organizations.
 - 1. American National Standards Institute (ANSI)
 - 2. National Electrical Manufacturers Association (NEMA)
 - 3. National Fire Protection Association (NFPA)
 - 4. National Electrical Code, NFPA-70 (NEC)
 - 5. Underwriters Laboratories, Inc. (UL)

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Equipment shall be manufactured by General Electric, Siemens, Square D, or Eaton/Cutler-Hammer.

2.2 MATERIALS

- A. Panelboards: NEMA PB-1; UL 67.
- B. Rating: Voltage and ampere ratings are shown on the Drawings. Unless otherwise indicated, interrupting ratings (RMS symmetrical) are 14,000 amps for 480-volt panelboards and 10,000 amps for 240- and 208-volt panelboards.
- C. Cabinets: Indoor panelboards shall be in NEMA 1 cabinets. The cabinet shall be code gage

gasketed steel. It shall consist of a box with a removable front complete with hinged door, latch, and master keying lock. The box shall be flanged galvanized sheet steel. Boxes shall be a minimum of 20 inches wide and 5-7/8 inches deep. Code gauge galvanized steel: sized to accommodate devices indicated and afford wire bending space in accordance with NEC requirements.

1. Outdoor panelboards shall be in a NEMA 4X cabinet.
- D. Fronts: Surface or flush as indicated, door-in-door construction, finished in light grey enamel over a rust inhibitor. Furnish flush lock for fronts less than 48-inches high and vault type handle with three points catch for fronts 48-inches and higher. Key all locks alike.
- E. Bus:
1. Rigid buses of copper or copper alloy shall be installed to provide consecutive phasing of branch circuit connections.
 2. The solid neutral bus shall have solderless connectors, numbered to agree with branch circuits. The bus shall be insulated from the cabinet with provisions for grounding.
 3. The equipment grounding bus with main lug shall have solderless connectors, numbered to agree with branch circuits.
- F. Circuit Breakers:
1. NEMA AB-1; molded case type, thermal-magnetic trip with internal common trip on multi-pole breakers.
 2. Protective overcurrent devices for branch circuits shall be of the size and type indicated on the drawings.
 3. Panelboard branch circuit breakers shall be the thermal magnetic, bolt-in, individually front replaceable type and shall indicate "On", "Off", and "Tripped". Circuit breakers indicated as multiple poles shall be common trip.
 4. Continuous and interrupting ratings shall be as shown on the drawings. Provide breaker fully rated for interrupting ratings noted; series ratings are not acceptable.
- G. Provide engraved nameplates giving the voltage rating and panel designation as indicated. Provide a UL service entrance label for panelboards used as service entrance equipment.
- H. Surge Protection: Where indicated, provide transient voltage surge suppressors.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All panelboards shall be installed so that circuit breakers are not more than 6 feet above the finished floor and not lower than 24-inches above the floor. Panels shall be installed in

accordance with the requirements of NEC Article 312 Paragraph 8, Article 408, and the following articles.

- B. The cabinets shall be leveled and securely fastened to the mounting surface, utilizing all of the mounting holes provided in the panelboard cabinets.
- C. Each cabinet shall be installed, conduits connected, and wires pulled before the panel interior is installed. A heavy cardboard panel front shall be temporarily secured to the front of the panelboard to protect the interior from dirt or damage until the permanent metal front is installed.
- D. Each panelboard front shall be carefully aligned and adjusted until its edges are parallel to the panelboard interior and the building lines, and then shall be firmly secured with the fasteners provided.
- E. For flush mounted panels provide a 3/4-inch empty raceway for each three unused spaces and spare poles. Terminate in a junction box located above the ceiling or other approved accessible location for future extension.
- F. Prior to energizing panelboards clean out construction dirt and debris. Paint any scratches on the trims or dead front barriers. Megger each phase to phase and ground to ensure that no short circuits exist.
- G. Adjust panel barriers so that no openings occur between them and panel front. Provide filler plates and plugs as necessary to maintain dead front integrity.
- H. A circuit directory cardholder and card with a clear plastic covering shall be provided on the inside of each cabinet door. The directory card shall provide a space to identify each circuit in the panelboard. The directory for each panelboard shall be accurately typed with the names of the load served by each breaker to permit ready location of the protective devices controlling circuit loads. Note spare circuits in pencil.
- I. Each panelboard shall be identified with a suitable engraved nameplate mounted at the top of the front plate. Each nameplate shall be engraved with the panelboard identification indicated on the Contract Drawings.

END OF SECTION

SECTION 26 24 19
MOTOR CONTROL CENTER

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. This section specifies freestanding, factory assembled 600 (480) volt Motor Control Center (MCC) with digital power monitors to display the voltage and current load parameters locally and via the Plant SCADA system via Modbus TCP/IP.

1.2 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/NEMA ICS 1	Industrial Control Systems: General Requirements
ANSI/NEMA ICS 18	Motor Control Centers
NFPA 79	Electrical Standards for Industrial Machinery
UL 845	Motor Control Centers

B. Codes and Standards:

1. Motor Control Centers and all components shall be Underwriters Laboratory listed to UL 845 and shall conform to NEMA ICS-1 and ICS-18 standards.

1.3 SUBMITTALS

- A. The following information shall be provided:
1. Elementary connection and interconnection diagrams as required in paragraph 2.07, in accordance with NFPA 79 and/or NEMA ICS 18 Part 1 standards.
 2. Time current curves for all protection devices.
 3. List of starters and feeder tap compartments indicating the size and type of circuit protection.
 4. Interrupting, withstand, and continuous current rating of:
 - a. Bus bars
 - b. Feeder tap units
 - c. Starter units
 - d. Main incoming units
 5. Nameplate schedule.
 6. Dimensioned drawings showing conduit access locations.
 7. Front view elevation with starter and component schedule.
 8. This project includes equipment control by MCC mounted VFDs. A significant portion of the equipment is mounted remotely (hundreds of feet) away from the MCC's location. Supplier/Subcontractor and supplier shall review the contract drawings for locations of electrical equipment and process equipment and provide input and output devices as needed to meet these specifications and to provide equipment protection from harmonics associated with VFDs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. The Owner and Engineer believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section. Motor Control Centers shall be as manufactured by Schneider, Eaton, ABB, or Allen-Bradley.

2.2 SERVICE

- A. Motor control centers shall be rated 480 volts, 60 Hertz, 3 phase, 3 or 4 wire as specified or

indicated, suitable for operation at the specified voltages and short circuit capacities.

2.3 STRUCTURE AND CONSTRUCTION

A. Structure:

1. Motor control centers shall be made of No. 14 gage steel minimum and, unless otherwise shown, each section shall be 90 inches high by 20 inches wide by 20 inches deep. The individual unit compartments shall be a minimum of 12 inches high.
2. Each section shall have 72 inches for stacking starter units into the sections.
3. The compartments shall have pan-type doors with a minimum of two quarter-turn hold-down latches; and neoprene gaskets.
4. A full height vertical wireway, 4 inch wide minimum, but not less than 30 square inches in cross section, shall be provided for each vertical motor control center section. The wireway shall contain full height removable doors. Horizontal wireways shall be provided top and bottom, extending the length of motor control centers.
5. Bottom channel sills shall be mounted front and rear of the vertical sections extending the full length of the motor control center lineup. A removable lifting angle shall be mounted on top and shall extend the width of the motor control center lineup.

B. Construction:

1. Motor control centers located indoors shall have NEMA 1, gasketed enclosures.
2. Motor control centers located outdoors shall be NEMA 1 gasketed in a NEMA-3R weatherproof non-walk-in enclosure.
3. Starter units, size 4 and smaller, and feeder tap units less than 225 amperes shall be drawout plug-in construction with hardened, tin-plated copper free-floating stabs, steel spring backups. The door shall have interference tabs which prevent door closure if unit is improperly installed.
4. Units shall be latched in the position to assure proper bus contact. The unit disconnect device shall be interlocked to prevent removal or reinsertion of a unit when the disconnect is in the "ON" or "TRIPPED" positions.
5. Fusible switch or circuit breaker disconnect operators shall be capable of accommodating three padlocks for locking in the "OPEN" position.
6. Hardware for mounting future starter and feeder tap units shall be provided at compartments specified as "FUTURE."

C. Seismic Bracing:

1. Motor control centers and related equipment shall conform to the seismic anchorage and

bracing requirements of state and local codes

2.4 BUS

A. General:

1. Bus shall be tin-plated copper with bolted connections between vertical and horizontal bus bars. Access for tightening these connections shall be from the front, without the need for tools on the rear of the connection. Insulated horizontal and vertical bus barriers shall be provided. Barriers shall be fabricated from high-strength, glass-filled polyester resin.
2. The bus shall be braced to withstand a fault current of 65,000 amperes, RMS, symmetrical.

B. Horizontal Bus:

1. Unless otherwise specified or shown, the main horizontal bus shall be rated a minimum 600 amperes continuous.

C. Vertical Bus:

1. Unless otherwise specified or shown, the vertical bus shall be insulated and rated a minimum 300 amperes continuous.
2. Bus shall be completely isolated and insulated by means of a labyrinth design barrier. It shall effectively isolate the vertical buses to prevent any fault-generated gases from passing from one phase to another.
3. Include a shutter mechanism that will allow the unit stabs to engage the vertical bus and provide complete isolation of the vertical bus when a unit is removed.

D. Neutral Bus:

1. If a 4 wire system is specified: The neutral bus shall be provided and have the same rating as the main horizontal bus, where specified or shown.

E. Ground Bus:

1. A 1/4-inch by 2-inch ground bus shall be provided the full length of the motor control center. Ground bus shall be located at the bottom of the motor control center. Provide a lug to terminate a bare 4/0 AWG copper ground conductors at each end of the ground bus.

2.5 WIRING

A. General:

1. Motor control center shall be provided with NEMA ICS 18 Class II, Type B wiring. All

starter units shall have terminal blocks for control wiring. Terminal blocks shall be provided for power wiring for starters size 2 and smaller.

2. Motor control center shall be provided with all necessary interconnecting wiring and interlocking. When an MCC control section is specified on the drawings or schedules, wire directly to the relays or programmable controller's input/output modules as part of the interconnecting wiring.
3. Provide elementary and connection diagrams for each starter unit and an interconnection diagram for the entire motor control center.

B. Power Wire:

1. Power wire shall be copper 90 degrees C insulated, sized to suit load; minimum power wire size shall be No. 12 AWG copper stranded.

C. Control Wire:

1. Control wire shall be No. 16 AWG stranded copper wire, rated 90 degrees C machine tool wiring (MTW) and UL listed for panel wiring.

D. Terminations and Cable Connections:

1. Terminals:
 - a. Control wiring shall be lugged with ring-tongue or locking spade crimp type terminals made from electrolytic copper, tin-plated.
2. Cable Connectors:
 - a. Cable connectors for use with stranded copper wire, sizes No. 8 AWG to 1,000 kcmil shall be UL listed. Dished conical washers shall be used for each bolted connection. Connectors shall be reusable and shall be rated for use with copper conductors. Incoming line and outgoing feeder compartments shall be provided with crimp type lugs, 3M Company, Burndy Company, or equal.

2.6 MAIN AND FEEDER CIRCUIT PROTECTION

A. General:

1. Main and feeder tap units shall consist of fused disconnect switches or circuit breakers, as specified or shown. Series ratings for overcurrent devices to meet specified short circuit withstand ratings is prohibited.

B. Circuit Breakers (Thermal Magnetic):

1. Thermal-magnetic circuit breakers shall be molded case equipped with toggle type handle, quick-make, quick-break over center switching mechanism that is trip-free so that breaker cannot be held closed against short circuits and abnormal currents. The

tripped position shall be clearly indicated by breaker handle maintaining a position between "ON" and "OFF." All poles shall open, close, and trip simultaneously. Minimum short circuit capacity shall be 65,000 amperes symmetrical.

2. Breakers with 1200 amp and larger frames shall be provided with trip units equipped with arc flash reduction maintenance system technology capability. The arc flash reduction maintenance system shall allow the operator to enable a maintenance mode which enables a preset accelerated instantaneous override trip to reduce arc flash energy. A blue LED on the trip unit shall indicate the trip unit is in the maintenance mode. Provide 30.5 mm switch and indicator mounted at the breaker/enclosure.

2.7 MOTOR STARTER UNITS

A. General:

1. Motor starter units shall be combination type with contactor and fused disconnect switch, thermal magnetic circuit breaker, or motor circuit protector, and electronic overload unit as indicated on the drawings or specified in the MCC schedule. The starter units shall have a minimum combination UL listing of 65,000 amperes RMS symmetrical or as indicated or specified in the schedule.

B. Motor Circuit Protectors:

1. The molded case motor circuit protector (MCP) shall operate on the magnetic principle with a current sensing coil in each of the three poles to provide an instantaneous trip for short circuit protection. The trip setting shall be adjustable from 700 to 1,300 percent of the motor full load amperes from the front of the MCP. The motor circuit protector shall be set at its lowest position at the factory.

C. Control Transformers:

1. Each control transformer shall be rated 480/240-120V, single phase, 2-wires, 60 Hertz. The transformer shall be sized for the load it feeds but shall not be less than the minimum ratings as follows:

NEMA starter size	Minimum transformer volt-ampere rating
1	100
2	150
3	200
4	300

2. Each control transformer shall be provided with time-delay, slow-blow secondary fuse rated to interrupt 10,000 amperes short circuit at 250 volts AC. Two primary fuses rated to interrupt 200,000 amperes at 600 volts shall be provided on all starters.

3. Fuse holder for secondary fuse shall be drawout indicating type and mounted on the door of the compartment. Fuse holders for primary fuses shall be fuse clips with full barriers between fuses.

D. Contactors:

1. Unless otherwise specified or shown, contactors shall be full voltage, 3-pole, 600 volt AC, NEMA Size-1 minimum. Contacts shall be double break, silver-cadmium oxide, and weld resistant. Contacts shall be isolated to prevent arcing. Coils and magnets shall be capable of being removed or replaced without special tools. IEC contactors are prohibited.
2. Reversing, multispeed, and reduced voltage starters shall have additional contactors, overload relays, and auxiliary relays as required, and shall have mechanically interlocked contactor coils to prevent simultaneous engagement.

E. Transient Voltage Surge Suppressor:

1. Provide metal oxide varistor (MOV) surge protective device (SPD) integral within each motor control center that indicates the status and condition of the SPD, tested per NEMA LS-1, rated IEEE C3 Combined Wave of 20kV and 10kA with 200kAIC internal fusing and listed / labeled per UL 1449. Minimum surge rating: 160kA per phase.
2. Provide a factory selected transient surge suppressor rated for each motor starter and power contactor encapsulated in a small module and mounted directly to the starter or contactor coil.

F. Auxiliary Contacts:

1. Contactors shall be equipped with auxiliary contacts, rated 10 amperes at 120 volts AC. Refer to drawings for actual quantities required. As a minimum, each contactor shall be equipped with two normally open and two normally closed electrically isolated auxiliary contacts with the used and auxiliary contacts wired out to terminal blocks.

G. Electronic Overload Relay:

1. The solid-state overload relay shall protect the power wiring and motor from excessive overcurrents. The relay shall be ambient compensated and have adjustment from 90 to 110 percent of the normal rating.
2. The sensing element shall be adjustable Class 20 tripping time of 20 seconds at 600 percent of current setting. The faster overload trip Class 10 (10 seconds at 600 percent of current setting) and the longer overload trip Class 30 (30-seconds at 600 percent of current setting) shall be field set by the installer during the driven equipment startup with the overload settings that are required by the type of motor driven load.
3. The relay shall provide motor protection for thermal overload, phase loss (single-

phasing), current unbalance protection and ground fault.

4. The relay shall provide monitoring for current per phase and average RMS, current unbalance percent, thermal capacity, frequency and overload status.

H. MSH / TSH Sensors

1. Where shown on the drawings, provide integral moisture / temperature monitoring relays for submersible pumps. Relays shall be coordinated with the pump manufacturer such that the relays are compatible with the pump sensors located in the head of the submersible pump. Relay indication shall be located on the front of the cubical. Provide auxiliary hi temp and moisture contacts for Owner's SCADA system

I. Terminal Blocks:

1. Terminal blocks shall be screw type rated 600 volts; 20 amperes for control wiring and 30 amperes power wiring with starters Size 3 and larger shall terminate the power leads directly to the contactor.
2. The number of terminal blocks shall be specified on the drawings. Terminal blocks shall be provided with integral marking strips and shall be permanently marked with the conductor number as specified on the drawings. Internal wiring shall be connected on one side of the terminal block; outgoing conductors shall be connected to the other side.

2.8 MISCELLANEOUS

A. General:

1. Control devices such as pushbuttons, selector switches, indicating lights and overload reset pushbuttons shall be mounted on the unit compartment door. Indicating lights shall be LED type with push-to-test feature.
2. The control devices shall comply with the requirements of Section 26 09 16.
3. Starters and drives for submersible pump and/or mixer motors shall be furnished with circuitry to interface with the motor leak and temperature protection modules (such as the Flygt CAS module). Coordinate with equipment supplier and obtain the pump/motor protection devices for mounting in the equipment structure as required. See the pump motor schematic diagram shown on the drawings for additional information.

B. Nameplates:

1. Nameplates shall be provided for all cubicles and compartments and identify the load per NEC. A Nameplate shall be provided identifying the motor control center. Provide equipment tag numbers and descriptions as shown.

2.9 ADJUSTABLE FREQUENCY DRIVES

- A. AFDs mounted in motor control centers shall be flush mounted and shall meet the following requirements.
1. AFD, ASD, VFD, VSD are interchangeable terms.
 2. AFDs shall be continuous duty, industrial drives without exception.
 3. Final drive model and selection shall be based on approved equipment. Requirements for constant or variable torque shall be coordinated and confirmed. Manufacturers that produce models specific for pumps and fans shall provide those models in coordination with equipment.
 4. Provide variable or constant torque PWM type drives for motors as indicated on the Drawings. MCC mounted AFDs shall not be applied for motors exceeding 75 horsepower. Include circuit breaker disconnecting means, 3 percent line reactors or filters as specified herein to meet IEEE 519 requirements and cooling fans as required to dissipate the heat into the room.
 5. Provide a motor output dv/dt filter to trim the reflected-wave voltage spike from reflected waves from the motor where indicated on the Drawings or as specified herein.
 6. Provide a 3% line reactor for each VFD.
 7. Provide ratings as indicated.
 8. Provide microprocessor Operator Interface Station (OIS) on the AFD door.
 9. Provide current limiting fuses for short circuit protection if required to meet short circuit requirements of the MCC.
 10. Provide factory technician for setup, startup services, and training.
 11. Onboard data communication capability: Modbus TCP/IP communications protocol.
 12. Provide four Form C relays with 5-ampere contacts for interlocks.
 13. Provide four programmable relay outputs for on-off status, alarm, “Remote” mode.
 14. Provide isolated 4-20mA_{dc} analog input for speed control.
 15. Provide isolated 4-20mA_{dc} analog output for speed indication.
 16. Provide individual line input harmonic filters, as required for harmonic mitigation with adaptive passive technology. Meet IEEE-519 for voltage and current harmonics with Point-of-Common-Coupling at the MCC bus. Individual line filters shall be MTE Matrix Series D or approved equal.

17. Provide forward and reverse indicators for VFDs to be used on equipment with reversing capabilities.
18. All drives shall meet the following requirements:
 - a. Underwriters Laboratories (UL508C: Power Conversion Equipment)
 - b. National Electrical Manufacturers Association (NEMA)
 - (1) ICS 7.0: Industrial Controls & Systems for AFD.
 - c. IEC 61800-2 and –3. EN 50082-1 and –2
 - (1) Fulfill all EMC immunity requirements
19. Constant torque drives shall meet these additional requirements:
 - a. Speed regulation of +/- 0.5% of base speed, .01% with encoder feedback
 - b. The controller's full load output current rating shall be based on 50 degrees C
 - c. The AFD shall have a one (1) minute overload current rating of 150% and a two (2) second overload current rating of 250% for constant torque drives.
 - d. Full torque control at all speeds.
 - e. Starting torque >200%, depending on motor and drive sizing
20. Provide motor thermal protection circuit.
21. VFDs shall be equal to GE/ABB ACQ Series, GE/Cutler Hammer SVX9000 Series, or Square D ATV630 Series.
22. Where shown on the drawings, provide integral moisture / temperature monitoring relays for submersible pumps. Relays shall be coordinated with the pump manufacturer such that the relays are compatible with the pump sensors located in the head of the submersible pump. Relay indication shall be located on the front of the cubical. Provide auxiliary hi temp and moisture contacts for Owner's SCADA system

2.10 REDUCED VOLTAGE SOLID STATE STARTERS (RVSS)

- A. RVSS mounted in motor control centers shall be flush mounted and shall meet the following requirements.
 1. Provide ratings as indicated and circuit breaker.
 2. Provide integral full-voltage operating contactor and output isolation contactor. Provide cooling fan and filter, as required.
 3. Provide EMI/RFI shielding as required for products and wiring.

4. Provide current limiting fuses for short circuit protection, as required.
5. Provide factory technician for setup, startup services, and training.
6. Data communication: Modbus TCP/IP.
7. Provide four Form-C relays with 5-ampere contacts for interlocks.
8. Provide selectable kick start, torque control and adjustable ramp up and ramp down speeds.
9. Provide overload protection with selectable classes of 10, 15, 20, and 30 with three-phase current sensing, initially set for 20 and field adjusted as required for the application by the Factory Engineer.
10. Provide the following selectable protection:
 - a. Under-load
 - b. Under-voltage
 - c. Over-load
 - d. Over-voltage
 - e. Voltage Unbalance
 - f. Excessive Starts Per Hour
 - g. Phase Reversal
 - h. Stall and Jam
11. Provide microprocessor Operator Interface Station (OIS) on the SSS door and display as a minimum:
 - a. Three-phase current
 - b. Three-phase voltage
 - c. Power in kW
 - d. Power usage in kWh
 - e. Power factor
 - f. Elapsed time
12. Provide programmable relay outputs for:

- a. Fault alarm
- b. On-Off status
- c. Auto mode or Remote mode status
- d. Ready status
- e. Full-Speed-Bypass status
- f. High Motor Temperature
- g. Pump control starting and stopping

2.11 SPARE PARTS

A. One set consisting of the following spare parts shall be provided:

- 1. 1--set each fuse size and type

2.12 5--indicating LED lamps or LED modules.PRODUCT DATA

A. The following information shall be provided in accordance with Section 01 33 00:

- 1. Manufacturer's certification that the following items are capable of interrupting and/or withstanding the specified short circuit condition:
 - a. Bus bar bracing
 - b. Feeder tap units
 - c. Starter units
- 2. Operation and maintenance information as specified in Section 01 78 23.
- 3. Dimensions and weights.
- 4. Installation instructions.
- 5. Manufacturer's product data.
- 6. Manufacturer's certification and calculations confirming that the equipment complies with the seismic anchorage and bracing requirements of all local and state codes.
- 7. Time current curves for all protection devices.

PART 3 EXECUTION

3.1 GENERAL

- A. The motor control centers shall be erected in accordance with the recommendations of the manufacturer and with the details specified herein.
- B. Cables larger than No. 6 AWG which hang from their vertical connections shall be supported within 2 feet of the connection.
- C. The solid-state overload relay settings shall be implemented by the Supplier/Subcontractor with the settings selected based on the actual full load amperes of the motor connected to the starter and the requirements of the motor driven equipment. Refer to the manufacturer's literature for setting the overload relays. Refer to the overload relay paragraph 2.09 Overload Relay for the setting options that available in the overload relay.
- D. The motor circuit protectors shall be adjusted by the Supplier/Subcontractor to the lowest setting not causing false tripping.
- E. Install motor control centers level and plumb on 3 1/2-inch concrete housekeeping pads per the manufacturer's installation instruction.
- F. Seismic anchorage shall be conform to all local codes.
- G. Supplier/Subcontractor and MCC supplier shall reference plan view drawings and make note of available space and proposed layouts for MCCs. Available space for MCCs is as shown on the plans; therefore, MCC layouts should be designed to fit within the limits shown.
- H. Manufacturer shall provide qualified field startup personnel and information to assist and provide all required startup and testing services. Provide 1 day of on-site services.

END OF SECTION

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**SECTION 26 28 16
MOTOR DISCONNECT SWITCHES**

PART 1 GENERAL

1.1 SELECTION INCLUDES

- A. Three phase motor disconnect switches.
- B. Single phase motor disconnects switches under 1 horsepower.
- C. Single phase motor disconnects switches over 1 horsepower.

1.2 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00.

PART 2 PRODUCTS

2.1 THREE PHASE MOTORS

- A. Disconnect switches for three phase motors shall be a heavy-duty type rated 600 volts and shall be UL listed. Outdoor switches shall be in NEMA 3R enclosures; indoor switches in non-corrosive atmospheres shall be in NEMA 1 enclosures; indoor switches in wet, corrosive atmospheres shall be in NEMA 4X enclosures.
- B. Switches shall be single throw non-fusible with provisions for padlocking the handle in the open position.

2.2 SINGLE PHASE MOTORS UNDER 1 HORSEPOWER

- A. Disconnect devices for single phase motors up to 1 horsepower, not controlled with magnetic starters, shall be toggle operated manual motor starters rated 240 volts ac. Outdoor switches shall be in NEMA 3R enclosures; indoor switches in non-corrosive atmospheres shall be in NEMA 1 enclosures; indoor switches in wet, corrosive atmospheres shall be in NEMA 4 enclosures.
- B. Switches shall be non-fusible type with a thermal overload trip assembly. The handle shall include a handle guard with provisions for padlocking the handle in the open position. Continuous ratings shall be as shown on the Contract Drawings.

2.3 SINGLE PHASE MOTORS OVER 1 HORSEPOWER

- A. Disconnect switches for single phase motors over 1 horsepower in non-corrosive atmospheres and having separate overload protection and control shall be general duty rated for 240 volts ac. Outdoor switches shall be in NEMA 3R enclosures and indoor switches shall be in NEMA 1 enclosures.
- B. Disconnect switches for single phase motors over 1 horsepower in corrosive atmospheres and

having separate overload protection and control shall be heavy duty rated for 600 volts ac in NEMA 4X enclosures.

- C. Switches shall be 2 pole non-fusible, single throw types with provisions for padlocking in the open position. Continuous ratings shall be as shown on the Contract Drawings.

2.4 VFD

- A. Disconnect switches for motors that are fed from variable frequency drives (VFDs) shall have an auxiliary set of NO/NC contacts to that should break when switch is open.

2.5 NAMEPLATES

- A. Nameplates shall be provided for each motor disconnect switch to identify the load served. Nameplates shall be engraved with 3/16-inch minimum height black letters on a white background and shall be mounted on the front of the enclosure with stainless steel screws.

2.6 ACCEPTABLE MANUFACTURERS

- A. Disconnect switches shall be manufactured by General Electric/ABB, Cutler Hammer, Square D, or Engineer approved alternate.

PART 3 INSTALLATION

3.1 INSTALLATION

- A. Install in accordance with the manufacturer's instructions.

END OF SECTION

**SECTION 26 32 13
GENERATOR AND ATS**

PART 1 GENERAL

1.1 REFERENCES

- A. The equipment covered by these specifications shall be designed, tested, rated, assembled, and installed in strict accordance with all applicable standards of ANSI, NEC, ISO, U.L., IEEE and NEMA.

1.2 WORK INCLUDED

- A. The work includes supplying a complete integrated emergency generator system. The system consists of a diesel generator set with related component accessories and connecting to a new automatic transfer switch.
- B. Provide a full tank of diesel fuel after the completion of all testing.
- C. A complete system load test shall be performed after all equipment is installed.
- D. The equipment supplied and installed shall meet the requirements of the NEC and all applicable local codes and regulations. All equipment shall be of new and current production by a Manufacturer who has 25 years of experience building this type of equipment. Manufacturer shall be ISO9001 certified.
- E. Generator shall be furnished with a 480V, 3P panel (70A MB), step down transformer, and 208/120V load center. Load center shall include a main breaker and all branch breakers required. All ancillary devices (lights, block heaters, battery charger, louvers, etc.) shall be factory wired back to the load center. All conduit in enclosures shall be RGS.
- F. Provide a 1,600A, 480V, 3P Automatic Transfer Switch with Programmed Transition in a NEMA 1 free-standing enclosure.

1.3 MANUFACTURERS

- A. There shall be one source responsibility for warranty, parts and service through a local representative with factory trained service personnel.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (Listed in Alphabetical Order)
 - 1. Generator Set:
 - a. Caterpillar
 - b. Kohler
 - c. Onan-Cummins

1.4 SUBMITTALS

- A. Engine-generator submittals shall include the following information.
1. Factory published specification sheet indicating standard and optional accessories, ratings, etc.
 2. Manufacturer's catalog cut sheets of all auxiliary components such as Automatic Transfer Switches, battery charger, control panel, enclosure, main circuit breaker, etc.
 3. Dimensional elevation and layout drawings of the generator set enclosure and transfer switchgear and related accessories.
 4. Weights of all equipment.
 5. Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems.
 6. Interconnect wiring diagram of complete emergency system, including generator, switchgear, day tank, remote pumps, battery charger, jacket water heater, remote alarm indications.
 7. Engine mechanical data including heat rejection, exhaust gas flows, combustion air and ventilation air flows, noise data, fuel consumption, etc.
 8. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
 9. Generator resistances, reactance's, and time constants.
 10. Generator motor starting capability.
 11. Control panel schematics.
 12. Oil sampling analysis, laboratory location, and information.
 13. Manufacturers and the dealer's written warranty.

1.5 WARRANTY

- A. The manufacturer's standard warranty shall in no event be for a period of less than two (2) years from date completion and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Warranty service calls shall not include a deductible cost. Submittals received without written warranties as specified will be rejected in their entirety.

1.6 PARTS AND SERVICE QUALIFICATIONS

- A. The engine-generator supplier shall have service facilities within 75 miles of the project site and maintain 24-hour parts and service capability. The distributor shall stock parts as needed to support the generator set package for this specific project.
- B. The dealer shall maintain qualified, factory trained service personnel that can be reached within 10 minutes of an emergency call and can respond on site within 4 hours of notification, 24 hours per day.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. The generator set shall be Standby and have an 800 kW/ 1000kVA rating. The ratings shall be at 1800 RPM, 0.8 power factor, 480Y/277 VAC, 3 phase, 4 wire, 60 hertz, including radiator fan and all parasitic loads.
- B. All materials and parts comprising the unit shall be new and unused.

2.2 DIESEL ENGINE

- A. The engine shall be as manufactured by one of the approved manufacturers listed above. The engine shall be water-cooled inline or vee-type, four cycle compression ignition diesel. The engine shall be equipped with fuel, lube oil, and intake air filters, lube oil cooler, fuel transfer pump, fuel priming pump, service meter, gear-driven water pump.
- B. The engine shall include a Closed Crankcase Ventilation (CCV) system. If the engine does not have integral CCV, an external system, by Racor or equal, shall be added. System shall filter crankcase fumes, returning the filtered air to the engine intake and the captured oil back to the oil pan.
- C. The complete engine block shall be machined from one casting. Designs incorporating multiple blocks bolted together are not acceptable.
- D. The engine shall utilize a gear-type, positive displacement, full pressure lubricating oil pump and water-cooled lube oil cooler. Pistons shall be spray cooled. Provide oil filters, oil pressure gauge, dipstick and oil drain.
- E. Fuel filter and serviceable fuel system components shall be located to prevent fuel from spilling onto generator set batteries.
- F. The engine shall be equipped with an isochronous electronic governor +/- 0.25% steady state frequency variation. The governor shall be equipped with speed adjustment.

2.3 GENERATION

- A. The synchronous generator shall be a single bearing, self-ventilated, drip-proof design in

accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling.

- B. The insulation material shall meet NEMA standards for Class H insulation and be vacuum impregnated with epoxy varnish to be fungus resistant. Temperature rise of the rotor and stator shall not exceed NEMA class F (130° C rise by resistance over 40° C ambient). The excitation system shall be of brushless construction.
- C. The brushless exciter shall be independent of main stator windings (either permanent magnet or auxiliary windings) and shall consist of a three-phase armature and a three-phase full wave bridge rectifier mounted on the rotor shaft. Surge suppressors shall be included to protect the diodes from voltage spikes. Generator shall have the ability to sustain short circuit current of 300% of rated current to allow protective devices to operate.
- D. The automatic voltage regulator (AVR) shall maintain generator output voltage within +/- 0.5% for any constant load between no load and full load. The regulator shall be a totally solid-state design which includes electronic voltage buildup, volts per Hertz regulation, three phase sensing, over-excitation protection, loss of sensing protection, temperature compensation, shall limit voltage overshoot on startup, and shall be environmentally sealed.

2.4 CIRCUIT BREAKER

- A. Provide a 1600A, 480V, 100% Rated, 65 kAIC generator mounted circuit breaker with L/S/I protective features, molded case or insulated case construction. Breaker(s) shall be 100% rated, UL Listed and sized as shown on the drawing(s). Breaker shall include a 12 or 24 VDC shunt trip and shall have auxiliary position contacts wired to the genset control panel for local and remote annunciation of the circuit breaker position. The breaker shall be connected to engine/generator safety shutdowns. Breaker shall be housed in NEMA 1P22, enclosure(s) mounted on the side of the generator. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing(s), shall be supplied on the load side of breaker. Breaker shall include long term, short term, and instantaneous trip settings. All breakers rated 1000 Amps and above shall include ground fault indication.

2.5 CONTROLS

- A. Generator Mounted Control Panel:
 - 1. Provide a generator mounted control panel for complete control and monitoring of the engine and generator set functions. Panel shall include automatic start/stop operation, adjustable cycle cranking, digital LCD AC metering (0.5% true rms accuracy) with phase selector switch, digital engine monitoring, shutdown sensors and alarms with horn and reset, adjustable cooldown timer and emergency stop push-button. Panel shall incorporate self-diagnostics capabilities and fault logging. Critical components shall be environmentally sealed to protect against failure from moisture and dirt. Components shall be housed in a NEMA 1/IP22 enclosure with hinged lid.
 - 2. Provide the following digital readouts on the Generator Mounted Control Panel:

- a. Engine oil pressure
 - b. Coolant temperature
 - c. Engine RPM
 - d. System DC Volts
 - e. Engine running hours
 - f. Generator AC volts
 - g. Generator AC amps
 - h. Generator frequency
3. Control Panel Annunciation - Provide the following indications for protection and diagnostics according to NFPA 110 level 1:
- a. Low oil pressure
 - b. High water temperature
 - c. Low coolant level
 - d. Overspeed
 - e. Overcrank
 - f. Emergency stop depressed
 - g. Approaching high coolant temperature
 - h. Approaching low oil pressure
 - i. Low coolant temperature
 - j. Low voltage in battery
 - k. Control switch not in auto. position
 - l. Low fuel main tank
 - m. Battery charger ac failure
 - n. High battery voltage
 - o. Generator supplying load
 - p. Spare

2.6 COOLING SYSTEM

- A. The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 122° F ambient air entering the room or enclosure (If an enclosure is specified) without derating the unit and 50/50 anti-freeze mixture. The generator set supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.

2.7 FUEL SYSTEM

- A. Filter/Separator - In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine.
- B. All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted.
- C. Flexible fuel lines shall be rated for 300 degrees F and 100 PSI.

2.8 EXHAUST SYSTEM

- A. A critical type silencer, companion flanges, and flexible stainless steel exhaust fitting properly sized shall be furnished and installed according to the manufacturer's recommendation.
- B. The silencer shall be located inside the generator set enclosure. The silencer shall be mounted so that its weight is not supported by the engine.
- C. Exhaust pipe size shall be sufficient to ensure that exhaust back pressure does not exceed the maximum limitations specified by the engine manufacturer.

2.9 STARTING SYSTEM

- A. A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.
- B. Jacket Water Heater: A unit mounted thermal circulation type water heater. The heater watt rating shall be sized by the manufacturer to maintain jacket water temperature at 90 degrees F in an ambient temperature down to -20 Deg F. Heaters <= 6000W shall be 208 – 240V single phase, 60 Hz. Heaters greater than 6000W shall be 208 – 240V, three phase, 60 Hz.
- C. Batteries: A lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system. The battery set shall be rated no less than 140 ampere hours and 1300 CCA. Necessary cables and clamps shall be provided.
- D. A battery tray shall be provided for the batteries and shall conform to NEC 480-7(b). It shall treated to be resistant to deterioration by battery electrolyte. Further, construction shall be

such that any spillage or boil-over battery electrolyte shall be contained within the tray to prevent a direct path to ground.

- E. Battery Charger: A current limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input. AC input voltage shall be 120 volts, single phase. Charger shall have LED annunciation for low DC volts, rectifier failure, loss of AC power, high DC volts. Amperage output shall be no less than ten (10) amperes. Charger shall be wall mounting type in NEMA 1 enclosure, installed in the generator set enclosure.

2.10 GENERATOR SET ENCLOSURE – SOUND ATTENUATED AND WEATHER PROTECTIVE

- A. The complete diesel engine generator set, including generator control panel, engine starting batteries and fuel oil tank, shall be enclosed in a factory assembled, weather protective enclosure mounted on the fuel tank base.
- B. The enclosure shall be constructed of corrosion resistant steel with electrostatically applied powder coated baked polyester paint. It shall consist of a roof, side walls, and end walls. Fasteners shall be either zinc plated or stainless steel.
- C. The enclosure shall reduce the ambient noise level at full load to a maximum of 75 dB at 23 feet.
- D. Number of doors on enclosure shall be as required so that all normal maintenance operations, such as lube oil change, filter change, belt adjustment and replacements, hose replacements, access to the control panels, etc., may be accomplished without disassembly of any enclosure components. Access doors shall be fabricated of the same material as the enclosure walls and shall be reinforced for rigidity.
- E. Provide six LED wall packs on exterior of enclosure to illuminate the access platform. Wall packs shall be controlled by an H-O-A switch located on interior of enclosure. In 'A' position, lights shall be controlled by a photocell mounted to exterior of enclosure.
- F. Handles shall be key lockable, all doors keyed alike, and hinges shall be zinc die cast or stainless steel. Fasteners shall be zinc plated or stainless steel. Doors shall be of a lift off design allowing one person to remove door if necessary.
- G. Air handling will be sized and designed by the manufacturer for 0.5" static pressure drops through enclosure.
- H. Air intake openings shall include fixed louvers with motorized dampers (120VAC power to close, fail open) and shall be screened to prevent the entrance of rodents.
- I. Radiator air exhaust shall include fixed louvers with gravity type dampers, and sound attenuated exhaust plenum with vertical discharge.

- J. Lube oil and coolant drains shall be extended to the exterior of the enclosure and terminated with drain valves. Radiator access shall be through a hinged, lockable cover on enclosure. Cooling fan and charging alternator shall be fully guarded to prevent injury.
- K. Lifting points shall be provided on base frame suitable for lifting combined weight of base tank, generator set and enclosure.
- L. A dual wall fuel tank base of 24-hour capacity at 100% load shall be provided as an integral part of the enclosure. It shall be contained in a rupture basin with 110% capacity. The tank shall be pressure tested for leaks prior to shipment and have all necessary venting per UL142 standards. A locking fill cap, a mechanical reading fuel level gauge, low fuel level alarm contact, and fuel tank rupture alarm contact shall be provided.
- M. The genset vendor shall supply a service access platform. The platform shall be of aluminum construction, shall be a minimum of 48" wide, shall provide room for full enclosure door opening, and shall include stairs and handrails per OSHA requirements. Platforms will be required on all sides / ends of the enclosure with door openings. Platform height shall be such that the control panel, breaker handle(s), and oil level dipstick shall all be within 6' from the top of the platform after installation. Installing contractor shall coordinate any additional concrete requirements to support the platform with generator supplier.

2.11 AUTOMATIC TRANSFER SWITCH

A. General:

- 1. The transfer switch shall be a 800A, NEMA 1, 480/277V, 4W, 3 Pole Automatic, 65kAIC Transfer Switch with programmed transition.
- 2. The transfer switch shall be rated for the voltage and ampacity as shown on the plans and shall have 600-volt insulation on all parts in accordance with NEMA standards.
- 3. The current rating shall be a continuous rating when the switch is installed in an unventilated enclosure and shall conform to NEMA temperature rise standards. Designs which require cabinet ventilation are unacceptable and do not meet this specification.
- 4. The unit shall be rated based on all classes of loads, i.e., resistive, tungsten, ballast and inductive loads. Switches rated 400 amperes or less shall be UL listed for 100% tungsten lamp load.
- 5. As a precondition for approval, all transfer switches complete with accessories shall be listed by Underwriters Laboratories, under Standard UL 1008 (automatic transfer switches) and approved for use on emergency systems.
- 6. The withstand current capacity of the main contacts shall not be less than 20 times the continuous duty rating when coordinated with any molded case circuit breaker established by certified test data.
- 7. Temperature rise tests in accordance with UL 1008 shall have been conducted after the

overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.

8. Transfer switches shall comply with the applicable standards of UL, CSA, ANSI, NFPA, IEEE, NEMA and IEC.
9. The transfer switches shall be supplied with a solid-state control panel as detailed further in these specifications.

B. Sequence of Operation

1. The ATS shall incorporate adjustable three phase under-voltage sensing of the normal source.
2. When the voltage of any phase of the normal source is reduced to 80% of nominal voltage, for a period of 0-10 seconds (programmable) a pilot contact shall close to initiate starting of the engine generator.
3. The ATS shall incorporate adjustable single-phase under-voltage sensing of the emergency source.
4. When the emergency source has reached a voltage value within 10% of nominal voltage and achieved frequency within 5% of the rated value, the load shall be transferred to the emergency source after a programmable time delay.
5. When the normal source has been restored to not less than 90% of rated voltage on all phases, the load shall be re-transferred to the normal source after a time delay of 0 to 30 minutes (programmable). The generator shall run unloaded for 5 minutes (programmable) and then automatically shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.
6. If the engine generator should fail while carrying the load, retransfer to the normal source shall be made instantaneously upon restoration of proper voltage (90%) on the normal source.
7. The transfer switch shall be equipped with a solid-state control panel. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position and source availability.
8. The control panel shall include indicators for timing functions, and ATS test switch.
9. The control panel shall be provided with calibrated pots (accessible only by first opening the lockable cabinet door) to set time delays, voltage and frequency sensors. The ATS shall be capable of being adjusted while the controls are energized and the unit in automatic mode. Designs which force a “programming mode” or require the controls be de-energized during adjustment are unacceptable.
10. The control panel shall be opto-isolated from its inputs to reduce susceptibility to

electrical noise and provided with the following inherent control functions and capabilities:

- a. An LED display for continuous monitoring of the ATS functions.
- b. Test switch to simulate a normal source failure.
- c. Time delay to override momentary normal source failure prior to engine start. Field programmable 0-10 seconds (continuously adjustable via a calibrated potentiometer factory set at 3 seconds).
- d. Time delay on retransfer to normal source, continuously adjustable 0-30 minutes, factory set at 30 minutes. If the emergency source fails during the retransfer time delay, the transfer switch controls shall automatically bypass the time delay and immediately retransfer to the normal position.
- e. Time delay on transfer to emergency, continuously adjustable 0-15 seconds, factory set at 1 second.
- f. An in-phase monitor or time delayed neutral shall be provided to prevent excessive transient currents from switching motor loads.
- g. An interval-type automatic clock exerciser with load/no load select ability shall be incorporated in the ATS.

C. Construction and Performance

1. The automatic transfer switch shall be of double throw construction operated by a reliable electrical mechanism momentarily energized. There shall be a direct mechanical coupling to facilitate transfer in 6 cycles or less.
2. The transfer switch shall incorporate a timed, center-off (neutral) position to allow for motor and inductive load decay. Transfer time shall be adjustable from 0 to 10 minutes on transfer to either source. A mechanical interlock shall be provided to positively ensure that both sets of power transfer contacts cannot be closed simultaneously (precluding the possibility of inadvertently paralleling the ATS input sources).
3. For switches installed in systems having ground fault protective devices, and/or wired so as to be designated a separately derived system by the NEC, a 4th pole shall be provided. This additional pole shall isolate the normal and emergency neutrals. The neutral pole shall have the same withstand and operational ratings as the other poles and shall be arranged to break last and make first to minimize neutral switching transients. Add-on or accessory poles that are not of identical construction and withstand capability are not acceptable.
4. The contact structure shall consist of a main current carrying contact, which is a silver alloy with a minimum of 50% silver content. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes above 400 Amps.

5. The transfer switch manufacturer shall submit test data for each size switch required for this project, showing that it can withstand fault currents of the magnitude and the duration necessary to maintain the system integrity. Minimum UL listed withstand and close into fault ratings shall be as follows:

a. Any Molded Case Breaker*:

(1) Size (Amps)	(RMS Symmetrical)
(2) Up to 200	10,000
(3) 201 - 260	35,000
(4) 261 - 400	35,000
(5) 401 - 1200	50,000
(6) 1201 - 4000	100,000

b. Specific Coordinated Breaker*:

(1) Size (Amps)	(RMS Symmetrical)
(2) Up to 150	30,000
(3) 151 - 260	42,000
(4) 261 – 400	50,000
(5) 401 - 800	65,000
(6) 801 - 1200	85,000
(7) 1201 - 4000	100,000

c. Current Limiting Fuse*:

(1) Size (Amps)	(RMS Symmetrical)
(2) Up to 4000	200,000

*All values 480 volt, RMS symmetrical, less than 20% power factor.

Note: Actual necessary current withstand ratings for this project may be higher than the minimums listed above. Refer to electrical plans for exact requirements.

6. The automatic transfer switch manufacturer shall certify sufficient arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 480 volts, 600% of rated current at .50 power factor. This certification is to ensure that there will be no current flow between the two isolated sources during switching.
7. All relays shall be continuous duty industrial type with wiping contacts. Customer interface contacts shall be rated 10 amperes minimum. Coils, relays, timers, and accessories shall be readily front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance.
8. Main and arcing contacts shall be visible without major disassembly to facilitate

inspection and maintenance.

9. A manual handle shall be provided for maintenance purposes with the switch de-energized. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection or manual operation.
10. The switch shall be mounted in a NEMA 1 indoor enclosure unless otherwise indicated on the plans.
11. Switches composed of molded case breakers, contactors or components thereof not specifically designed as an automatic transfer switch will not be acceptable.
12. To afford the advantage of a single source of supply to the owner, the automatic transfer switch shall be supplied by the manufacturer of the engine generator set and covered under the same warranty program.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install equipment in accordance with manufacturer's recommendations, the project drawings and specifications, and all applicable codes. Installation of the system includes but is not limited to pouring a concrete pad for the generator set and automatic transfer switch, receiving and offloading the equipment, providing all labor, permits and material to install the total system.

3.2 START UP AND TESTING

- A. Coordinate all start-up and testing activities with the Engineer and Owner.
- B. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:
 1. Verify that the equipment is installed properly.
 2. Check all auxiliary devices for proper operation, including battery charger, jacket water heater(s), generator space heater, remote annunciator, etc.
 3. Test all alarms and safety shutdown devices for proper operation and annunciation.
 4. Check all fluid levels.
 5. Start engine and check for exhaust, oil, fuel leaks, vibrations, etc.
 6. Verify proper voltage and phase rotation at the transfer switch before connecting to the load.
 7. Connect the generator to building load and verify that the generator will start and run all designated loads in the plant.

8. Verify and test all connections to the existing automatic transfer switch.
- C. Perform a 4-hour resistive load bank test at full nameplate load using a load bank and cables supplied by the local generator dealer. Observe and record the following data at 15-minute intervals:
 1. Service meter hours
 2. Volts AC - All phases
 3. Amps AC - All phases
 4. Frequency
 5. Power factor or Vars
 6. Jacket water temperature
 7. Oil Pressure
 8. Fuel pressure
 9. Ambient temperature
- D. Operation and Maintenance Manuals
 1. Provide three (3) sets of operation and maintenance manuals covering the generator, switchgear, and auxiliary components. Include parts manuals, final as-built wiring interconnect diagrams and recommended preventative maintenance schedules.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 1 Section "Demonstration and Training."
 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
 2. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data".
 3. Schedule training with Owner, with at least seven days' advance notice.
 4. Minimum Instruction Period: Four hours.

END OF SECTION

**SECTION 26 50 00
LIGHTING**

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section specifies luminaires (lighting fixtures) features and installation.

1.2 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
NFPA 70	National Electrical Code (NEC)

1.3 WARRANTY

- A. Emergency Lighting Unit Batteries Warranty:
1. Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period: Two years from date of Substantial Completion. Provide full warranty for first year and prorated warranty for the remaining warranty period.
- B. LED Luminaires Warranty:
1. A written 5-year on-site replacement material, fixture finish and workmanship. On-site replacement includes transportation, removal, and installation of new products. Finish warranty must include warranty against failure or substantial deterioration such as

blistering, cracking, peeling, chalking or fading.

2. A written 5-year replacement material warranty for defective or non-starting LED source assemblies.
3. A written 5-year replacement material warranty on all power supply units (PSU).
4. The warranty period shall begin on the date of Substantial Completion. The Supplier/Subcontractor shall provide the Owner with appropriate signed warranty certificates.
5. The warranty period for batteries for emergency power on fixtures used for both normal and emergency lighting shall be within the specified warranty period: Two years from date of Substantial Completion.

1.4 SUBMITTALS

- A. Luminaire model numbers are provided on the drawings in the lighting schedule. The manufacturer's catalog numbers listed are examples of the basic model or series. Referenced catalog numbers may not include voltage, mounting style, modifications, and other special features that are specified. The Supplier/Subcontractor, and manufacturer shall provide the specified requirements.
- B. The Supplier/Subcontractor may propose an alternate luminaire for approval; however, sufficient information shall be provided as a part of the submittal for the Design-Builder's Representative to review and compare the listed luminaire and the proposed alternate. Supplier/Subcontractor and luminaire supplier shall provide a photometric, energy usage (efficiency), approvals/listings and materials comparison between the two fixtures. If an alternate luminaire layout is required the Supplier/Subcontractor and luminaire supplier shall provide all illuminance calculations as part of the submittal to verify minimum illuminance levels are met by the proposed revisions. Proposed alternates shall be shown to be equivalent or superior to the luminaire listed. It shall be the Supplier/ Subcontractor's responsibility to provide sufficient information to the Design-Builder's Representative to verify and approve alternates.

PART 2 PRODUCTS

2.1 LIGHTING MATERIALS

- A. Unless otherwise specified, lighting materials, including fixtures, accessories, and hardware, shall conform to the detailed requirements specified on the applicable Light Fixture Schedule. Lighting fixtures shall be provided where specified on the drawings. The drawing's light fixture placement is diagrammatical in nature. The actual installation and fixture layout shall be coordinated with the various trades and equipment.

2.2 LED LUMINAIRES (LED)

- A. LED luminaires shall be a complete functioning unit with all components including light source, lamps, power supply, control interface and any additional components needed for

operation and shall be assembled by the luminaire manufacturer.

- B. Luminaires shall comply with ANSI chromaticity standard for classifications of color temperature. See the Light Fixture Schedule for specified LED lamp color and color temperature. Luminaire shall be UL or ETL listed and labeled.
- C. Luminaire testing shall be per IESNA LM-79 AND LM-80 procedures.
- D. Provide shop drawings showing illumination levels with LED systems based on lumen output at 70 percent lumen depreciation for white LEDs and 50 percent for colored LEDs. Initial lumen output for all LEDs shall be listed individually.
- E. LED drivers shall have reversed polarity protection, open circuit protection and require no minimum load. Drivers shall operate at a minimum 80 percent efficiency and have a class A noise rating.
- F. Where LED systems are required to be dimmable, the LED system shall be capable of full and continuous dimming.

PART 3 EXECUTION

3.1 GENERAL

- A. The location and type of luminaries, associated poles, fixtures, and receptacles are as shown on the drawings.
- B. Fixture locations indicated on the drawings are approximate and shall be coordinated with other work in the same area to prevent interference between lighting fixtures and other equipment. Any fixture shall be relocated if, after installation, it is found to interfere with other equipment or is so located to prevent its practical intended use.
- C. The Supplier/Subcontractor shall mark the locations of exterior pole mounted fixtures and verify the location is acceptable to the Owner and Design-Builder's Representative prior to installation.
- D. Labels and marks, except the UL label, shall be removed from exposed parts of the fixtures. Fixtures shall be cleaned when the project is ready for acceptance. Photoelectric cells shall be oriented toward the south and shall be installed in an unobstructed location.
- E. Raceways, wire, or cable shall be provided in accordance with Division 26. Raceways and wire shall be provided from the fixtures, switches and receptacles to the lighting panel in accordance with the NEC. Underground and outdoor wire splices shall be in accordance with Section 26 05 19.
- F. Fixtures labeled to require conductors with a temperature rating exceeding 75 degrees C shall be spliced to circuit conductors in a separately mounted junction box. Fixture wire shall meet UL and NEC requirements. Fixture shall be connected to junction box using flexible conduit with a temperature rating equal to that of the fixture.

- G. Recessed fixtures shall be provided with mounting hardware for the ceiling system specified. A concealed latch and hinge mechanism shall be provided to permit access to the lamps and ballasts and for removal and replacement of the diffuser without removing the fixture from ceiling panels. Fixtures recessed in concrete shall have protective coating of bituminous paint.
- H. Fixtures shall be aligned and directed to illuminate an area as specified. Fixtures shall be directly and rigidly mounted on their supporting structures. The conduit system shall not be used to support fixtures.
- I. Fixtures installed in rows shall be carefully aligned vertically and horizontally. Lighting fixtures mounted on building steel, shall be centered on the beam flanges or webs, except where deviations are required to avoid interference.
- J. Mount continuous rows of luminaries in straight line. Utilize alignment clips between reflectors, where applicable.
- K. Fixture supports that are welded to steel members shall be treated with rust-resistant primer and finish paint where brackets or supports for lighting fixtures.
- L. Provide manufacturer recommended mounting hardware and brackets.

3.2 WIRE CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values or use torque values specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage then replace damaged fixtures and components. Verify normal operation of each fixture after installation.
 - 1. Test for Emergency Lighting:
 - 2. Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. Retest to demonstrate compliance with specification requirements where adjustments are made. Replace fixtures with damage or corrosion during warranty period.
- C. Lamps shall be furnished for all fixtures.
- D. Fixture maintenance shall be continuous until the date the Supplier/Subcontractor leaves the jobsite. All fixtures shall be cleaned immediately prior to the Supplier/Subcontractor leaving the jobsite unless otherwise directed by the Engineer.
- E. Immediate lamp replacement, whenever burnouts occur, shall be continuous until the date

the Supplier/Subcontractor leaves the jobsite.

- F. Touch up luminaire and pole finish at completion of work.
- G. Clean lenses and diffusers at completion of work. Clean paint splatters, dirt and debris from installed luminaires.

END OF SECTION

**SECTION 31 10 00
SITE CLEARING**

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of Site Clearing is shown on the Contract Drawings.
- B. Site Clearing operations include, but are not limited to the following:
 - 1. Protection of existing trees and other vegetation.
 - 2. Removal of trees and other vegetation.
 - 3. Topsoil stripping.
 - 4. Clearing and grubbing.
 - 5. Abandoning buildings and structures.
 - 6. Removing above-grade improvements.
 - 7. Removing underground improvements.
 - 8. Salvaging, storing, and protecting designated items.

1.2 RELATED SECTIONS

- A. Section 01 50 00 Temporary Facilities and Controls
- B. Section 31 20 00 Concrete Reinforcing
- C. Section 31 23 33 Excavation and Fill for Pipeline

1.3 PROTECTION OF EXISTING IMPROVEMENTS

- A. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing improvements indicated to remain in place.
- B. Protect improvements on adjoining properties as well as those on the project site.
- C. Restore any improvement damaged by this work to their original condition, as acceptable to the Owners or other parties or authorities having jurisdiction.

1.4 PROTECTION OF EXISTING TREES AND VEGETATION

- A. Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by

stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary fences, barricades or guards as required to protect trees and vegetation to be left standing.

- B. Water trees and other vegetation which are to remain within the limits of the Contract Work as required to maintain their health during the course of construction operations.
- C. Provide protection for roots over 1-1/2 inches diameter that are cut during construction operations. Coat the cut faces with an emulsified asphalt, or other acceptable coating, especially formulated for horticultural use on cut or damaged plant tissues. Temporarily cover all exposed roots with wet burlap to prevent roots from drying out; provide earth cover as soon as possible.
- D. Repair or replace trees and vegetation damaged by construction operations, in a manner acceptable to the Engineer. Perform tree damage repair by a qualified tree surgeon. Replace trees which cannot be repaired and restored to full-growth status, as determined by the tree surgeon.

1.5 PROTECTION OF ADJACENT PROPERTY

- A. Protect improvements, trees, and vegetation on adjoining property as well as those on property designated for site clearing work.
- B. Execute work so as not to create a nuisance to persons utilizing adjacent property.
- C. Use work methods and provide temporary facilities as necessary to prevent washing, erosion, siltation or dust damage, or hazard to persons and property, within and off the project site.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 STRUCTURE ABANDONMENT

- A. Prior to removal of indicated buildings and structures, disconnect, and seal or have utility owner disconnect and seal all active utility services. Perform disconnection and sealing work in accordance with utility owner's standard service removal policy. Assume all costs associated with disconnecting and sealing utility services.
- B. Remove all equipment, furnishings and exposed four inch and larger piping within a building or structure to be demolished before undertaking its removal. Protect, properly store and prevent damage to any item removed which is shown on the Drawings to be reused in the project.

3.2 CLEARING

- A. Remove vegetation, trees, brush, stumps, logs, grass, weeds, roots, poles, stubs, rubbish, refuse dumps, sawdust piles, loose boulders of one cubic yard or less, debris, and other

objectionable matter resting on or protruding through the ground surface, or appearing within the work limits before final project acceptance.

- B. Remove above-grade improvements, surfacing and pavements (including bases for pavements), concrete slabs, curbs, gutters, walks, concrete or wood headers, abandoned utilities and utility structures, abandoned buildings and structures, and other work as specifically indicated which is resting on or protruding through the ground surface, or appearing within the work limits before final project acceptance.

3.3 GRUBBING

- A. Completely remove stumps and other organic matter protruding through the ground surface. Use only hand methods for grubbing inside the drip line of trees indicated to be left standing (if any).
- B. Remove abandoned underground facilities, such as utilities and structures, walls, footings, basements, wells, septic tanks, cisterns, underground pipe and other indicated work, to a depth of three feet below finished grade or to such greater depth as may be necessary for construction. Break up or penetrate on-grade floor slabs at abandoned underground structures to permit movement of ground water. At a minimum provide openings of at least four-square inches per ten square feet of floor slabs. The abandonment or removal of certain underground pipe or conduits may be shown on mechanical and electrical drawings and is included under work of these headings. Removal of abandoned underground piping or conduit which interferes with construction is included under this Section.
- C. Stumps within the clearing limits prescribed on the Contract Drawings that are more than 5 feet from the pipeline trench excavation may be left in place IF GROUND DOWN TO 4 INCHES BELOW the natural or final grade whichever is lower.

3.4 HOLES AND DEPRESSIONS

- A. Fill holes, depressions and voids created or exposed by clearing or grubbing operations, including abandoned underground structures, with satisfactory soil material, unless further excavation or earthwork is indicated.
- B. Place fill material in horizontal layers not exceeding six inches loose depth, and thoroughly compact to a density equal to adjacent original ground.

3.5 TOPSOIL REMOVAL

- A. Topsoil is defined as friable clay loam surface soil found in a depth of not less than four inches or more than eight inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over two inches in diameter, and without weeds, roots, and other objectionable material.
- B. Strip topsoil in such manner so as to prevent intermingling with the underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.

- C. Where trees are indicated to be left standing, stop topsoil stripping a sufficient distance from such trees to prevent damage to the main root system.
- D. Stockpile topsoil in storage piles in areas shown, or where otherwise authorized. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent windblown dust.

3.6 DISPOSAL GENERAL REQUIREMENTS

- A. Waste matter generated from clearing and grubbing operations becomes the property of the Contractor unless otherwise provided by the Contract Documents. Dispose of all such matter legally and without nuisance to others.
- B. Accomplish disposal of cleared and grubbed matter daily so as to maintain site in a safe and neat condition at all times.
- C. Owners of the property may remove merchantable timber, equipment, furnishings, buildings, or other items of value from the project site before the Contractor begins his operations, and no assurance exists that any such material, except for items specifically designated for reuse in the project, will be on the construction site when the Contractor begins his work.

3.7 BURNING

- A. Construction waste may NOT BE BURNED.

3.8 CHIPPING

- A. Where practical, chip brush and roots to maximum dimension of one inch and use for soil erosion control and/or a substitute for mulch in finished grassing or landscaping.
- B. Where chips are used for mulch, it may be substituted pound for pound for any mulch required for the project.

3.9 REMOVAL OF WASTE MATTER

- A. When matter generated from clearing and grubbing operations can be disposed of on-site other than chipping, disposal areas and methods permitted will be indicated on the Drawings. In the absence of such indication, remove from the project site and legally dispose of all waste and objectionable matter.

END OF SECTION

**SECTION 31 23 01
EARTHWORK FOR BUILDINGS**

PART 1 GENERAL

1.1 SCOPE

- A. This specification section includes earthwork and related operations, including, but not limited to, clearing and grubbing the construction site, dewatering, excavating all classes of material encountered, pumping, draining and handling of water encountered in the excavations, handling, storage, transportation, and disposal of all excavated and unsuitable material, construction of fills and embankments, backfilling around structures and pipe, backfilling all trenches and pits, compacting, all sheeting, shoring and bracing, preparation of subgrades, surfacing and grading, and any other similar, incidental, or appurtenant earthwork operation which may be necessary to properly complete the work.
- B. The Contractor shall provide all services, labor, materials, and equipment required for all earthwork and related operations necessary or convenient to the Contractor for furnishing a complete work as shown on the Drawings or specified in these Contract Documents.

1.2 GENERAL

- A. The elevations shown on the Drawings as existing are intended to give reasonable, accurate information about the relative elevations. The Contractor should satisfy himself as to the exact quantities of excavation and fill required.
- B. Earthwork operations shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards.
- C. All excavated and filled areas for structures, trenches, fills, topsoil areas, embankments and channels shall be maintained by the Contractor in good condition at all times until final acceptance by the Owner. All damage caused by erosion or other construction operations shall be repaired by the Contractor using material of the same type as the damaged material.
- D. Earthwork within the rights-of-way of the State Department of Transportation, the County Road Department, and the respective cities shall be done in accordance with requirements and provisions of the permits issued by those agencies for the construction within their respective rights-of-way. Conflicts between such requirements and these specifications shall be brought to the attention of the Engineer.
- E. The Contractor shall control grading in a manner to prevent water running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm water can be uninterrupted in existing gutters, other surface drains, or temporary drains. Free access must be provided to all fire hydrants, watergates, and meters.
- F. No classification of excavated materials will be made. Excavation work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition

thereof.

- G. Tests for compaction and density shall be conducted by an independent testing laboratory. Costs of compaction tests performed by an independent testing laboratory shall be paid for by the Owner, see Section 0145 23. The Contractor shall make all necessary excavations and shall supply any samples of materials necessary for conducting compaction and density tests. The cost of all retests made necessary by the failure of materials to conform to the requirements of these Contract Documents shall be paid by the Contractor.
- H. All earthwork operations shall comply with all the applicable requirements of OSHA Construction Standards, Part 1926, Subpart P, Excavations, Trenching, and Shoring, and Subpart O, Motor Vehicles, Mechanized Equipment, and Marine Operations.
- I. It is understood and agreed that the Contractor has made a thorough investigation of the surface and subsurface conditions of the site and any special construction problems which might arise as a result of nearby watercourses and flood plains, particularly in areas where construction activities may encounter water-bearing sands and gravels or limestone solution channels. The Contractor shall be responsible for providing all services, labor, equipment, and materials necessary or convenient to him for completing the work within the time specified in these Contract Documents.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 INITIAL SITE PREPARATION

- A. Preparatory to beginning of construction operations, the Contractor shall remove from the project area all vegetable growth, trees, brush, stumps, roots, debris, and any other objectionable matter, including fences, buildings, and other structures shown on the Drawings in the construction areas which are designated for removal or which, if left in place, would interfere with the proper performance or completion of the contemplated work, would impair its subsequent use, or would form obstructions therein.
- B. Stumps and roots shall be grubbed and removed to a depth not less than 2 feet below grade. All holes or cavities which extend below the subgrade elevation of the proposed work shall be excavated and filled with compacted layers of crushed rock or earth backfill conforming to the requirements specified herein for backfill. Organic material from clearing operations shall not be incorporated in excavation backfill or embankment material.
- C. The Contractor shall exercise special precautions for the protection and preservation of trees, cultivated shrubs, sod, fences, buildings, and other structures which are located in the construction area but not within designated clearing limits as shown on the Drawings or within the limits of embankments, excavations, or proposed structures. The Contractor shall be responsible for the repair and/or replacement of any of the aforementioned items damaged by his operation or construction activities.
- D. The Contractor shall remove and dispose of all excess material resulting from clearing or site

preparation operations. The Contractor shall dispose of such materials in a lawful manner and at a location where such materials can be lawfully disposed.

3.2 DEWATERING

- A. The Contractor shall provide and maintain at all times during construction ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. Dewatering shall be accomplished by methods which will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations. Methods of dewatering may include sump pumps, well points, deep wells, or other suitable methods which do not damage or weaken structures, foundations, or subgrades. Shallow excavations may be dewatered using open ditches provided such ditches are kept open and free-draining at all times.
- B. Unless specifically authorized by the Engineer, no concrete or mortar shall be placed in water nor shall water be allowed to rise over newly-placed concrete or mortar for at least 24 hours after placement. No concrete structure shall be exposed to unequal hydrostatic forces until the concrete has reached its specified 28-day strength. Water shall not be allowed to rise above bedding during pipe laying operations. The Contractor shall exercise care to prevent damage to pipelines or structures resulting from flotation, undermining, or scour. Dewatering operations shall commence when ground or surface water is first encountered and shall be continuous until such times as water can safely be allowed to rise in accordance with the provisions of this section. Excavations shall be protected from the entrance of surface water to the extent possible by the use of dikes and/or covers.
- C. Standby pumping equipment shall be on the job site. A minimum of one standby unit (a minimum of one for each ten in the event well points are used) shall be available for immediate installation should any pumping unit fail. The design and installation of well points or deep wells shall be suitable for the accomplishment of the work and shall comply with all local codes.
- D. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with crushed rock at no cost to the Owner.
- E. The Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property. Conveyance of the water shall be such as to not interfere with traffic flow or treatment facilities operation. No water shall be drained into work built or under construction. The Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.
- F. Sedimentation and desilting basins shall be provided as necessary to prevent the entrance of excessive or injurious amounts of sand and silt from surface runoff or dewatering operations into storm drains or receiving waters. The system used for desanding or desilting the water shall be a baffled structure and shall provide not less than five minutes detention time and shall be designed to have a “flow-through” velocity not exceeding 0.2 feet per second at the

anticipated peak flow.

- G. Water shall be disposed of in such a manner as not to be a menace to the public health and in accordance with applicable Environmental Protection Agency, Corps of Engineers, and State Environmental Protection Division standards and permits.

3.3 SHEETING, SHORING, AND BRACING

- A. The sides of all excavations shall be sufficiently sheeted, shored, and braced as necessary to prevent slides, cave-ins, settlement or movement of the banks, to maintain the excavation clear of all obstructions, and to provide safe working conditions. Wood or steel sheeting of approved design and type shall be used in wet, saturated or flowing ground. All sheeting, shoring, and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to maintain shape and position under all circumstances.
- B. The responsibility for correctly assessing the need for sheeting and analyzing the stresses induced shall be the total responsibility of the Contractor. Since the Engineer does not dictate or determine the Contractor's sequence or limits of excavation, the Engineer assumes no responsibility for sheeting and shoring. The Contractor must employ or otherwise provide for adequate professional structural and geotechnical engineering supervision to assess the need for sheeting and shoring and design same. Results of sheeting and shoring analysis and design shall be submitted to the Engineer on request.
- C. Excavations adjacent to existing or proposed buildings and structures, or in paved streets or alleys shall be sheeted, shored, and braced adequately to prevent undermining beneath or subsequent settlement of such structures or pavements. Underpinning of adjacent structures shall be done when necessary to maintain structures in safe condition. Any damage to structures or pavements occurring through settlements, water or earth pressures, slides, caves, or other causes; due to failure or lack of sheeting or bracing, or due to improper bracing; or occurring through negligence or fault of the Contractor in any other manner shall be repaired by the Contractor at his own expense.
- D. Sheeting, shoring, or bracing materials shall not be left in place unless otherwise specified or shown on the Drawings or ordered by the Engineer in writing. Such materials shall be removed in such manner that no danger or damage will occur to new or existing structures or property, public or private, and so that cave-ins or slides will not take place. Trench sheeting shall be left in place until backfill has been brought to a level 12 inches above the top of the pipe. It shall then be cut off and the upper portion removed. Sheeting for structures shall be left in place until backfill has been brought to a level of 12 inches above the top of the bottom footing. It shall then be cut off and the upper portion removed.
- E. All holes and voids left in the work by the removal of sheeting, shoring, or bracing shall be filled and thoroughly compacted.

3.4 EXCAVATION

- A. General

1. Excavation shall include the removal of all material from an area necessary for the construction of a pipeline, structure, basin, flume, or building. Excavations shall provide adequate working space and clearances for the work to be performed therein.
2. Except where otherwise shown on the Drawings or specified herein, all material excavated below the bottom of concrete walls, footings, and foundations shall be replaced, by and at the expense of the Contractor, with compacted layers of crushed rock, sand, or other approved material conforming to the requirements specified herein for backfill to the lines and grades shown on the Drawings.
3. Where quicksand, soft clay, spongy, swampy or other materials unsuitable for subgrade or foundation purposes are encountered below the excavation limits, they shall be removed and disposed of to the level of suitable material. Areas so excavated shall be backfilled with compacted layers of crushed rock, sand, or other approved material conforming to the requirements specified herein for backfill to the lines and grades shown on the Drawings.
4. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until the excavations are backfilled. All excavations shall be barricaded in such a manner as to prevent persons from falling or walking into any excavation.

B. Rock Excavation

1. Rock encountered in the process of excavation for structures shall be uncovered and stripped of all loose materials over the entire limits of excavation. Rock encountered for removal in a trench section shall be uncovered for a distance of not less than 50 feet.
2. Rock and large boulders in trenches shall be excavated over the horizontal limits of excavation and to depths as follows:

Size of Pipe (inches)	Depth of Rock Excavation Below Bottom of Pipe (inches)
3 and smaller	4
4 to 6	6
8 to 18	8
18 to 30	10
32 and larger	12

3. The space below grade for pipe sewers shall then be backfilled to the proper grade with compacted layers of crushed rock or sand conforming to the requirements specified herein for backfill. Where pipe sewers are constructed on concrete cradles, rock shall be excavated to the bottom of the cradle as shown on the Drawings.
4. Rock under structures shall be excavated to lines and grades shown on the Drawings. Unless specified otherwise, where rock excavation has been carried below grade the Contractor shall backfill to grade with compacted layers of crushed rock, sand, or other approved material conforming to the requirements specified herein for backfill at his own expense.
5. Where rock foundation is obtained at grade, the rock shall be removed for a depth of 24 inches below grade and the space below grade shall be backfilled to the proper grade with compacted layers of crushed rock, sand, or other approved material conforming to the requirements specified herein for backfill.
6. Blasting and excavation shall be performed in accordance with OCG, Chapter 9, Title 25.
7. Drilling and blasting operations shall be conducted with due regard for the safety of persons and property in the vicinity and in strict conformity with requirements of all ordinances, laws and regulations governing blasting and the use of explosives. Rock excavation near existing pipelines or other structures shall be conducted with the utmost care to avoid damage. Injury or damage to other structures and properties shall be promptly repaired to the satisfaction of the Owner by the Contractor at his own expense.
8. Rock excavation for all structures and adjacent trenches under this Contract and any other rock excavation shall be completed before construction of any structure is started in the vicinity.

C. Borrow Excavation

1. Wherever the backfill of excavated areas or the placement of embankments or other fills requires specified material not available at the site or material in excess of suitable material available from the authorized excavations, such materials shall be obtained from other sources. This may require the opening of borrow pits at points not immediately accessible from the work. In such cases the Contractor shall make suitable arrangements with the property owner and shall pay all costs incident to the borrowed material including royalties, if any, for the use of the material. Before a borrow pit is opened, the quality and suitability of the material to be obtained therefrom shall be approved by a Soils Engineer. The Contractor will pay for the geotechnical inspection and testing.
2. The Contractor may investigate opening a borrow pit on the Owner's property adjacent to and surrounding the site so long as activities will not disturb any existing or proposed land uses.

3. Borrow pits shall be cleared, grubbed, and finish graded in accordance with the requirements specified herein. Contractor is responsible for installing soil erosion and sedimentation control measures, including permanent vegetation, for all borrow pits.

D. Structural Excavation

1. Structural excavation shall consist of the removal of all materials necessary for the construction of structures, including tanks, foundations, footings, wet wells, dry wells, box culverts, flumes, channels, buildings, and other miscellaneous structures.
2. The bottom of structural excavations shall be true to the lines and grades shown on the Drawings. Faces of excavations shall not be undercut for extended footings. Except as provided herein for excavation of unsuitable material or rock, where the excavation is carried below the grade elevation shown on the Drawings, the Contractor shall backfill the void thus made to the proper grade with compacted layers of crushed rock, sand, or other approved material conforming to the requirements specified herein for backfill at his own expense.

E. Trench Excavation

1. Trenches shall be excavated to the lines and grades shown on the drawings with the centerlines of the trenches on the centerlines of the pipes.
2. The sides of all trenches shall be vertical to a minimum of one foot above the top of the pipe. Unless otherwise indicated on the drawings, the trench width shall be equal to the sum of the outside diameter of the pipe plus 2 feet, within a tolerance of ± 3 inches. This distance will be measured at an elevation in trench which is 12 inches above the top of the pipe when laid to grade.
3. Wherever the prescribed maximum trench width is exceeded, the Contractor shall use the next higher class (load factor) of embedment or encasement for the full trench width as actually cut, at no additional cost to the Owner.
4. The trenches shall be excavated to the required depth allowing for the placement of pipe bedding to the thickness shown on the Drawings.
5. Should the bottom of the trench become an unstable foundation for the pipe through the failure of the Contractor to adequately perform, the Contractor shall remove the unstable material and fill the trench to the proper subgrade with crushed rock. No extra compensation will be allowed for this material or work. Should the trench be inadvertently excavated to a greater depth than necessary, crushed rock fill to the proper subgrade shall be provided at no additional cost to the Owner.
6. Should the undisturbed material encountered at the grade depth constitute, in the opinion of the Engineer, an unstable foundation for the pipe, the Contractor shall be required to remove such unstable material and fill the trench to the proper subgrade with crushed rock.

7. Control drainage in the vicinity of excavation so the ground surface is properly pitched to prevent water from running into the excavation.

3.5 BACKFILLING

A. Materials

Materials for backfilling shall conform to the following requirements:

- | | |
|--------------------------|---|
| 1. Select Earth Backfill | Fine, sound, loose earth containing optimum moisture content for compaction to 98 percent of maximum density, free from all wood, vegetable matter, debris, and other objectionable material, and having scattered clods, stones, or broken concrete less than 2 inches in maximum dimension except that the maximum particle size shall be 3/4 inch when used with PVC or other flexible thermoplastic pipe. |
| 2. Common Earth Backfill | Sound, loose earth containing optimum moisture content for compaction to 98 percent of maximum density, free from all wood, vegetable matter, debris, and other objectionable material, and having scattered clods, stones, or broken concrete and pavement less than 6 inches in maximum dimension. |
| 3. Sand | Natural or imported sand conforming to ASTM D 1073. |
| 4. Crushed Rock | Crushed rock conforming to Section 815.01, Class A, Georgia Department of Transportation Standard Specifications, Construction of Roads and Bridges. |

B. General

1. Unless otherwise specified herein, earth backfill shall be compacted to not less than 98 percent of the Standard Proctor maximum dry density as determined by ASTM D698. Crushed stone and sand shall be compacted or consolidated to 100 percent of the Standard Proctor maximum dry density as determined by ASTM D698.
2. Material that is too dry for adequate compaction shall receive a prior admix of sufficient water to secure optimum moisture content. Material having excessive water content shall not be placed unless dried to optimum moisture content.
3. Unless otherwise specified herein backfill material required to be compacted shall be placed in horizontal layers not to exceed 6 inches in thickness (before compaction) and compacted in place by ramming, tamping, or rolling. Compaction shall be

accomplished by power driven tools and machinery wherever possible. Compaction and consolidation of sand and crushed rock backfill shall be accomplished using vibrating equipment.

C. Backfilling Around Structures

1. Backfilling around structures shall consist of common earth backfill placed in 6-inch layers and compacted by tamping to a minimum of 95 percent of the maximum density determined as specified herein for the full depth of the excavation from the bottom to the finished grade. No backfill shall be placed against concrete structures until the concrete has reached its specified 28-day compressive strength. Where practical, compaction of structural backfill shall be accomplished by power-driven tamping equipment.
2. Where crushed rock mats under slabs and foundations are called for on the Drawings, the Contractor shall excavate below grade to the depth of the crushed rock mat as shown on the Drawings and shall install a compacted crushed rock bed. This shall be finished to a true line or plane and even with the subgrade of the concrete foundations, piers, footings, or slabs. Before placing any crushed rock, all loose earth or debris shall be removed. This crushed rock mat shall extend 12 inches beyond all slabs and foundations or to edges of sheet piling.
3. Crushed rock mats, 12 inches or less in thickness, shall be constructed of compacted layers of crushed rock conforming to Section 815.01 Class A, Georgia Department of Transportation Standard Specifications, Construction of Roads and Bridges.
4. Crushed rock mats of thickness greater than 12 inches shall have the top 12 inches constructed of compacted layers of crushed rock as specified above. That portion below the top 12 inches shall be constructed of compacted layers of crushed rock as specified, with a modified gradation of 6 inches to dust as received from the crusher.
5. The upper 12 inches of mat foundation subgrade soils shall be compacted to at least 98% of the Standard Proctor Density ASTM D698.
6. Fill under slab-on-grade shall be compacted to 98% Standard Proctor Density ASTM D698, at a moisture content between 2 percent below and 3 percent above the optimum moisture content.
7. Granular structural fill under foundation elements, i.e., footings and base slabs for tanks and basins shall be compacted to 100 percent Standard Proctor Density ASTM D698, at a moisture content between 2 percent below to 3 percent above the optimum moisture content. Granular structural fill shall be placed in 6 inch lifts.
8. Unless otherwise shown on the Drawings, the use of earth backfill to support footings, foundations, and structures shall not be permitted.

D. Backfilling Trenches

1. The backfilling of sewer, water and other pipe line trenches shall be started immediately after the construction of same has been inspected by the Engineer. Selected backfill material shall consist of finely divided earth, stone dust, sand, crushed stone, or other approved material free from all wood, vegetable matter, debris and other objectional material and having scattered clods, stone or broken concrete less than 2 inches in maximum dimension.
2. Selected backfill material shall be carefully placed in the trench on each side of the pipe in 6-inch layers for the full width of the trench and thoroughly and uniformly compacted by tamping or ramming. Sufficient select backfill material shall be placed around the pipe and compacted to provide not less than 12 inches cover over the top of the pipe.
3. Backfilling shall be carried on simultaneously on both sides of the pipe and in a manner which will prevent injurious side pressures. If suitable select materials are not available from the trench excavation, the Contractor will be required to obtain the select material elsewhere at his own expense.
4. Across sidewalks and driveways and at any other places subject to vehicular traffic or other superimposed loads, trench backfill shall be compacted in 6-inch layers to the density of the original adjacent material for the full depth of the trench. The top 6 inches of backfill shall consist of uniformly graded crushed stone.
5. Trenches under concrete slabs and footings of structures shall be filled with crushed stone and tamped in 6-inch layers. Piping under concrete slabs and footings shall be encased (6 inches minimum) in concrete.

3.6 FILLS AND EMBANKMENTS

- A. Fills and embankments shall consist of all earth fills except backfills in trenches or around structures. Unless special material is specified or shown on the Drawings, material for fills and embankments shall consist of excavated material from structures or of a mixture of such excavated materials and materials borrowed from other sources by the Contractor. All material used for fills and embankments shall be free from wood, vegetable matter, debris, soft or spongy earth or clay, large rock, or other objectionable material. No rock over 2 inches in diameter shall be used in conjunction with backfill material.
- B. Materials shall be placed in the fill or embankment in successive layers 6 inches or less in thickness before compaction, each layer being approximately horizontal and extending to the full limit of the required cross section and shall be compacted at optimum water content over the entire surface to not less than 95 percent of the maximum density as determined by AASHTO T-99, Method A. The process shall be repeated for each layer of material until the fill or embankment conforms to the plan lines, grades, and cross sections.
- C. The area over which the fill or embankment is to be constructed shall first be cleared of all vegetation, debris, and other objectionable material and, if the ground is in a loose, uncompacted condition, it shall be compacted to a minimum 95 percent of maximum density determined as specified herein.

- D. No material shall be placed beyond the sloping lines of embankment.
- E. Material for embankments or roadway fills shall be placed in 6-inch maximum lifts and shall be compacted by rolling with power rollers weighing not less than 10 tons, with sheepsfoot rollers, with vibrating rollers, or with pneumatic tire rollers, as required to accomplish the work. While and as each layer is deposited, water shall be applied in sufficient amount to ensure optimum moisture to secure the compaction specified.
- F. The use of trucks, carryalls, scrapers, tractors, or other heavy hauling equipment shall not be considered as rolling in lieu of rollers, but the traffic of such hauling equipment shall be distributed over the fill in such a manner as to make the use of the compaction afforded thereby as an addition to compaction by the use of rollers.
- G. Wherever a trench passes through a fill or embankment, the fill or embankment material shall be placed and compacted to an elevation 12 inches above the top of the pipe before the trench is excavated.

3.7 DISPOSAL OF WASTE AND UNSUITABLE MATERIALS

- A. All materials removed by excavation, which are suitable for the purpose, shall be used to the extent possible for backfilling pipe trenches, foundations, and footings and for making embankment fills or for such other purposes as may be shown on the Drawings. All materials not used for such purposes shall be considered as waste materials and the disposal thereof shall be made by the Contractor in a lawful manner and at a location where such materials can be lawfully disposed.
- B. Waste materials shall be spread in uniform layers and neatly leveled and shaped. Spoil banks shall be provided with sufficient and adequate openings to permit surface drainage of adjacent lands. Contractor is responsible for erosion and sedimentation control measures, including permanent vegetation, for all spoil banks.
- C. Unsuitable materials, consisting of wood, shot rock, vegetable matter, debris, soft or spongy clay, peat, and other objectionable material shall be removed from the work site and disposed of by the Contractor in a lawful manner.
- D. No unsuitable or waste material shall be dumped on private property unless written permission is furnished by the Owner of the property and unless a dumping permit is issued from the local jurisdiction.

3.8 FINAL GRADING

- A. After other earthwork operations have been completed, the sites of all structures, roads, and embankments shall be graded within the limits and to the elevations shown on the Drawings. Grading operations shall be so conducted that materials shall not be removed or loosened beyond the required limits. The finished surfaces shall be left in smooth and uniform planes such as are normally obtainable from the use of hand tools. If the Contractor is able to obtain the required degree of evenness by means of mechanical equipment, he will not be required to use hand labor methods. Slopes and ditches shall be neatly trimmed and finished to slopes

shown on the Drawings.

- B. Unless otherwise specified or shown on the Drawings, all finished ground surfaces shall be graded and dressed to present a surface varying not more than plus or minus 0.10 foot as regards local humps or depressions.

3.9 TOPSOIL

- A. All areas to be sprigged or planted with grass as shown on the plans shall be prepared by grading to a smooth, even surface to a level 4 inches below the elevation of the finished grade shown on the Drawings. It shall then be brought to a neat and finished grade by the addition of 4 inches of approved topsoil.
- B. Topsoil removed from the construction area may be stockpiled and reused or topsoil may be obtained from approved borrow areas. If obtained from borrow areas, the Contractor shall make suitable arrangements with the property owner and shall pay all costs incident to the borrowed material including royalties.

3.10 SETTLEMENT

- A. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within one year after final acceptance of the work by the Owner.
- B. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after receipt of written notice from the Engineer or Owner.

END OF SECTION

**SECTION 31 23 33
EXCAVATION & FILL FOR PIPELINE**

PART 1 GENERAL

1.1 SCOPE

- A. Work under this Section shall include all clearing and grubbing, trench excavation, preparation of trench for pipe laying, pipe bedding, tamping of fill around piping, complete trench backfill, dressing of completed backfill.
- B. The Contractor shall determine, as far as possible in advance, the location of all existing water, sewer, and gas pipes, storm drains, and all existing buried cables. Coordination with the local utilities, in particular the gas and telephone utilities shall be maintained to allow those utilities sufficient time to locate and protect their properties in accordance with local and/or state laws. In case of damage to any existing structures, repair and restoration shall be made at once and backfill shall not be replaced until this is done.

1.2 RELATED SECTIONS

- A. Section 01 50 00 Temporary Facilities and Controls
- B. Section 31 10 00 Site Clearing
- C. Section 32 92 00 Turf and Grasses
- D. Section 33 31 00 Sanitary Utility Sewerage Piping

1.3 LABORATORY TESTS

- A. All laboratory tests to determine compliance of embedment and backfill materials with specified requirements and to determine compliance with specified compaction requirements will be paid for by the Owner, except for retesting of failed samples, which will be at the Contractor's expense.

1.4 CLOSING OF STREETS AND DRIVES

- A. The Contractor shall not close more than one city block at a time to traffic and shall maintain at least one lane open for local traffic except for locations where this is not possible in the opinion of the Engineer.
- B. Driveways which are cut for installation of piping must be backfilled and cleared for traffic within four hours of being cut. Property owners must be given 24 hours advance notice that work will be done.
- C. The Engineer shall be notified of any scheduled street closing, and his approval must be obtained for such closing. Notification must include a scheduled time for closing the street and a scheduled time for completion of work.

PART 2 PRODUCTS

2.1 BACKFILL AND FILL MATERIALS

- A. Provide acceptable soil materials for backfill and fill, free of stumps, trees, roots, sod, muck, trash and other deleterious matter.
- B. Handle, conserve, store and place excavated material to provide least desirable acceptable material at the bottom of fills and backfills and grade up to the best material at the top. Do not permit rock having any dimension in excess of two inches to be used in the top two feet of fill and backfill.

2.2 BEDDING MATERIAL

- A. Provide #57 stone conforming to GDOT Specification 800, latest revision.

PART 3 EXECUTION

3.1 PREPARATION OF SITE

- A. Prior to starting construction operations, the Contractor shall remove all vegetation, debris and other objectionable matter standing or lying on the surface within the limits of the areas to be excavated or filled. Removal and disposal of such materials shall be done in a manner acceptable to the Engineer.
- B. Areas occupied by trees, brush or other vegetation shall be cleared of such growth and suitably grubbed. All large roots or stumps shall be removed to a depth at least 2' below original ground surface. Any pits or cavities thereby created which extend beyond the excavation limits shall be filled with the materials and in the manner specified herein.
- C. Ornamental trees, cultivated shrubs, and similar growth which occupies streets, alleys, or other public rights-of-way or easements, but which lies outside the exact limits of excavation shall remain undisturbed and shall be carefully preserved and protected by the Contractor throughout all stages of the construction work.
- D. The Owner will secure rights-of-way or easements through private lands where required; but the Contractor shall give due notice to tenants therein and shall be responsible for damage to property therein. Each building, wall, fence, pole, tree, lawn, or other property or improvement encountered, whether public or private, shall be carefully protected from all injury, and, in case of damage or removal, shall be completely repaired or restored to its original condition. All costs related to damage to such improvements shall be borne by the Contractor. Special care shall be taken in trenching under or near buildings to avoid or minimize all damage or injury thereto.
- E. Exploratory excavation shall be made when necessary to locate underground obstructions. Every pipe, conduit, foundation or other "underground structure" encountered in trenching shall be carefully protected from injury or displacement. All costs related to damage to such structures and pipelines or damage to property or persons resulting from damage to such

structures and pipelines shall be borne by the Contractor. Damage shall be completely repaired within a reasonable time. No claim shall be made for damage or delay of the work on account of the proximity of or the leakage from such structures and pipelines.

- F. Preparation of the site as specified above shall be considered as an integral part of the excavation, and no separate payment therefore will be allowed.
- G. Where high-pressure gas lines are to be crossed, they shall be uncovered by hand excavation methods before other excavation near them is started. No blasting operations will be allowed within 5' of gas pipes. Removal of rock in this area shall be done by jackhammer and/or hand excavation. The Contractor shall be responsible for the requirements of Georgia law with regard to blasting or excavating near gas pipes.

3.2 TRENCH EXCAVATION

- A. Trench excavation or excavation for pipelines shall consist of excavation necessary for the construction of sewer lines and all appurtenant facilities therefore, including sand or crushed stone cushion, and pipe protection as called for on the plans or as specified herein. It shall include site preparation, backfilling and tamping of pipe trenches and the disposal of waste materials, all of which shall conform to the applicable provisions of these Specifications.
- B. Trench excavation shall be made in open cut and true to the lines and grades shown on the plans or established by the Engineer, unless tunneling or boring is shown or specified. When practical, the banks of the trenches shall be cut in vertical, parallel planes equidistant from the pipe centerline. The horizontal distance between such planes - that is, the overall width of trench - shall vary with the size of pipe to be installed. The overall width of trench shall be 24" for pipe 6" in diameter and smaller and the pipe outside diameter plus 16" for pipe 8" in diameter and larger. When sheeting is used, the distance between vertical planes shall be measured from the inside faces of the sheeting. When vertical banks for trench excavation are not practical to construct or create conditions dangerous to workers, the banks may be sloped provided that such excavation does not damage adjacent structures. When trench banks are sloped, such banks shall be cut to vertical planes as specified above for that part of the ditch below the level of 12" above the top of the pipeline. The bottom of the trench shall be level in cross section and shall be cut true to the required grade of the pipe except where concrete cradles or cushion materials are shown on the plans, specified or authorized by the Engineer, in which case the excavation shall extend to the bottom of the cradle or cushion.
- C. Bell holes for bell-and-spigot pipe shall be excavated at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper installation of joints in the pipe. Bell holes shall not be excavated more than 10 joints ahead of pipe laying.
- D. Excavation for other pipeline structures shall be as specified for structural excavation.
- E. When muck, quicksand, soft clay, or other materials unsuitable for foundations or subgrade are encountered extending beyond the limits of the excavation, such material shall be removed and replaced with sand cushion as specified in these Specifications.

- F. Pipe trenches shall not be excavated more than 500 feet in advance of pipe laying, and all work shall be performed so as to cause the least possible inconvenience to the public. Temporary bridges or crosswalks shall be constructed where necessary to maintain vehicular or pedestrian traffic. Crosswalks and bridges shall have handrails or other features necessary for safe use by the public.
- G. Pipe trenches shall not be excavated in advance of the pipe laying a distance greater than that which can be completed within a day's operation. Trenches will not be allowed to remain open overnight. In areas where the excavation must remain open, adequate barricades and safety equipment shall be placed around the excavation to provide warning and protection to vehicular and pedestrian traffic.
- H. In all cases where materials are deposited along open trenches, they shall be placed so that, in the event of rain, no damage will result to the work or adjacent property.
- I. Excavation shall be considered as an integral part of laying pipe and no specific payment will be allowed, therefore.

3.3 SHEETING, SHORING AND BRACING

- A. The sides of all excavations shall be sufficiently sheeted, shored and braced whenever necessary to prevent slides, cave-ins, settlements or movement of the banks and to maintain the excavation clear of obstructions that will, in any way, hinder or delay the progress of the work or endanger workers. Wood or steel sheet piling of ample design and type shall be used when necessary. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressures exerted and to maintain the walls of the excavation properly in place and protect all persons and property from injury or damage.
- B. Where excavations are made adjacent to existing buildings or other structures or in paved streets or alleys, the Contractor shall take particular care to sheet, shore and brace the sides of the excavation adequately so as to prevent any undermining of or settlement beneath such structures or pavement. The Contractor will be liable for any damage to any structure or injury to any person that results from his operations.
- C. Sheeting and shoring materials shall be withdrawn as trenches are being backfilled, after backfill has been placed over pipe at least 18". If their removal before backfill is complete endangers any adjacent structure, they shall be left in place until backfill is complete and pulled then, if possible. Voids caused by sheeting withdrawal shall be backfilled and tamped with thin rammers designed for the purpose. If not withdrawn, sheeting shall be cut off at least 18" below surface.
- D. Sheeting, shoring and bracing shall be considered as an integral part of the excavation work and no specific payment will be allowed, therefore.

3.4 UNDERWATER EXCAVATION

- A. Where the excavation area shown on the plans falls under the groundwater surface or near the banks of a flowing stream or other body of water, the Contractor may adopt and carry out

any method he may deem feasible for the performance of the excavation work and for the protection of the work, thereafter, provided the method and equipment to be used result in completed work which complies with the Specifications and is acceptable to the Engineer. In such cases, the excavation area shall be effectively protected from damage during the excavation period and until all contemplated construction work therein has been completed.

- B. The cost of all temporary construction work necessary or incidental to work under water or in wet conditions, including the cost of installing and removing sandbags, coffer dams, sheet piling, excavation and backfill, pumping and dewatering, shall be considered as an integral part of the cost of excavation and no separate payment therefore shall be allowed or made.

3.5 BORROW EXCAVATION

- A. Wherever the backfill requires a volume of material that is in excess of the volume of suitable materials available from excavation or trenching, Contractor shall be responsible for obtaining additional backfill material from borrow pits which are acceptable to the Engineer.
- B. Borrow pits shall be properly cleared and grubbed and all objectionable matter shall be removed from the borrow pit material prior to its placement in the backfills.
- C. Borrow excavation shall be considered an integral part of the excavation work and no separate payment therefore will be allowed.

3.6 ROCK IN PIPE TRENCHES

- A. Rock encountered in trench excavation shall be removed for the overall width of trench which shall be a minimum of 12" plus the diameter of the pipe. It shall be removed to a depth of 6" below the bottom of the pipe if rock extends to such depth.
- B. The space below the ultimate pipe grade shall be filled with fine earth, sand, crushed stone, or other approved materials as required, compacted to proper grade and made ready for pipe laying. Unless otherwise specified or authorized by the Engineer, fine earth removed from the pipe trench shall be used as cushion material. Fine earth so used shall be thoroughly compacted with approved power tools. No allowance shall be made under this item for bell hole excavation. Bedding shall be included in the unit price proposed per foot of pipe.

3.7 DRILLING AND BLASTING

- A. Drilling and blasting methods used in rock excavation shall be optional with the Contractor but shall be conducted with due regard for the safety of persons or property in the vicinity of the work and in strict conformity with all laws, ordinances and of the work and in strict conformity with all laws, ordinances and regulations governing blasting and the use of explosives. Rock excavation near existing structures of all types shall be conducted with the utmost care and every precaution shall be taken to prevent damage to such structures. Any damage or injury of whatever nature to persons or property caused directly or indirectly by blasting operations shall be promptly repaired, replaced, or compensated for by the Contractor at his own expense and to the entire satisfaction of the persons injured or the owners of the property damaged.

3.8 BACKFILLING TRENCHES

- A. Place #57 stone for pipe bedding and hunch to 1 foot above the pipe.
- B. The backfilling of pipeline trenches shall be started immediately after the pipe work has been inspected and approved by the Engineer. Backfill material shall consist of fine loose earth free of large clods, stones, vegetable matter, debris, and/or other objectionable material. Backfill shall be deposited and compacted in accordance with the manufacturer's recommendations. If the trench extends along or across streets, roadways, proposed roadways, useable alleys or sidewalks, the remainder of the trench shall be backfilled and tamped to it full depth in the manner specified above with a minimum density of 95% Standard Proctor for the full depth. Otherwise, it may be filled with loose material without compaction. Where tamping of material is not required for the full depth of the trench, this material (from a height of one foot above the pipe upward) shall be as herein before specified, except that a broken stone content of not more than 50% by volume will be allowed of stones not exceeding 6" maximum dimensions, provided that these stones are thoroughly mixed with earth.
- C. Before being placed under pavement, earth material for backfill which is, in the opinion of the Engineer, too dry to allow thorough compaction, shall receive an admix of sufficient water prior to compaction to insure such compaction. Earth material considered by the Engineer to have excessive water content shall not be placed.
- D. Backfill material having less than a 10% clay content may be compacted by puddling with water in lieu of tamping when authorized by the Engineer. Such puddling shall consist of applying water under pressure to the entire content of the trench beginning near the trench bottom and working through pipes or well points.
- E. Backfill materials used shall contain a sufficient amount of moisture for proper compaction. In areas to be paved and areas not to be paved but inside road rights-of-way, the backfill shall be brought up in accordance with this Paragraph and compacted to not less than 95% of Standard Proctor.
- F. Compaction tests may be required at varying depths and intervals determined by the Engineer. Tests shall be made by a qualified independent testing laboratory selected by the Engineer. The Owner shall pay for all compaction testing. However, in the event that such tests fail to meet the requirements of the Specifications, the expense of such tests shall be borne by the Contractor.
- G. Where the test results indicate that compaction is less than the allowable minimum specified in this Paragraph, the material will be removed to the depths and limits determined by the Engineer and new material placed and compacted to minimum standards at no additional cost to the Owner.
- H. Where excavation has been made within the limits of finished areas across private property such as golf course, the top one foot of backfill material shall consist of fine loose earth free of large clods, vegetable matter, debris, stone and/or other objectionable materials.

- I. Where tamping of backfill, material is not required for the full depth, the backfill material shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation. Any deficiency in the quantity of materials for backfilling the trenches or for filling the depressions caused by settlement shall be supplied by the Contractor.
- J. Where pipe trenches are cut across pavement, the Contractor shall construct a temporary surface over the cut by filling and tamping the upper 6" of the cuts with selected gravel or crushed stone which will not disintegrate under the traffic, and which shall be maintained in good condition under traffic until the permanent pavement has been constructed. No specific payment will be allowed for temporary surfacing.
- K. All backfilling shall be done in a manner which will not disturb or injure the pipe or structure over or against which it is being placed. Any pipe or structure injured, damaged or moved from its proper alignment during backfilling operations shall be opened up and then re-backfilled as herein specified.
- L. The Contractor shall replace all surface materials and shall restore drives, curbing, sidewalks, gutters, shrubbery, fences, sod and other disturbed surfaces to a condition equal to that before the work began, furnishing all labor and materials incidental thereto. No payment for such items shall be made unless specifically stated in these Specifications and/or in the Bid Schedule.

3.9 SAND CUSHION

- A. Sand cushion shall consist of either coarse sand, gravel, or crushed stone. All cushion material shall pass a 1-1/2" screen and 90% shall be retained on 20 mesh screens. The material shall be handled on the job so that it will be kept clean and free of dirt, clay and other foreign matter and will retain its ability to pass water freely.
- B. Sand cushion shall be used, 1) at locations shown on the plans or when specified to provide bedding for pipe where rock has been removed from the trench; 2) in local areas where rock has been removed from the pipe trench and the excavated materials are not suitable for bedding the pipe; and 3) in local areas where unsuitable materials such as muck, quicksand, soft clay, swampy material or excessive groundwater make it necessary to provide a satisfactory pipe foundation.
- C. Sand cushion used to provide bedding for pipe where rock has been removed from the trench shall be placed to the overall width of trench, which shall be as specified in this Section. It shall be placed to the depth of 6" below the bottom of the pipe. Sand cushion used to provide additional bedding for pipe installed in deep cuts shall be placed to the width and depth shown on the plans or as directed by the Engineer.
- D. Sand cushion under structures shall be placed in the areas and to the depth shown on the plans or as authorized by the Engineer.
- E. Cushion material shall be compacted by tamping with suitable tools and shaped to receive the pipe and to support the full length of the barrel of the pipe at exact line and grade.

- F. All costs pertaining to sand cushion requirements contained herein shall be included in the unit price proposed per foot of pipe submitted in the Bid Schedule.

3.10 MAINTENANCE

- A. All excavated areas, backfills, embankments, trenches and access roads, grading and ditches shall be maintained by the Contractor in good condition at all times until final acceptance by the Owner. Where trench backfill has settled, trenches shall be rebackfilled.
- B. At the end of each work week, Contractor shall inspect road surfaces where excavations have been made and make all necessary repairs to the surfaces disturbed by the construction work.

3.11 PAVEMENT REPLACEMENT

- A. Where pipe trenches are cut across paved driveways a temporary surface, as specified in this Section, shall be provided before permanent pavement patch is made.
- B. Where pipe is installed running longitudinally with paving, installation of backfill shall be as specified in this Section.
- C. Payment for pavement replacement shall be per linear foot of pipeline covered and shall include excavation Class A concrete trench cap and surfacing material. Trench widths are considered to be widths as specified in this Section and extra paving width due to sloping trench sides shall be done at no additional cost to Owner.
- D. Contractor shall be responsible for any pavement replacement that is made necessary by construction equipment while working on off-road excavation.
- E. Where pipe trenches cut across or along dirt or gravel-based roads or driveways, installation of backfill shall be according to this Section.

3.12 BLASTING

- A. The Contractor shall comply with all laws, ordinances, applicable safety code requirements, and regulations relative to the handling, storage, and use of explosives and the protection of life and property. The Contractor shall be responsible for all damage caused by his blasting operations. Suitable methods shall be employed to confine all materials lifted by blasting within the limits of the excavation or trench.
- B. All rock which cannot be handled and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials except as specified or directed.

3.13 UNAUTHORIZED EXCAVATION

- A. Except where otherwise authorized, shown, or specified, all materials excavated below the bottom of concrete walls, footings, slabs on grade, and foundations shall be replaced, at no additional expense to the Owner, with concrete placed at the same time and monolithic with

the concrete above.

3.14 DEWATERING

- A. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter, until the structure to be built or the pipe to be installed therein is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.
- B. All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level beneath such excavations 12" or more below the bottom of the excavation.
- C. Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.
- D. The Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes and all such pipes or conduits shall be left clean and free of sediment.

3.15 DISPOSAL OF EXCESS EXCAVATION

- A. Transport excess excavated material, including unsatisfactory soil material, to any designated spoil areas, and spread as specified; otherwise remove from the Owner's property and construction site, and legally dispose of such material.

3.16 DISPOSAL OF WASTE MATERIAL

- A. Remove waste materials from Owner's property and legally dispose of such material.

3.17 SETTLEMENT

- A. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within one year after final completion of the Contract under which the work was performed.
- B. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the Engineer or Owner.

3.18 PROTECTION OF GRADED AREAS

- A. Protect newly graded areas from traffic and erosion and keep free of trash and debris.
- B. Repair and re-establish grades in settled, eroded, and rutted areas to specified compaction and tolerances.

3.19 RECONDITIONING COMPACTED AREAS

- A. Where completed compacted areas are disturbed by subsequent construction, adverse weather, or other cause, scarify surface, re-shape, and compact to required density prior to further construction.

END OF SECTION

**SECTION 31 23 34
EXCAVATION & FILL FOR STRUCTURES**

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of excavation, filling and grading is shown on the Contract Drawings.
- B. Excavating, filling and grading operations include, but are not limited to the following:
 - 1. Earthwork inside and outside structure limits.
 - 2. Preparation of subgrade for slabs and pavements.
 - 3. Providing borrow material.
 - 4. Spreading of topsoil.
 - 5. Finishing and dressing of graded surfaces.
 - 6. Maintaining graded areas including erosion and sediment control.

1.2 RELATED SECTIONS

- A. Section 01 50 00 Temporary Facilities and Controls
- B. Section 31 10 00 Site Clearing
- C. Section 32 92 00 Turf and Grasses
- D. Section 33 39 00 Sanitary Utility Sewerage Structures

1.3 SITE INFORMATION

- A. Verify existing site grades to be substantially consistent with grades shown on the Drawings before commencing work. Report any significant conflict in grades to the Engineer before proceeding.
- B. Subsurface conditions presented, if any, are not intended as representations or warrants of continuity of such conditions between soil borings or pits. It is expressly understood that the Contractor is solely responsible for interpretations or conclusions drawn there from. Data are made available for the convenience of the Contractor who may perform additional test borings and other exploratory operations at his expense, provided such operations are acceptable to the Engineer.

1.4 LABORATORY TESTS

- A. All laboratory tests to determine compliance of embedment and backfill materials with

specified requirements and to determine compliance with specified compaction requirements will be paid for by the Owner, except for retesting of failed samples, which will be at the Contractor's expense.

1.5 PROTECTION OF PERSONS AND PROPERTY

- A. Barricade open excavations and post warning lights for safety of persons. Operate warning lights during hours from dusk to dawn each day.
- B. Protect structures, utilities, sidewalks, pavements, and other facilities adjacent to excavations, from damage caused by settlement, lateral movement, undermining, washout and other hazards.
- C. Take precautions and provide necessary bracing and shoring to prevent movement or settlement of existing improvements or new construction.
- D. Use work methods and provide temporary facilities as necessary to prevent washing or siltation damage or hazard to persons and property, within and off the project site.

1.6 USE OF EXPLOSIVES

- A. Do not bring explosives onto site or use in work without prior written permission from authorities having jurisdiction. Use explosives in accordance with OCGA, Chapter 9, Title 25.
- B. Use explosives only as legally permitted and when other work methods are impractical.
- C. Do not permit explosives on the project site other than during the least practicable use period.
- D. Assume sole responsibility for handling, storage and use of any explosive materials.

PART 2 PRODUCTS

2.1 BACKFILL AND FILL MATERIALS

- A. Provide acceptable soil materials for backfill and fill, free of stumps, trees, roots, sod, muck, trash, and other deleterious matter.
- B. Handle, conserve, store and place excavated material to provide least desirable acceptable material at the bottom of fills and backfills and grade up to the best material at the top. Do not permit rock having any dimension in excess of two inches to be used in the top two feet of fill and backfill.

PART 3 EXECUTION

3.1 EXCAVATION

- A. Excavation consists of removal and disposal of material encountered to obtain required subgrade elevations.

- B. Borrow excavation consists of the removal and utilization of approved materials from authorized areas.
- C. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations, finished grade or dimensions without specific authorization of the Engineer.
- D. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending the indicated bottom elevation of the footing or base to the excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring excavation elevations to proper positions, only when acceptable to Engineer.
- E. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise requested by Engineer.

3.2 STABILITY OF EXCAVATION

- A. Slope sides of excavations to comply with local codes and authorities having jurisdiction. Shore and brace where sloping is not possible either because of space restrictions or stability of material excavated.
- B. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

3.3 SHORING AND BRACING

- A. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
- B. Maintain shoring and bracing in excavation regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
- C. Provide minimum requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

3.4 DEWATERING

- A. Perform earthwork in a manner to prevent surface water and minimize subsurface or ground water from flowing into excavations, and to prevent water from flooding project site and surrounding area.
- B. Do not allow water to accumulate in excavations. Remove water using dewatering methods which will prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
- C. Convey water removed from excavations and rainwater to collecting or run-off areas. Provide and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.

- D. Dewatering for wetwell excavation shall remain in place until top slab has been poured.

3.5 BORROW AND BORROW AREAS

- A. Obtain and use borrow only when there is an insufficient quantity of suitable material derived from project earthwork operations to complete earthwork and site grading and when authorized by the Engineer. (Borrow is not a pay item unless included on the Bid Schedule.)
- B. Borrow areas will be furnished by the Contractor.
- C. Reclaim borrow areas in accordance with local codes and authorities having jurisdiction. But in no case shall borrow area reclamation consist of less than the following:
 - 1. Drainage so as to prevent standing water.
 - 2. Grading, finishing and dressing as necessary so that excavated surfaces are left in a smooth, neat and even condition and are sloped not steeper than three horizontal to one vertical.
 - 3. Removing all trash, debris, rock, boulders, and other deleterious material from the borrow area.
 - 4. Vegetative planting in accordance with the requirements of Georgia Manual for Erosion and Sediment Control, latest version.

3.6 MATERIAL STORAGE

- A. Stockpile satisfactory excavated materials where authorized until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
- B. Locate and retain materials away from edge of excavations.
- C. Dispose of excess soil material and waste materials, such as unsatisfactory excavated soil material, trash and debris, as specified hereinafter.
- D. When select excavated materials are indicated on the Drawings for use in constructing fills or backfills, perform operations, including stockpiling and rehandling, as necessary to assure use of the most desirable materials at intended locations.

3.7 EXCAVATION FOR STRUCTURES

- A. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.1 feet. Extend excavation a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction required, and for inspection.
- B. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete is placed. Trim bottoms to required lines and grades so as to obtain a solid base on which to place concrete.

- C. When dewatering is required, the mass excavation must extend only to within 2 or 3 feet of the design bottom elevation. The remaining excavation should be performed in small sections after confirmation of adequate dewatering. As small sections of the subgrade are exposed, they should be inspected by the geotechnical engineer and then protected with a layer of crushed stone. Equipment traffic on the prepared subgrade should be avoided. Even with successful dewatering, it will probably be necessary to undercut localized areas of very weak subgrade soils and replace them with crushed stone based on geotechnical inspection at the time of construction.

3.8 GENERAL EXCAVATION

- A. Conform to elevations and dimensions shown. Remove exposed rock to a depth approximately one foot below finished grade. (Rock excavation is not a pay item unless included on the Bid Schedule).
- B. For areas designated for spreading of topsoil, carry excavation a uniform depth below finished grade by an allowance appropriate to attainment of required finished grade after placement of topsoil.

3.9 EXCAVATION FOR PAVEMENTS

- A. Undercut finished pavement lines to comply with cross-sections, elevations and grades, as shown.

3.10 EXCAVATION FOR CHANNELS

- A. Cut channels, ditches, and swales to shape and grades as shown. Deposit excavated materials a sufficient distance from the edge of channels and ditches to prevent cave-ins or material falling or sliding into excavation. Keep all waterways free of obstructions, debris and siltation until final acceptance.

3.11 REMOVAL OF UNSATISFACTORY SOIL MATERIALS

- A. To the extent authorized, over-excavate those soil materials which are unsatisfactory in the opinion of the Engineer. Such additional excavation, provided it is not due to fault or neglect of Contractor, will be measured and paid for as Additional Work at the Adjustment Price listed in the GENERAL REQUIREMENTS of these Specifications, unless otherwise provided in the Contract Documents.
- B. Where removal of unsatisfactory soil material is due to fault or negligence of Contractor in his performance of shoring and bracing, dewatering, material storage, or other specified requirements, excavate resulting unsatisfactory soil material and replace with satisfactory soil material at no additional cost.

3.12 COLD WEATHER PROTECTION

- A. Protect footing and foundation subgrades against freezing when atmospheric temperature is less than 35°F by covering with dry insulating materials of sufficient depth to prevent frost

penetration.

3.13 PERCENTAGE OF MAXIMUM DENSITY REQUIREMENTS

- A. Achieve not less than the following percentages of maximum density of soil material compacted at optimum moisture content, for each layer of soil material-in-place as determined by ASTM D698 (Standard Proctor) test procedures:
1. Structures: Under structures and within 10 feet outside of exterior walls, compact top 12 inches of subgrade and each layer of backfill or fill material to 98 percent of maximum density.
 2. Building Slabs and Steps: Under and within five feet outside perimeter of slabs and steps, compact top 12 inches of subgrade and each layer of backfill or fill material to 98 percent of maximum density.
 3. Berms and Liquid Holding Fills: Compact each layer of backfill or fill material to 98 percent of maximum dry density.
 4. Lawn or Unpaved Areas: Compact each layer of backfill or fill material to 88 percent of maximum dry density.
 5. Walkways: Under and within two feet horizontal distance of paved walks, compact top six inches of subgrade and each layer of backfill or fill material to 98 percent of maximum dry density.
 6. Pavements: Under and within entire roadbed, compact top 12 inches of subgrade and each layer of backfill or fill material to 98 percent of maximum dry density.
 7. Spoil Areas: Compact each layer of backfill or fill material to 88 percent of maximum dry density.

3.14 MOISTURE CONTROL

- A. Where subgrade or layer of soil material is too dry to achieve required compaction, uniformly apply water to surface of subgrade or layer in such manner as to prevent excessive free water from appearing on surface during or subsequent to compaction operations.
- B. Remove, dry and replace, or scarify and air dry in place, soil material that is too wet to achieve required compaction.

3.15 BACKFILL AND FILL - GENERAL

- A. Place acceptable soil material in layers, to required subgrade or finish grade elevations. Backfill excavations as promptly as work permits.

3.16 PRIOR TO BACKFILL PLACEMENT

- A. Backfill excavations as promptly as work permits, but not until completion of the following

EXCAVATION & FILL FOR STRUCTURES

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where applicable:

1. Inspection of Engineer of construction below finish grade, such as damp-proofing, waterproofing, perimeter insulation and similar work.
2. Inspection by Engineer and recording locations of underground utilities.
3. Removal of concrete formwork.
4. Removal of shoring and bracing and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities or leave in place as authorized.
5. Removal of trash and debris.
6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

3.17 PREPARATION OF GROUND SURFACE TO RECEIVE FILL

- A. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up sloped surfaces steeper than one vertical to four horizontal so that fill material will bond with existing surface.
- B. When existing ground surface has a density less than that specified under "Compaction" for the particular area classification, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.

3.18 PLACEMENT AND COMPACTION

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage of maximum density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- B. Place backfill and fill materials in uniform layers to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each lift.
- C. Do not mix excavated rock, masonry or concrete with backfill material placed within two feet of installed pipe.
- D. Spread stockpiled topsoil uniformly over areas designated for grassing or landscaping.

3.19 GRADING - GENERAL

- A. Uniformly grade areas within limits of earthwork, including adjacent transition areas.

Smooth and compact finished surface within specified tolerances, with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

- B. Grade area adjacent to structures to drain away from structures (except drainage inlets), and to prevent ponding. Finish surfaces free from irregular surface changes, and as follows:
 - 1. Grassed or Landscaped Areas: Finish areas to within not more than 0.10 feet above or below the required elevations.
 - 2. Walks and Pavements: Shape surface of areas under walks and pavements to line, grade and cross-section, with finish surface not more than 2 inch above or below the required subgrade elevation.

3.20 COMPACTION

- A. After grading, compact subgrade surfaces to the depth, percentage of maximum density, and elevation tolerance for each area classification. Retest for compaction as per Section 1.03 for each area disturbed.

3.21 PROTECTION OF GRADED AREAS

- A. Protect newly graded areas from traffic and erosion and keep free of trash and debris.
- B. Repair and re-establish grades in settled, eroded, and rutted areas to specified compaction and tolerances.

3.22 RECONDITIONING COMPACTED AREAS

- A. Where completed compacted areas are disturbed by subsequent construction, adverse weather or other cause, scarify surface, re-shape, and compact to required density prior to further construction.

3.23 DISPOSAL OF EXCESS EXCAVATION

- A. Transport excess excavated material, including unsatisfactory soil material, to any designated spoil areas, and spread as specified; otherwise remove from the Owner's property and construction site, and legally dispose of such material.

3.24 DISPOSAL OF WASTE MATERIAL

- A. Remove trash, debris, garbage, and waste materials to designated spoil areas. Spread material in layers approximately one foot thick and compact. Do not place waste material within two feet of finished grade.
- B. If no spoil areas are designated, remove waste materials from Owner's property and legally dispose of such material.

END OF SECTION

**SECTION 32 12 16
ASPHALT PAVING**

PART 1 GENERAL

1.1 PROJECT SCOPE

- A. The work covered by this Section of the Specifications consists of furnishing all materials, equipment, and labor necessary for clearing and grubbing, excavating, backfilling, grading, preparation of base and subbase, curb and gutter, paving, drainage structures and all other work as indicated on the Contract Drawings and/or as specified herein.

1.2 RELATED SECTIONS

- A. Section 31 10 00 Site Clearing
- B. Section 31 23 33 Excavation & Fill for Pipeline.
- C. Section 31 23 34 Excavation & Fill for Structures.

1.3 GENERAL

- A. The work include both new pavement and the full restoration of pavement due to construction related activities and as shown on Construction Drawings. Sections of existing pavement need to be replaced in their entirety as shown on the Construction Documents and required by these Specifications. The Contractor is responsible for the scheduling of all related work.

1.4 STANDARD SPECIFICATIONS

- A. The Standard Specification Construction of Roads and Bridges latest revision of the Department of Transportation, State of Georgia (DOT) shall govern in all matters. Such Specifications are hereby incorporated by reference into these Contract Specifications.

PART 2 PRODUCTS

2.1 CONTROL OF MATERIALS

- A. In accordance with Section 106, GDOT Standard Specifications, latest revision.

2.2 HOT MIX ASPHALTIC CONCRETE CONSTRUCTION

- A. In accordance with Section 400, GDOT Standard Specifications.

2.3 COLD MIX FOR PATCHING

- A. In accordance with Section 401, GDOT Standard Specifications latest revision.

2.4 BITUMINOUS PRIME

- A. In accordance with Section 412, GDOT Standard Specifications, latest revision; Viscosity grade MC-70.

2.5 BITUMINOUS TACK COAT

- A. In accordance with Section 413, GDOT Standard Specifications latest revision; Grade SS-1 or SS-1h.

2.6 GRADED AGGREGATE

- A. In accordance with Section 815, GDOT Standard Specifications, latest revision.

2.7 AGGREGATES FOR ASPHALTIC CONCRETE

- A. In accordance with Section 802, GDOT Standard Specifications latest revision.

2.8 HOT MIX ASPHALTIC CONCRETE MIXTURES

- A. In accordance with Section 828, GDOT Standard Specifications latest revision.
- B. Base course 19mm Superpave
- C. Surface Course 9.5mm Superpave

2.9 LIME

- A. In accordance with Section 882, GDOT Standard Specifications latest revision.

2.10 PAINT TRAFFIC STRIPING

- A. In accordance with Section 652, GDOT Standard Specifications latest revision.

2.11 PLASTIC PAVEMENT MARKINGS

- A. In accordance with Section 657, GDOT Standard Specifications latest revision.

PART 3 EXECUTION

3.1 HOT MIX ASPHALTIC CONCRETE CONSTRUCTION

- A. Work includes installation asphaltic concrete pavement construction and associated work as shown on the Contract Drawings and detailed in these Specifications.
- B. All work shall be performed in accordance with the appropriate sections of the GDOT standard specifications, latest revision.

3.2 TRAFFIC MARKINGS

- A. Work includes the installation of temporary traffic markings during the construction to safely direct the public during construction.
- B. Work includes the installation of permanent traffic markings to match existing traffic markings, restoration the traffic markings to original conditions prior to construction.

3.3 ACCEPTANCE

- A. Final payment is subject to Hall County acceptance for smoothness and trafficability.

END OF SECTION

**SECTION 32 31 00
CANTILIEVERD ENTRANCE GATE**

PART 1 GENERAL

1.1 GENERAL

- A. The existing entrance gate is to be removed and replaced. The cantilevered entrance gate shall be installed in the location shown on the Contract Drawings and shall be furnished complete with electric operator, as shown on the Contract Drawings.

1.2 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 31 10 00 Site Clearing

PART 2 PRODUCTS

2.1 GENERAL

- A. All tubular members shall comply with provisions of ASTM A120 for weight and coating. All structural and roll formed shapes shall conform to provisions of ASTM A123 for galvanized coating.

2.2 GATE POSTS

- A. Gate posts shall be 4-inch O.D. Galvanized Pipe (9.11 #/ft.).

2.3 TOP RAIL

- A. Top rail shall be 1.660" O.D. Galvanized Pipe (2.27 #/ft.) in standard lengths of approximately 21' with 6" couplings for each joint, one coupling in each 5 to have expansion spring. Top rail shall form a continuous brace from end-to-end of each run of fence.

2.4 CANTILEVER GATES

- A. Type: Cantilever
- B. 20' opening
- C. 6' tall with 3 strands of barb wire to match fence.
- D. 4" sch 40 Roller posts.
- E. 3" sch 40 Latch post.
- F. Poly, maintenance free, sealed bearing rollers with covers.

2.5 CANTILEVER SLIDE OPERATORS

- A. Lift master CSL24UL commercial slide gate operator w/ battery backup.
- B. Power supply: 120 Volt
- C. Concrete operator pad.
- D. Gooseneck pedestal, black.
- E. Liftmaster LMTBU safety beam.
- F. Liftmaster LMWEKITU wireless edge kit.
- G. Safety loops 6' x 20'
- H. Free exit loop 6' x 20'
- I. Liftmaster LOOPDETLT Loop detectors
- J. Key pad station with call box.
- K. Doorking 8040-090 Wiegand wireless receiver.
- L. Ground rods w/ clamps.
- M. Gates shall have 1.90" O.D. tubular member perimeter frames with additional horizontal and vertical members to ensure proper gates operation and for attachment of fabric hardware and accessories including 3 strands of barbed wire.

2.6 CONCRETE

- A. Concrete shall be furnished with a minimum compressive strength of 3,000 PSI at 28 days.

2.7 FABRIC

- A. Galvanized steel chain-link fabric shall be furnished in accordance with ASTM F 668, Type 2B. The core wire will be 9-gauge, woven to 2-inch squares, in a 6-foot-wide roll. The steel core wire shall be galvanized in accordance with ASTM A392. Continuous tension wire shall be provided at the lower edge of the mesh.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify areas to receive fencing are completed to final grades and elevations.
- B. Ensure property lines and legal boundaries of work are clearly established.

3.2 CHAIN LINK FENCE FRAMING INSTALLATION

- A. All posts shall be set in concrete footings having a diameter equal to 3 times the diameter of the post.
- B. Gate post shall be excavated to a depth of 6-inches below the post bottom, with the bottom of the post set not less than 36-inches below surface. Concrete shall be placed around posts in a continuous pour, tamped for consolidation.
- C. Check each post for vertical and top alignment and maintain in position during placement and finishing operations.
- D. Tension Wire: Provide tension wire at bottom of fabric. Install tension wire before stretching fabric and attach it to each post with ties. Secure tension wire to fabric with 12-1/2-gauge (0.0985") hog rings 24" on center.
- E. Top Rail: Install lengths, 21'. Connect joints with sleeves for rigid connections for expansion/contraction.
- F. Bottom Rails: Install bottom rails between posts with fittings and accessories.

3.3 CHAIN LINK FABRIC INSTALLATION

- A. Fabric: Install fabric on security side and attach it so that fabric remains in tension after pulling force is released. Leave approximately 2" between finish grade and bottom selvage. Attach fabric with wire ties to line posts at 15" on center and to rails, braces, and tension wire at 24" on center.
- B. Tension (stretcher) Bars: Pull fabric taut; thread tension bar through fabric and attach to terminal posts with bands or clips spaced maximum of 15" on center.

3.4 3.4 ACCESSORIES

- A. Tie Wires: Bend ends of wire to minimize hazard to persons and clothing.
- B. Fasteners: Install nuts on side of fence opposite fabric side for added security.
- C. Barbed Wire: Uniformly space parallel rows of barbed wire on security side of fence. Pull wire taut and attach in clips or slots of each extension.

3.5 CLEANING

- A. Clean up debris and unused material and remove it from the site.

END OF SECTION

**SECTION 32 92 00
TURF AND GRASSES**

PART 1 GENERAL

1.1 SCOPE

- A. Work under this Section shall include seeding or sodding all disturbed areas. Such areas shall be restored as nearly as possible to original condition.
- B. Sod replacement due to erosion on steep slopes will be done at no additional cost to the Owner.

1.2 RELATED SECTIONS

- A. Section 31 10 00 Site Clearing
- B. Section 31 23 33 Excavation & Fill for Pipeline
- C. Section 31 23 34 Excavation & Fill for Structures

1.3 DELIVERY, STORAGE AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer and indication of conformance with state and federal laws, as applicable.

1.4 PROJECT CONDITIONS

- A. Weather Limitations: proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 PRODUCTS

2.1 FERTILIZER:

- A. Before planting, a fertilizer of 10:10:10, or other approved composition, shall be hand-raked into the topsoil at a rate of 10 pounds per 1,000 square feet and then watered. Apply lime as per soil test made by Contractor.

2.2 SEED

- A. The area shall be seeded with either common hulled Bermuda, at a rate of 15 lbs. per acre, or Kentucky 31 tall fescue, at a rate of 50 lbs. per acre.

2.3 MULCHES

- A. The area shall be mulched with hay at a rate of 2-1/2 tons per acre.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
 - 1. Verify that no foreign or deleterious material or liquid such as concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, or chemicals has been deposited in soil within a planting area.
 - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable, and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements and other facilities, trees, shrubs and plantings from damage caused by planting operations.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus ½ inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.3 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions in right angles to each other.
- B. Do not use wet seed or seed that is moldy or otherwise damaged.
- C. Sow seed at a total rate of 3 to 4 lb./1,000 sq. ft.
- D. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly and water with fine spray.

3.4 3.4 CLEAN UP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks or other paved areas.
- B. All seeding shall be watered thoroughly as soon as completed and shall be watered at least twice daily, or more often is necessary, to provide continuous growth without setback until all growth from seed is thoroughly established.
- C. An acceptable stand of grass shall be obtained by the Contractor, as determined by the Engineer, and defined as covering 98% of the area to be grassed with no bare area greater than one square foot and the entire area fully stabilized against erosion.
- D. If the schedule of construction is such that grassing cannot be accomplished before final inspection of all other items of the Work, the Contractor shall obtain a signed proposal to the Owner for an approved local landscaper for the work specified. The Owner shall deduct the amount of the proposal from the final payment. The work of spreading and compacting topsoil shall be performed, as specified above, by the local landscaper at time of grassing and this work shall be included in his proposal.

END OF SECTION

**SECTION 33 11 00
DUCTILE IRON PIPING FOR WATER, PROCESS AND FORCE MAINS**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The work includes furnishing all material, labor, tools, equipment, skills, and incidentals necessary to construct required ductile iron water mains, force mains and process piping.

1.2 ORDER OF WORK

- A. The Engineer will designate the starting point, or points, for construction and the order in which the work shall be constructed, completed, and placed into operation for water mains and force mains. All other process piping is to be installed in the order required by the Contractor.

1.3 SINGLE SOURCE OF PIPE AND FITTINGS

- A. A single pipe manufacturer will be responsible for providing all pipe on this project. This pipe manufacturer will be responsible for the quality of all materials and shall provide a one-year warranty for all materials supplied for this project.

1.4 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00 Submittal Procedures.
- B. The Contractor shall submit for review fabrication and layout drawings. The submittal shall include all pipe, fittings, and valves to be installed for this project. For exterior piping in the yard, minimum scale is 1-inch equals 10 feet. For interior piping use minimum scale of 1/8 inch per foot.
- C. Layout drawings for each piping system showing the following as a minimum:
 - 1. Pipe material, class, grade, joint type, coating system and lining system.
 - 2. Joint and gasket dimensions.
 - 3. Use AWS welding symbols to show welded connections. Indicate the net weld length.
 - 4. Fittings, couplings, joints, and joint harnesses.
 - 5. Centerline elevations.
 - 6. Location, size, and type of anchor bolts.
 - 7. Wall and floor penetrations. Include sleeves, castings, sealant, escutcheons, and other accessories.

8. Complete bill of materials.
 9. Orientation of valves and valve operators.
 10. Critical clearances.
 11. Thrust restraint. Address materials, sizes, assembly ratings and pipe attachment methods for each type of pipe.
 12. Expansion compensation.
 13. Insulation.
 14. Pipe coatings.
 15. Pipe identification.
 16. Miscellaneous details required for a complete and functional installation.
- D. Laying schedules for underground piping systems. As a minimum, identify the following:
1. Pipe invert station and elevation at each grade and alignment change.
 2. Pipe length as measured along the centerline.
 3. Limit of each reach of pipe thickness class and joint restraint system. Include joint restraint design calculations.
 4. Limit of concrete encasement.
 5. Location of valves and other mechanical equipment.
 6. Details of special piping and fittings.
 7. Thrust block details. Include concrete quantity, bearing area on pipe and fitting locations.
 8. Joint information for dissimilar pipes.
 9. Joint deflection (both horizontal and vertical).
 10. Test pit information as indicated on the drawings and as required by the Engineer.
- E. Restrained joint details. Include:
1. Calculations.
 2. Drawings showing where each type of restrained joint is used. Mechanical joints may not be used as a restrained joint.

PART 2 PRODUCTS

2.1 GENERAL

- A. The Contractor shall furnish all materials and incidental items (whether or not they are specifically described herein) necessary to complete all work called for under the contract, except for any items that are specifically listed in these contract documents as being furnished by the Owner.

2.2 DUCTILE IRON PIPE

- A. Pipe: Pipe shall be ductile iron (D.I.P.) pressure class 350, designed and manufactured in accordance with the latest revision of ANSI/AWWA C151/A21.51.
 - 1. The Pressure Class or nominal thickness, net weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the manufacture's mark, country where cast, year in which the pipe was produced and the letters "DI" or "Ductile" shall be cast or stamped on each length of pipe.
 - 2. Pipe manufactured by American Cast Iron Pipe Company, US Pipe, and McWane Ductile meet the requirements of this specification. Therefore, pipe shall be manufactured by the above-named manufacturers. No substitution is permitted.
- B. Pipe Joints: Pipe joints shall be the type specified on the project plans. Restrained Joint Pipe shall be:
 - 1. For 30" through 42" DIP, restrained by Flex-Ring restrained joints TR Flex or HP Lok restrained joints.
 - 2. For 4" through 24" DIP, restrained by Fast-Grip or Field Lok gaskets inserted in Push-On Joints.
 - 3. For all mechanical joints, restrained by Megalug Glands by EBAA Iron, Inc. or approved equal.
 - 4. Standard "Push-On" type joints shall be in accordance with the latest revision of ANSI/AWWA C111/A21.11 and furnished complete with gaskets.
- C. Inspection and written certification that the pipe meets all applicable specifications will be required in accordance with section 51-4 of ANSI A21.51-81. A written transcript of foundry acceptance tests must be furnished in accordance with section 51-14 of ANSI A21.51-81. These documents must be forwarded to the Engineer prior to shipping the pipe.
- D. Fittings shall be ductile iron. Fittings shall conform to the latest revision of either ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. Fittings shall also have a cement-mortar lining on the interior in accordance with ANSI/AWWA C104/A21.4, of latest revision.

- E. Fittings and accessories less than 30-inches shall be furnished with Mechanical Type Joints in accordance with ANSI/AWWA C111/A21.11, or latest revision.
- F. MJ fittings manufactured by Sigma Corporation, Star Pipe Products or named pipe manufacturers meet the requirements of this specification. Therefore, fittings shall be as manufactured by the above-named manufacturers. No substitution is permitted.
- G. Fittings and accessories greater than 30-inches shall be HP Lok as manufactured by US Pipe or Flex-Ring by American Cast Iron Pipe Company. Therefore, pipe shall be as manufactured by the above-named manufacturers. No substitution is permitted.
- H. Coating and Lining:
 - 1. For buried pipe: The exterior of ductile iron pipe shall be coated with a layer of arc-sprayed zinc. The mass of the zinc applied shall be 200g/m² of pipe surface area. A finishing layer topcoat shall be applied to the zinc. The mean dry film thickness of the finishing layer shall not be less than 3 mils with a local minimum not less than 2 mils. All pipes shall be manufactured and coated in the United States at the pipe manufacturer's facility. Fittings shall be coated with Tnemec-Zinc 90-98-Zinc rich paint with 2.5-3.0 mils DFT, or approved equal, with 2.0 mil minimum and asphalt topcoat. Pipe and fittings shall be Protecto 401 ceramic epoxy lined. Air piping will be provided with no interior coating.
 - 2. For exposed piping: the exterior shall be the manufacturers standard prime coating suitable for painting after installation. The interior of the pipe shall be cement lined in accordance with ANSI/AWWA C104/A21.4, latest revision.
 - 3. For plant air piping exposed: the exterior shall be the manufacturers standard prime coating suitable for painting after installation. No interior cement lining.
 - 4. Potable water pipe and fittings shall be lined with a bituminous asphalt coating in accordance with ANSI A21.4 and AWWA C104, NSF 61 for water applications.
- I. Restrained Joints: Restrained gaskets shall be color other than the color of the pipe and shall be consistent throughout the entire cross section of the gasket. The color shall not be attained by surface coating; it shall be inherent within the rubber. Gaskets shall meet applicable requirements of AWWA/ANSI C111/A21.11 and shall be ANSI/NSF Standard 61 certified.
- J. Assembly of restrained pipe joints shall allow for a radius of not greater than 600-feet with no additional fittings.
- K. Gaskets:
 - 1. Flanged: Gaskets for use with flanged surfaces shall be full face bulb gasket, American Toruseal Flange Gasket for approved equal.
 - 2. Push on:

- a. Sewer: Styrene Butadiene Rubber (SBR) conforming to ANSI AWWA C104 (A21.11)
- b. Water: Styrene Butadiene Rubber (SBR) or EPDM in accordance with AWWA C104 (A21.11)
- c. Air: Viton (FKM) in accordance with ASTM D200

2.3 CASING PIPE

- A. Jacked casing pipe shall be a smooth steel pipe with a minimum yield point of 35,000 psi, meeting ASTM A53 or ASTM A139. The minimum wall thickness shall be as indicated below:

Nominal Diameter (Inches)	Nominal Thickness (Inches)
Under 14	0.188
14	0.219
16	0.219
18	0.250
20	0.281
22	0.312
24	0.344
26	0.275
28	0.375
30	0.406
32	0.438
34	0.469
36	0.469
42	0.500
48	0.625
54	0.750

2.4 GATE VALVES

- A. These valves shall be non-rising stem design, ductile iron body, bronze mounted with compression resilient seat manufactured in accordance with AWWA Standard C-515. Valves shall be designed for a minimum working pressure of 250 psi (except where plans call for a higher-pressure rating) and shall have 2" square operating nuts, except in meter vaults where handwheels shall be installed. The wedge shall be constructed of ductile iron fully encapsulated with EPDM rubber. Valves shall have non rising stems, shall open when turned to the left and shall meet AWWA Specifications. The valves shall have a flange connection conforming to ANSI B 16.1 when flanges are shown on the plans.
- B. Restrained valve ends shall employ a boltless positive joint restraint equal to the Flex-Ring joint. Friction style restrainers, which point load the adjoining pipe, will not be allowed.

- C. Gate valves shall be Series 2500 Flex-Ring RW Ductile Iron Resilient Wedge Gate Valve as manufactured by American Flow Control or approved equal.

2.5 VALVE BOXES

- A. Valve boxes shall be provided for all buried valves. Valve boxes for valves shall be approved standard cast iron, adjustable-shaft boxes having a minimum shaft diameter of 5-1/4 inches. The casting shall be coated with two coats of coal tar pitch varnish. The lids of all water main boxes shall bear the word "Water" or the letter "W". Boxes shall be equal to Vulcan Pattern VVB-4. Valve boxes shall be flush with the final grade after grading and / or paving.
- B. Valve extension stems shall be constructed with standard valve operating nut, 4-1/2" diameter x 1/4" steel guide plate, 1-1/4" square solid steel stem, and standard operating wrench coupling with four 3/8" set screws. The material shall be galvanized. The extension stem must be capable of surviving a torque test to 1000 ft-lb without failure. Extension stem shall be terminated two feet from finished grade.
- C. The valve box top and lid shall be constructed of ductile iron.

2.6 VALVE MARKER (NOT IN CONTRACT)

- A. One concrete valve marker shall be furnished and set at each valve located in the yard. The marker shall be made of 3000 psi concrete and shall be four (4) feet long and 4" on each side, with #4 reinforcing bars as shown on the detail.
- B. The markers shall be set an even number of feet between the center line of the valve and the center line of the aluminum disc in the top of the marker, and the distance in feet between the valve and marker shall be stamped in the marker at the time of setting.

2.7 COMBINATION AIR AND VACUUM RELEASE VALVES

- A. Air release and vacuum break valve shall be of the compact single chamber design with solid cylindrical HDPE control floats housed in a tubular stainless-steel body with epoxy powder coated cast iron or steel ends secured by stainless steel tie rods. The valve shall have an integral orifice mechanism, which shall operate automatically to limit transient pressure rise induced by closure to twice valve rated working pressure. The intake orifice shall be equal to the nominal size of the valve. The flat face or the control float seating against a nitrile rubber O-ring housed in a dovetail groove circumferentially surrounding the orifice shall affect large orifice sealing. The seating and unseating of a small orifice nozzle on a natural rubber seal affixed into a control float shall control discharge of the pressurized air. The nozzle shall have a flat seating land surrounding the orifice so that damage to the rubber seat is prevented. All components shall be easily replaced. Connection to valve inlet shall be flanged.
- B. The valve shall be Vent-O-Mat series RBX. No substitution permitted.

2.8 MEGALUGS

- A. Restraint devices for nominal pipe sizes 3 inch through 48 inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10. The devices shall have a working pressure rating of 350 psi for 3-16 inch and 250 psi for 18-48 inch. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 BHN. Three (3) test bars shall be incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation shall be done in accordance with ASTM E8. Chemical and nodularity tests shall be performed as recommended by the Ductile Iron Society, on a per ladle basis.
- B. Restraint devices shall be Listed by Underwriters Laboratories (3" through 24" inch size) and Approved by Factory Mutual (3" through 12" inch size).
- C. Restraint devices manufactured by EBBA Iron Sales, Inc., Sigma Corporation, and Star Pipe Products meet the requirements of this specification. Therefore, restraint devices shall be as manufactured by the above-named manufacturers. No substitution is permitted.

2.9 SUBGRADE STABILIZER

- A. Subgrade stabilizer shall consist of crushed stone meeting size and graduation requirements for GDOT #57 or #56 designation.
- B. The use of recycled concrete is NOT permitted.

2.10 SAND FOR BACKFILL

- A. Sand for backfilling over water mains, when required, shall be coarse, well graded sand relatively free from dirt and other foreign matter. Sand shall be approved by the Engineers.

2.11 BORROW MATERIAL

- A. Borrow material may be either:
 - 1. Material hauled from borrow areas outside the project area.
 - 2. Suitable material that is excavated from the pipe trench and is unsuitable for immediate use as backfill due moisture.
- B. The Contractor shall identify the source of borrow material, have performed the geotechnical testing of the material to determine its suitability as a backfill material, transport the material to the project, and place the material to specified soil density. Final determination of the suitability of the material is the responsibility of the Engineer. The Contractor may choose to stockpile suitable material from the pipe trench that is too wet for immediate use as backfill material. The Contractor shall identify a procedure for drying the material to the optimum

moisture content; either through air drying or the addition of lime. This procedure is subject the review of the Engineer and acceptance by the Engineer. The Contractor shall transport the material to the project and place the material to specified soil density. Final determination of the suitability of the material is the responsibility of the Engineer.

2.12 FLEXIBLE (TRANSITION) COUPLINGS

- A. Flexible couplings shall be Catalog No. 441 as manufactured by Smith-Blair, JCM 215 Long DI Coupling by JCM Industries, or approved equal.

2.13 PIPE CONNECTION COUPLINGS

- A. Pipe connections between new pipe and existing pipe shall be made with Dresser Style 90 long steel couplings for pipe sizes 2" and below; for pipe sizes above 2", M.J. solid sleeves (long style) shall be used. Spacer rings must be used at all solid sleeve locations. A spacer ring is defined as a short section of pipe cut to fit into the gap between the two plain ends of pipe at the sleeve location.

2.14 FLANGE ADAPTOR

- A. Contractor shall furnish and install ductile iron flange adapters to joint plain-end pipe to flanged pipe where shown in the Drawings. Adapters shall be manufactured to meet ASTM A-536, high strength ductile iron. Flange end of adapter shall mate with ASA 16.1 and B16.5 flanges of the same nominal size. T-head bolts and nuts shall be high-strength, low alloy steel pins conforming to ANSI/AWWA C111/A21.11. Adapters shall be Sigma SIGMAFLANGE, EBAA Iron, Inc. MEGAFLANGE Series 2100, or equal.

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING

- A. Where necessary, the construction zone will be cleared to allow trenching and pipe laying operations. Clearing will be restricted to easement limits shown on plans, plus areas within the highway right-of-way. The cleared area shall be left free of stumps, limbs, rocks and other debris. Cleared areas in forested zones will be left in a condition suitable for bush-hog cutting; areas adjacent to lawns shall be left suitable for lawn mower cutting and at least in as good a condition as the adjoining property. Trees, brush, stumps and other debris from clearing and grubbing shall be disposed of in accordance with local ordinances (which place restrictions on burning); burial within the right-of-way or easement will not be permitted.
- B. The Contractor is responsible for restoring any property (shrubs, signs, sidewalks, paving, trees, structures, etc.) that is damaged by his operations. It is understood that any item which is not specifically listed as a pay item but which exists at the time the project is bid is included in the overall bid price.

3.2 FENCES

- A. The Contractor shall take down fences on or crossing right of way for such periods of time

only as are necessary to prosecute the work of clearing, grubbing, trenching, pipe laying and backfilling. Gaps made in fences shall be closed in substantial manner at night and during any suspension of work, and, upon completion of the pipeline, fences shall be restored to as good condition as before disturbed. No charges shall be made by the Contractor for any expense incurred in taking down or restoring fences, except where listed in the bid proposal.

3.3 PROTECTION OF TREES

- A. The Contractor shall remove only such trees on or along the work as necessary and shall carefully protect all other trees adjacent to the work. He shall not permit excavating machinery or trucks to scrape the bark or tear the limbs from the trees, nor connect ropes or guy cables to them.

3.4 INTERFERENCE WITH EXISTING STRUCTURES

- A. All existing pipes, drains, or other structures on, above, or below ground shall be carefully supported and protected from injury, and if injured, they shall be restored in a satisfactory manner by and at the expense of the Contractor.

3.5 INFORMATION CONCERNING CONDITIONS

- A. The accuracy of information furnished by the Engineer and/or the plans and specifications as to underground and surface structures, foundation conditions, character of soil, position and quantity of ground and subsoil water, etc., are not guaranteed by the Owner. Bidders must satisfy themselves by personal examination and by such other means as they desire with respect to actual conditions in the nature of the ground and subsoil water and in regard to the locations of existing underground or surface structures. Unforeseen conditions shall not constitute a claim for increased compensation under the terms of the contract, nor constitute a basis for the cancellation thereof.

3.6 CLEAN UP

- A. The Contractor shall remove all unused material, excess rock and earth, and all other debris from the construction site as closely behind the work as practical. All trenches shall be backfilled and tamped before the end of each day's work.
- B. If at any time during the course of the work, the cleanup, grassing and/or pavement replacement falls too far behind the pipe laying (at the discretion of the Engineer) the Contractor shall be required to close down pipe laying operations until the cleanup, grassing and/or pavement replacement is caught up to the work in progress.

3.7 TRENCH EXCAVATION

- A. Pipe trenches shall be straight and true to grade and, in the location, shown on the plans. The bottom of trenches shall be dressed to facilitate laying conditions called for on construction plans. For Type 5 laying conditions, the pipe shall be bedded to its centerline in suitable material as determined by the Engineer excavated from the site or in compacted stabilizer stone with a minimum of 4" under pipe. Suitable materials shall be clean and free of rock

larger than 2 inches at its largest dimension, organics, cinders, stumps, limbs, frozen earth or mud, man made wastes and other unsuitable materials. Should the material excavated from the trench be saturated, the saturated material may be used as earth material, provided it is allowed to dry properly and it is capable of meeting the specified compaction requirements. The bottom of the trenches shall be dressed so that the pipe has an even bearing on bedding material throughout the entire length of the pipe barrel.

- B. All trenches shall be of sufficient width to provide ample working space on each side of the pipe for maintaining a straight line of pipe, and bell or coupling holes of sufficient size to allow making perfect joints shall be provided at all joints.
- C. Water lines shall have a minimum cover of 48-inches unless otherwise specified or shown on the drawings. The depth of cover shall be a minimum of 48-inches below grade, 48-inches below the edge of pavement, or 48-inches below the drainage ditch paralleling the road, whichever is deepest. All changes in grade shall be made gradually.
- D. In laying pipe across water courses, railroad crossings, or depressions of any kind, the minimum depth herein specified shall be maintained at the bottom of the depression.
- E. Where necessary, the line shall be lowered at valves so that the top of the valve stem is approximately one foot below the finished grade. The trench shall be deepened to provide a gradual approach to all low points of the line, and no additional payment shall be allowed for extra excavation involved.
- F. The Engineer shall have the right to limit the amount of trench open at any one time.
- G. All excavation material shall be so placed so as not to interfere with public travel on the streets and highways along which the lines are laid. All excess excavated material shall be disposed of without extra cost to the Owner.

3.8 LAYING PIPE

- A. All pipes, before being placed in trench, shall be examined, and any pipe showing defects shall be rejected. The inside of the pipe shall be clean and free of trash and dirt, and if necessary a swab or brush shall be used to clean the pipe before lowering it into the trench.
- B. All pipes shall be laid straight, true to line and grade. For all laying conditions, bell and coupling holes shall be dug to allow the pipe to have continuous bearing with bedding throughout the entire length of the barrel between bell or coupling holes. No shimming or blocking up of the pipe will be allowed. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods. Trench dewatering methods (gravel bedding with pumps, etc.) must be used where necessary to maintain a dry ditch during pipe laying operations.
- C. In making ductile iron joints, the outside of the spigot end of the pipe and the inside of the bell shall be thoroughly cleaned and the gasket inspected to see that it is properly placed. Lubricant shall be applied to the spigot end of the pipe and gasket and it shall be inserted into

the bell of the adjoining pipe to the "Stop Mark" shown on the pipe. Joint deflection shall be checked by Contractor for compliance with the pipe manufacturer's recommended limits.

- D. As pipe is installed, each joint shall be air tested for leakage. A dual bladder system allowing for the testing of deflected (up to 5%) DI pipe. The dual bladders shall seal the pipe joint on both sides of the joint permitting the pressuring of the joint up to a minimum of 5 psi for 5 seconds. If the joint fails to maintain the air pressure, the pipe shall be re-installed and re-tested. Equipment shall be similar to equipment produced by Petersen Products Co.

3.9 BACKFILLING

- A. After the pipe has been laid and all joints have been made, the trench shall be backfilled as described on the detail sheet of the construction plans for the Type 3 and Type 5 condition that shall be used throughout this project.

- 1. Type 3:

- a. Backfill shall be bedded in 4" minimum loose, select soil material. Backfill lightly consolidated to top of pipe.

- 2. Type 5:

- a. Backfill shall be granular or select material free from rocks and foreign material compacted to the top of the pipe. It shall be tamped in layers not over 6 inches thick to at least 100% standard proctor, AASHTO T-99. Remainder of backfill to top of trench shall be tamped in layers not over 12 inches thick (6 inches under roads) to 100% standard proctor, AASHTO T-99. Under roadways, the top 12 inches of backfill shall be compacted to 100% standard proctor, AASHTO T-99.
 - b. Tamping shall be done with mechanical tamps in such a manner as to meet compaction requirements without moving or injuring pipes. Compaction shall be done with either pneumatic hand tamps, hydro tamps or other approved methods. Compaction tests will be run as directed by Engineer to ensure that the above specifications are being met.
 - c. In rock excavation, the backfill from the bottom of the trench to two feet above the top of the pipe shall be finely pulverized soil, free from rocks and stones. The rest of the backfill shall not contain over 50% broken stone, and the maximum sized stone placed in the trench shall not have a weight exceeding 25 pounds. Excess rock and fragments of rock weighing more than 25 pounds shall be loaded and hauled to disposal as directed by the Engineer. If it is necessary, in order to comply with the above specifications, selected backfill shall be borrowed and hauled to the trenches in rock excavation, at no additional cost to the Owner. Under no circumstances shall bottom of pipe rest against rock or unyielding material. Minimum bedding of 4" carefully compacted backfill shall separate bottom of pipe from rock or unyielding material.
 - d. Pipe trenches crossing highways shall be backfilled with select material during

backfilling; the optimum amount of moisture shall be added and compacted to minimum of 95% standard proctor. The pavement shall be replaced immediately after backfilling is completed.

3.10 ROCK EXCAVATION

- A. All material shall be considered as trench rock if the material has an original volume of at least on-half cubic yard and the material cannot be excavated with a hydraulic excavator having a minimum flywheel power rating of 123 kw (165 hp); such as a Caterpillar 322 C L, John Deere 230 C LC or a Komatsu PC220L-C-7; equipped with a short tip radius bucket not wider than 42 inches.
- B. The Contractor shall notify the Engineer when rock is encountered. Rock will be removed to a depth of six inches below normal bottom and this area below the pipe will be backfilled with select material. NO separate payment will be made for rock excavation.
- C. Rock excavation by blasting shall be at least 75 feet in advance of pipe laying.
- D. Before blasting, the Contractor shall cover the excavation with heavy timbers and mats in such manner as to protect the adjacent property Owners from damage. The Contractor will be held responsible for all damage done.

3.11 THRUST RESTRAINT

- A. General: At changes in direction of the main and at other points shown on the plans or directed by the Engineer, thrust forces in the line shall be absorbed by restrained joints, concrete blocking, or reinforced concrete collars, or a combination thereof.
- B. Restrained Joints: Where restrained joint is called for on the construction plans, they shall be of the type specified in these specifications, and assembly shall be in accordance with manufacturer recommendations. Torque wrenches shall be used to verify that all bolts and nuts have tightened to manufacturer's recommendations.
- C. Concrete Blocking: The Engineer shall be notified by the Contractor before blocking is placed. Blocking will be of the dimensions called for on the construction plans and will be placed against a vertical surface of undisturbed soil that has been cleared of all loose material.
- D. Reinforced Concrete Collars: Reinforced concrete collars shall be cast in place as shown on detailed plans and as specified in ACI 318 83.

3.12 LEAKAGE TEST

- A. Pressurization:
 - 1. After the pipe has been laid, all newly laid pipes or any valved section thereof shall be subjected to a hydrostatic pressure of 150 psi at the lowest point. Each valved section of pipe shall be slowly filled with water, and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the

elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Owner. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. It is good practice to allow the system to stabilize at the test pressure before conducting the leakage test.

2. If the Contractor intends to perform hydrostatic testing against existing valves which are in service, the Contractor must obtain permission from the Owner. Prior to testing, the Contractor shall disinfect the pipeline in accordance with the requirements of Paragraph 3.14. If, after repairs are made to the pipeline to correct leakage test deficiencies, the Engineer deems that the sanitation of the pipeline has been compromised, the Contractor shall disinfect the pipeline at the Contractor's expense.
- B. Air Removal: Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed, and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the Owner.
- C. Leakage Defined: Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipes or any valved section thereof to maintain the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section.
- D. Minimum test period shall be two hours. However, if in the opinion of the Engineer additional testing is required, such additional testing shall be performed by the Contractor at no additional expense to the Owner. Leakage shall NOT exceed the following gallons per hour per 1,000 feet of pipe:

Pipe Size	Allowable Leakage
4	0.38
6	0.57
8	0.76
10	0.96
12	1.15
16	1.53
20	1.91
24	2.29
30	2.87
36	3.44
42	4.01

- E. Test Restrictions:
 1. The hydrostatic test shall be of at least 2-hour duration. Test Pressure shall not vary by more than +5 psi for the duration of the test; this may require periodic pumping.
 2. Valves shall not be operated in either direction at differential pressure exceeding the rated valve working pressure. Use of a test pressure greater than the rated valve pressure

can result in trapped test pressure between the gate of a double-disc gate valve. For tests at these pressures, the test setup should include provision, independent of the valve, to reduce the line pressure to the rated valve pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or fully opened is desired.

3. Test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.

3.13 DISINFECTION

- A. After leakage testing and all necessary repairs have been made, the lines shall be flushed clean and then disinfected (**water mains only**) in strict accordance with AWWA Standard for Disinfecting Water Mains, C651- latest edition, subject to the following special conditions:
 1. The method of disinfection shall be either the Continuous-Feed Method or the Slug Method. The Tablet Method is not acceptable.
 2. The form of chlorine may be either: (1) a 1 percent solution made from either sodium hypochlorite or calcium hypochlorite and pumped and metered into the pipeline; or (2) liquid chlorine fed from a pressurized cylinder through a gas-flow chlorinator and metered into the pipeline. With either form, water must be flowing during the feeding operation and the injection point must be located so that the flow of water will disperse the chlorine throughout the pipeline.
 3. Unless otherwise approved by the Owner, Contractor shall dechlorinate the highly chlorinated water being flushed from the pipeline.
 4. The Owner shall be responsible for bacteriological sampling and testing water from the disinfected pipeline.
 5. Before any flushing or disinfection work is begun, the Contractor shall submit procedures for these tasks in accordance with Section 01 33 00 – Submittal Procedures.
- B. The Contractor is responsible for the installation and removal of sample points as required by AWWA C651 on the water main.

3.14 DECHLORINATION

- A. After the disinfection process has been completed, the heavily chlorinated water shall be flushed from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the distribution system or is acceptable for domestic use. The area where the chlorinated water is to be discharged shall be inspected. If there is any possibility that the chlorinated discharge will cause damage to the environment, then a neutralizing chemical shall be applied to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water.

- B. The chlorine residual of the water being disposed may be neutralized by treating the water with ascorbic acid or sodium ascorbate. Minimum dosage requirements are listed in the table below. Additional dosage for the complete neutralization of chlorine residual is the responsibility of the Contractor.

Chlorine	Ascorbic Acid	Sodium Ascorbate
1 Kg	2.5 Kg	2.8 Kg
1 Lb	2.5 Lb	2.8 Lb

3.15 CONNECTION TO EXISTING MAINS

- A. At beginning of construction, the Contractor shall make exploratory excavation at each location where connections to existing pipes are shown for the purpose of determining the exact location, elevation and type of fittings required to make the connections. Where it is necessary to disrupt service on existing lines, the Contractor shall first obtain permission from the Owner and schedule his work accordingly.
- B. Where existing pipe is to be abandoned, the Contractor shall plug the opening by pouring concrete in an around the opening as needed to completely seal the opening.

3.16 SETTING VALVES

- A. Valves shall be placed where shown on the plans or directed by the Engineer. Valves shall be set plumb and shall have cast iron valve boxes and/or manholes as called for on the plans. The valve boxes shall be placed directly over the valve and set plumb; the top of the box being brought to the surface of the ground. After the boxes are in place, earth shall be filled in the trench and thoroughly tamped around the box, and after all settlement has taken place, each valve box shall have a concrete collar as shown on the plans.

3.17 VALVE STEM EXTENSION

- A. Valve stem extensions shall be installed within two feet of finished grade at all buried valves except for those for which a manhole is being provided.

3.18 INSTALLATION OF SOLID SLEEVES

- A. Spacer rings must be used with all solid sleeves and no exceptions will be allowed. When connecting to existing water lines, one full length joint of pipe must be installed between solid sleeves and adapter pieces.

3.19 FLANGED OUTLETS

- A. Where flanged outlets are shown on the plans, they shall be installed as recommended by the manufacturer. When attaching a valve to the outlet, the valve and tapping machine, when used, shall be supported to relieve stress on the outlet fixture. The hole in the ductile iron pipe may be cut by either a mechanical tapping machine or by use of a cutting torch.

3.20 MEGALUG

- A. When installing the Megalug gland, clean the inside of the pipe bell and lubricate both the Megalug gasket and the spigot end of the pipe. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket. Insert the pipe into the pipe bell and press the gasket firmly and evenly into place. Keep the joint straight during assembly. Push the gland toward the pipe bell and center it around the pipe with the gland lip against the gasket. Install bolts and hand tighten nuts. Make any required deflection after joint assembly and before the bolts are tightened. Tighten the bolts to the manufacture's recommendation for the gland size. Tighten the twist-off bolts per manufacture's recommendation. Should removal of this application be necessary, this should be done in accordance with manufactures recommendation.

3.21 SPECIALS AND FITTINGS

- A. Specials and fittings shall be properly braced to ensure that they will not be blown off or broken loose under the greatest possible working pressure, where it is necessary to use concrete to block vertical bends, etc., the concrete will be included in the Lump Sum Price as shown on the Bid Schedule.

3.22 REMOVE & DISPOSE OF EXISTING APPURTENANCES

- A. Where called for on the plans, all existing above ground appurtenances shall be removed and disposed of by the contractor after prior approval and refusal from the Owner. The area where these appurtenances are removed shall be re-graded and grassed to match the existing landscaping.

3.23 REMOVE & DISPOSE OF EXISTING WATER MAIN

- A. Where called for on the plans, existing ductile iron piping shall be removed and disposed of by the Contractor after prior approval and refusal from the Owner. The Contractor will be responsible for proper disposal of the existing piping off site.

3.24 REMOVING AND REPLACING PAVEMENT

- A. General: Removing and replacing pavement bituminous or concrete shall consist of removing the type of pavement and base encountered and replacing same as shown on the detailed drawings. Pavement shall be removed only as necessary to install piping.
- B. Subgrade: The trench shall be backfilled in layers not more than 6" thick and shall be thoroughly compacted with mechanical tamps. No base course shall be placed on loose earth or dusty material.
- C. Bituminous Pavement: Bituminous pavement shall be replaced with base as shown on drawings and 1 1/2" of asphaltic concrete topping. Edges of cut pavement shall be neatly squared off. Then the base and edges shall be primed with a tack coat of AC 15 or equal, applied at the rate of 0.25 gallons per square yard prior to placement of asphalt topping. Extreme care shall be executed to assure that the squared edges of existing pavement will not

be broken or disturbed during rolling of 1 1/2" asphalt topping.

- D. Binder and Base Pavement Replacement: Replace binder and base bituminous pavement courses following installation in accordance with Contract Drawings.

3.25 REMOVE & REPLACE CONCRETE SIDEWALK

- A. Debris from sidewalks removed shall be collected and hauled away and disposed of by the Contractor in an approved disposal area. Sidewalks shall be replaced with Portland Cement Concrete of not less than 3,000 psi compressive strength at 28 days of age. Sidewalks shall be replaced to the original width and thickness or a minimum of 4" thick. The sidewalks shall have a broom finish. All instructions in Placing of Concrete in these specifications shall be adhered to.

3.26 REMOVE & REPLACE CULVERTS (ALL SIZES & TYPES)

- A. When culverts are encountered during the construction of the pipeline, the said culvert shall be removed and then replaced upon installation of the pipeline. If the culvert, in the opinion of the engineer, is damaged beyond use the contractor shall be responsible for replacing new culvert pipe to match the existing pipe.

END OF SECTION

**SECTION 33 14 19
HYDRANTS**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The work to be done under this Section of the Specifications consists of furnishing all materials and performing all labor necessary for the complete the installation of fire hydrants, as indicated on the Contract Drawings and/or specified.

1.2 GENERAL

- A. All materials used in the construction shall be new and unused when delivered to the site and shall be subject to inspection by the Engineer before installation.

1.3 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 01 78 23 Operation and Maintenance Data
- C. Section 01 45 34 Product Delivery Storage and Handling

1.4 SUBMITTALS

- A. submit for review in accordance with Section 01 33 00.
- B. Submit manufacturer's catalog data, descriptive literature, and assembly drawings. Show dimensions, materials of construction by specification reference and grade, and coatings.
- C. Submit Operation and Maintenance Manuals in accordance with Section 01 78 23.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle, and store the equipment in accordance with Section 01 45 34.

1.6 WARRANTY

- A. The manufacturer shall warrant in writing all equipment against defects in materials and workmanship for a period of 12 months from the date of substantial completion. Within this 12-month period, any defective or malfunctioning equipment, component, or accessory shall be repaired or replaced upon notice at no additional cost to the Owner.
- B. Refer to Section 01 70 00 for additional information.

PART 2 PRODUCTS

2.1 FIRE HYDRANT

- A. Fire hydrants shall conform to the latest requirements of AWWA C502, be the traffic type, dry top, 5-1/4-inch valve opening with O-ring seals, three-way only.
- B. The three-way hydrants are to have two, 2-1/2-inch NST hose nozzles and one, 4- 1/2-inch NST hose nozzle.
- C. The main valve shall be rubber faced, shall seat against a bronze seat, and shall open against pressure. Hydrants shall range from 3-foot to 5-foot bury with 6-inch mechanical joint inlet connection.
- D. Operating nuts shall be pentagon (1-1/2-inch point to flat) and shall open by turning counterclockwise.
- E. All fire hydrant laterals shall have 6-inch gate valves and valve boxes. Fire hydrants shall be as manufactured by Clow or M & H.

2.2 HOSE BIBS

- A. Hose bibs shall be furnished and installed where shown on the Drawings and shall be 3/4", non-freeze type with brass casings and T-handle. Furnish 1 quick female coupling hose fitting for each hose bib.

2.3 WALL HYDRANTS

- A. Wall hydrants shall be cast brass, non-freeze with 1" HPT outlet, T-handle, polished face, brass wall casing, renewable nylon seat, and brass operating parts. Wall hydrants shall be Josam Model 71000-8, Wade Model W8600L6+2, or equal.

2.4 POST HYDRANTS

- A. Post hydrants shall be non-freezing, self-draining type. These hydrants will be furnished with a 2" FIP inlet, a non-turning brass operating rod and galvanized casing pipe. Hydrant shall open to the left. All working parts shall be bronze to bronze design and serviceable from above grade with no digging. The outlet shall also be bronze with a 1" NST nozzle. Hydrants shall be Model TF-300 manufactured by Kupferle Foundry Co., Model 8900-97 manufactured by Wade, or equal.

2.5 YARD HYDRANTS

- A. Yard hydrants shall be 1" post hydrant with galvanized casings 1" inlet and discharge hose connections, non-freeze with vacuum breaker and sanitary siphon drain system. Yard hydrants shall be Josam Model 71400-91, MIFAB MHY-68-0 or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install hydrants at locations indicated and in accordance with AWWA M17.
- B. All fire hydrants shall be connected to the water main with a 6-inch ductile iron pipe lead. PVC pipe will not be allowed for fire hydrant leads.

3.2 COATINGS

- A. All fire hydrants shall be painted in accordance with AWWA C502, Section 2.22 and Section 4.5. The color shall be silver and red (silver with a red top). Use Sanders Paint, Product No. A400 Aluminum, Metal Bright, or equal.

END OF SECTION

**SECTION 33 31 00
SANITARY UTILITY SEWERAGE PIPING**

PART 1 GENERAL

1.1 SCOPE

- A. The work to be done under this Section of the Specifications consists of furnishing all materials and equipment and performing all labor necessary for the complete construction of the gravity sewer system including all sewer pipe, house service lines and other appurtenances as indicated on the Contract Drawings and/or specified.

1.2 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 31 23 33 Excavation & Fill for Pipeline
- C. Section 33 39 00 Sanitary Utility Sewerage Structures

1.3 GENERAL

- A. All materials used in the construction shall be new and unused when delivered to the site and shall be subject to inspection by the Engineer before installation.

1.4 APPROVED BORING CONTRACTORS

- A. Strack, Inc.
125 Laser Industrial Ct., Fairburn, GA 30213, 770-969-1591, Keith Mayfield
- B. Alpha Boring,
7633 Buchanan Hwy, Dallas, GA 30157, 770-560-7514, David Wiley
- C. Horizontal Unlimited, Inc.
195 Barton Creek Rd., Westminster, SC 29693, 864-647-1338
- D. Metro Horizontal Boring
2200 Commerce Pl., McDonough, GA 30253, 678-577-2122
- E. D&G Boring, Inc.
2690 Cobb Pkwy, Suite A-5 389, Smyrna, GA 30080, 770-794-7083

PART 2 PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe shall be push-on or mechanical joint conforming to AWWA C106 or C108. Pipe thickness shall be in accordance with AWWA C150, Class 50, or pressure Class 350. The pipe shall be cement-lined in accordance with AWWA C104. Rubber-gasket joints shall

conform to AWWA C111.

- B. Fittings for gray iron or ductile iron pipe shall be mechanical joint gray iron or ductile iron fittings conforming to AWWA C153, unless noted otherwise on the drawings, and shall be cement lined.
- C. The exterior of ductile iron pipe shall be coated with a layer of arc-sprayed zinc. The mass of the zinc applied shall be 200g/m² of pipe surface area. A finishing layer topcoat shall be applied to the zinc. The mean dry film thickness of the finishing layer shall not be less than 3 mils with a local minimum not less than 2 mils. All pipes shall be manufactured and coated in the United States at the pipe manufacturer's facility. Fittings shall be coated with Tnemec-Zinc 90-98-Zinc rich paint with 2.5-3.0 mils DFT, or approved equal, with 2.0 mil minimum and asphalt topcoat. Pipe and fittings shall be Protecto 401 ceramic epoxy lined.

2.2 PVC GRAVITY SEWER PIPE

- A. PVC sewer pipe and fittings shall be plastic gravity sewer pipe with integral wall bell and spigot joints for the conveyance of domestic sewage. Pipe and fittings shall meet the strength minimum of DR 18 and AWWA C900.
- B. Pipe and fitting markings shall include the appropriate ASTM and Cell Classification Numbers (12454-B or 12454-C or other ASTM approved classifications) and be any color. Unmarked pipes and fittings will be rejected.
- C. Each length of pipe shall be marked with the manufacturer's name, trade name, nominal size, class, hydrostatic test pressure, manufacturer's standard symbol to signify it was tested, and date of manufacture. Each rubber ring shall be marked with the manufacturer's identification, the size, the year of manufacture and the classes of pipe with which it can be used.
- D. PVC pipe shall be joined with a rubber gasket or PVC ring which is designed to prevent inflow and ex-flow. Mechanical compression joints shall be molded plastic or similar material (with or without the use of rubber or elastic plastic compression rings) as described in ASTM C425 for polyvinyl chloride (slip joint). Precast joints or rubber push-type gaskets for compression joint sealing (ASTM D3312 or F477) are all acceptable. (PVC pipe shall not be joined by a solvent cement joint in which the pipe spigot wedges into the tapered socket and the surfaces fuse together.)
- E. In cases where pipe joints are required to be restrained the pipe shall utilize an internal restraint system suitable for C900/905 PVC pipe such as the CertainTeed Certa-Lok C900/RJ Restrained Joint System, Diamond Plastics Diamond Lok-21, JM Eagle Loc900, RieberLOK or approved equal.

2.3 CASING PIPE

- A. Jacked casing pipe shall be a smooth steel pipe with a minimum yield point of 35,000 psi, meeting ASTM A53 or ASTM A139. The minimum wall thickness shall be as indicated below:

Nominal Diameter (Inches)	Nominal Thickness (Inches)
Under 14	0.188
14	0.219
16	0.219
18	0.250
20	0.281
22	0.312
24	0.344
26	0.275
28	0.375
30	0.406
32	0.438
34	0.469
36	0.469
42	0.500
48	0.625

PART 3 EXECUTION

3.1 STAKING AND GRADING

- A. Owner shall provide all staking including clearing limits, temporary and permanent easements, manholes, mid-point between manholes, force main at 200-LF intervals and at bends, and steel casing.
- B. The Contractor shall be responsible for providing laser beam equipment and using this equipment to grade and align all sewer lines between manholes. The Engineer will provide a list of benchmark elevations from which the Contractor may work.

3.2 INSPECTION OF PIPE AND JOINTS

- A. All pipes shall be subject to inspection by the Engineer for uniform diameter, straightness, and defects before being lowered into trench. Rejected pipe shall be marked in such a way as will not impair its value and separated from accepted pipe and removed from the project.
- B. No backfilling (except for securing pipe in place) over pipe will be allowed until the Engineer has had an opportunity to make an inspection of the joints, alignment and grade in the section laid.
- C. Inspection of piping and joints shall not relieve the Contractor of further liability in case of defective piping and/or joints which prove defective.

3.3 TRENCH WIDTHS

- A. Maximum permissible trench widths from bottom of trench to a point 12" above top of pipe shall be equal to the outside diameter of pipe barrel plus 16", except as noted otherwise.

- B. If the trench walls collapse, or if the excavated trench width up to a point 12" above the top of sewer pipe is greater than the maximum permissible trench width as set forth in Paragraph A above, then the Contractor shall, at no additional cost to the Owner, lay and backfill the line as specified in ASTM D2321.

3.4 JOINT CONSTRUCTION

- A. Each joint shall be laid so that it will form a close concentric joint with adjoining pipe and so as to avoid sudden offsets or inequalities in the flow line. The inside of all bells and the outside of all spigots shall be wiped to remove all dirt, water, or other foreign matter so that their surfaces are clean and dry when the pipes are joined.
- B. Rubber ring gasket joints for PVC pipe shall be installed according to the pipe manufacturer's Specifications and recommendations. Extreme care shall be used in joining large diameter pipes to avoid damaging the rubber ring or displacing it from the proper operating position.
- C. Push-on or mechanical joints on cast iron sewer shall be installed according to the pipe manufacturer's Specifications and recommendations.
- D. After the joints have been completed, they shall be inspected by the Engineer before they are covered up. Any leaks or defects discovered at any time after completion of the work shall be repaired immediately. All pipes in place shall be carefully protected from damage until the backfilling operations have been completed. Any pipe which has been disturbed shall be taken up, the joint cleaned and remade and the pipe re-laid at no addition cost to the Owner.
- E. Water shall not be allowed to run or stand in the trench while pipe laying is in progress or before the joints are completed or before the trench has been backfilled. The Contractor shall not open up, at any time, more trench than his available pumping facilities are able to dewater.

3.5 PIPE LAYING - GENERAL

- A. Before sewer pipe is placed in position in the trench, the bottom and sides of trench shall be carefully prepared, bedding shall be placed and compacted, and necessary bracing and sheeting shall be installed.
- B. Each piece of pipe and special fitting shall be carefully inspected before it is placed, and no defective pipe shall be laid in the trench. Pipe laying shall proceed upgrade starting at the lower end of the grade and with the bells upgrade.
- C. All sewer lines shall be laid to constant grades between invert elevations shown on the plans. Grades shown on the Drawings are invert of pipe and not trench subgrade. The pipe lengths shall be fitted together and matched so that when they are laid in the trench, they will form a sewer with a smooth and uniform invert visible as a full circle from manhole to manhole.
- D. No filling of trench with earth to bring pipe to grade will be permitted. If trenches are dug too deep, they must be brought to grade and supported by No. 57 crushed stone for pipe bedding, at no additional cost to Owner. No pipe shall be laid in the trench until subgrade is tested and found correct.

- E. Pipe shall not be laid on solid rock. A pad of crushed stone for pipe bedding as hereinbefore specified at least 6" deep, shall provide support for at least the bottom quadrant of the pipe.
- F. No walking upon the completed pipelines will be permitted until trench has been backfilled to a depth of at least 6" over the top of pipe. Exception may be made at the discretion of the Engineer where it is necessary in order to tamp the backfill around the pipe.
- G. The interior of the pipe shall, as the work progresses, be cleaned of all dirt, jointing materials, and superfluous materials of every description. When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a plywood plug fitted into the pipe bell so as to exclude earth and other material, precautions being taken to prevent floatation of pipe by runoff into trench.
- H. Laying of pipe may be delayed by the Engineer until trenching has progressed far enough ahead to remove the possibility of having to change grade or alignment on account of other structures, pipelines, or conduits.
- I. Unless permitted or directed for the following reasons, not less than 100' of pipe shall be laid at one operation:
 - 1. Street crossings.
 - 2. Wet caving trenches; and
 - 3. Business, houses, or institutions which would be damaged by prolonged disconnection from street.
- J. In wet, yielding, and mucky locations where pipe is in danger of sinking below grade or floating out of grade or line, or where backfill materials are of such a fluid nature that such movements of pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective.
- K. When ordered by the Engineer, mucky and quicksand trench subgrades shall be removed below ordinary trench depth. Pay for such excavation shall be included in the unit prices bid for stone stabilization.
- L. Pipes shall be laid free from all structures other than manholes. Any pipes entering structures underground unsupported by original earth shall be supported by Class "C" concrete or brick and mortar masonry.
- M. Avoid permitting dirt, rubbish, surplus construction material, and other foreign matter to enter structures or pipe during construction. Use whatever means may be necessary to obtain a clean and internally smooth drainage system prior to final acceptance.
- N. Pipe stubbed out of manholes for future connection shall be plugged and tightly sealed with a plug jointed in the bell with joint compound approved by the Engineer. Plugs shall be made of the same material as the pipe used for the stubs.

- O. Sewer pipe laid shall be paid for as specified in the MEASUREMENT AND PAYMENT Section of these Specifications.
- P. No joints that show leakage will be accepted. If, after backfilling and inspection, any joints are found that are allowing groundwater to enter the sewer, such joints must be dug up and corrected at no additional cost to Owner.

3.6 WATER LINE SEPARATION

- A. Horizontal Separation: Sewers shall be laid at least 10 feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten-foot separation, the Contractor shall notify the Engineer who may allow deviation on a case-by-case basis. Such deviation may allow installation of the sewer closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation, so the bottom of the water main is at least 18 inches above the top of the sewer.
- B. Crossings: Sewers crossing water mains and service lines shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer, 10 linear feet of concrete encasement shall be provided for the sewer to prevent damage to the water main.
- C. Special Conditions: When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be installed inside steel casing pipe.

3.7 SERVICE CONNECTIONS TO SEWER MAIN

- A. Branch service pipes shall be laid to serve the abutting property at points to be designated by the Engineer. Such pipes shall be connected to the sewer through tees or wyes with the same run size as the main sewer and 6" side branch and 6" 45-degree bends. Side branches shall be supported from bottom of trench with crushed stone (No. 8 to 3/4") where cover is less than 6'.
- B. Six-inch service pipe shall be laid from the main sewer to the property line of the abutting property. Where practical, due to the slope of the existing ground, the service lines shall end at the property line with a wye which shall provide service connections to two adjacent properties. These locations shall be determined by the Engineer. Payment for service connections to sewer main shall be made at the unit prices stated in the Bid Schedule.
- C. Under normal conditions, where elevations are not critical, branch service sewers to customers shall be laid on not less than 0.025 feet per foot of length grade. Where elevations are critical, minimum grade shall be 0.0125 feet per foot laid with batter boards and grade line string.
- D. In the case of deep sewers, as directed by the Engineer, branch pipes may be brought up to a depth of approximately 4' below ground level with suitable bends and service pipe. These

pipes shall be laid on a slant outside sewer trench, so they will be supported on original earth and not dragged down and cracked by backfill settlement. Where depth of cover over wye or tee branches is greater than 6', these wyes or tees shall be encased in concrete. Cost of such concrete shall be included in the price bid for service pipe.

- E. In the case of branches to deep sewers in rock or narrow places, the service pipe shall be brought up to a depth of approximately 4' below ground level with suitable bends and riser pipe and encased in Class "C" concrete or brick and mortar masonry to subgrade of branch trench. The cost of such concrete and forms or masonry above the wye or tee branch shall be included in the price bid for service connections.
- F. The Contractor shall make an accurate dimensional record of the service connections as the installations are made. The following information shall be recorded:
 - 1. Distance from nearest manhole to wye or tee connection at main sewer.
 - 2. Distance from main sewer to end of service line.
 - 3. Angle between main sewer and service line; and
 - 4. Depth at end of service line.
- G. These records shall be kept by the Contractor until all connections are made and then submitted to the Engineer prior to the final work claim.
- H. Exact location of the service connections and stub tee or wyes shall be determined by the Engineer in the field.

3.8 GRAVITY SEWER PIPE LAYING

- A. Gravity sewers, where indicated on the Drawings, shall be laid to line and grade and according to provisions regarding bedding, laying, and jointing of AWWA C400, except that joint shall be made with mechanical or push-on joints, according to the manufacturer's specifications and using manufacturer-recommended tools. A copy of the manufacturer's instructions shall be made available at the site of work at all times when pipe is being laid.
- B. Cutting of pipe may be done with wheeled pipe cutters or with hammer and chisel, as the Contractor may elect; but the Contractor will be held responsible for breakage or damage caused by careless cutting or handling.
- C. No pipe shall be laid on rock, blocking, or other unyielding objects, except where laid above ground on piers or in permanent tunnels.
- D. Materials for use as foundation, embedment and backfill shall be classified in accordance with ASTM D2487.
- E. Class IA Soils: Class IA soils include open-graded, clean manufactured aggregates and should be considered suitable for embedment and backfill.

- F. Class IB Soils: Class IB soils include dense-graded, clean manufactured, processed aggregates and should be considered suitable for embedment and backfill.
- G. Class II Soils: Class II soils include groups GW, GP, SW, SP, GW-GC and SP-SM as defined by the Unified Soil Classification System (USCS) and should be considered suitable for embedment and backfill.
- H. Class III Soils: Class II soils include groups GM, GC, SM and SC as defined by the USCS and should be considered suitable for embedment and backfill.
- I. Class IVA Soils: Class IVA soils include groups ML and CL as defined by the USCS and should be considered suitable for embedment and backfill.
- J. Class IVB and V Soils are not recommended for embedment and should be excluded from final backfill. Class IVB and V soils include groups MH, CH, OL, OH and PT as defined by the USCS.

3.9 COMPACTION REQUIREMENT AND TESTING

- A. Compactions shall be as specified in the PIPELINE EXCAVATION AND BACKFILL Section.

3.10 INFILTRATION TESTS

- A. Weir tests shall be made of flow of water from all sewers before they are put into service.
- B. No more than 3,000 feet of sewer in one section shall be weir tested at one time.
- C. Suitable metal or wooden weirs shall be installed at the lower end of the section of sewer being tested, and measurements of flow shall be made.
- D. Any leaks into the sewer of significant magnitude that can be located shall be repaired or corrected as authorized by the Engineer, regardless of infiltration tests results.

3.11 INFILTRATION ALLOWANCE

- A. Infiltration of groundwater or other leakage into the sewer (including manholes) shall not exceed 25 gallons per mile of sewer per inch of inside diameter of the sewer per 24 hours in any section of the completed work.
- B. Inspection during pipe laying shall in no way relieve the Contractor of the responsibility for passing tests or correcting poor workmanship. Before acceptance, infiltration shall be reduced by repair of leaks to the allowable rate.
- C. Hydraulic Testing of Sewers: Measurement shall be performed by the City on any lines with a visible flow of water. In no case will an infiltration rate greater than 25 gallons per inch of pipe diameter per mile of sewer per day is allowed. All visible or audible leaks must be dug up and repaired unless the leak is found to be in a joint and can be repaired by chemical

grouting. The testing procedure shall be in accordance with ASTM C1091 (Infiltration Testing), or ASTM C969.

3.12 AIR TESTS

- A. Air Pressure Testing of Sewers: A low pressure test of each sewer should be conducted according to Unibell UNI-B-6 or ASTM F1417.
- B. The Contractor shall air test the completed sewer line between each two consecutive manholes. If the test fails between manholes, the testing shall continue at closer intervals until the faulty construction is located and repaired.
- C. Test manholes and equipment used shall be approved by the Engineer prior to beginning the testing operation.
- D. Test sections shall be cleaned and flushed and shall have all pipe openings plugged and adequately braced to withstand the test pressure.
- E. The test section shall be pressurized until the internal pressure reaches 4.5 psig. Allow sufficient time for the air temperature in the test section to stabilize.
- F. Reduce the internal pressure to exactly 3.5 psig and accurately determine the time required for the pressure to drop to 3.0 psig.
- G. The minimum time required for the pressure drop shall be 5 minutes for 8-inch pipe and 10 minutes for 16-inch pipe.
- H. Any section of the sewer line which fails to meet the requirements state above, shall be repaired as necessary to eliminate all detectable leaks and shall be retested until satisfactory test results can be obtained. The Engineer shall approve final test results.
- I. The prescribed test pressure shall be in excess of the hydrostatic pressure of the groundwater above the top of the pipe. The pressure drop shall remain as indicated above.
- J. All Gravity Sewer pipe shall be air tested after installation in accordance with this specification.

3.13 VIDEO INSPECTION OF SEWER LINES

- A. All sewer lines shall be video inspected.
- B. Video should show pipe free of dirt and debris. Prior to test, pipe should be jetted, flushed and vacuumed.
- C. Televising cable attached to a video monitor shall be directed through pipe to view for the following deficiencies:
 - 1. Cracks in pipe and liner material.

2. Rolled gaskets.
 3. Leaking joints.
 4. Deviations from line and grade.
 5. Other deficiencies.
- D. Contractor shall repair all deficiencies noted by the Owner. Method of repair must be approved by the Owner's Engineer.
- E. Test shall be considered acceptable when the televised pipe does not reveal deficiencies as described above in paragraph C.
- F. The Owner's inspector must witness televising.

3.14 HIGHWAY CROSSINGS

- A. Installation of the gravity sewers and appurtenances along or crossing State, Federal and County Highway rights-of-way shall be done only with written consent and in strict accordance with the specifications of the right-of-way owner.
- B. Sewers crossing State and Federal Highways shall be inserted in a steel casing pipe. Casing pipe shall be of a size as shown on the Drawings. Carrier pipe shall be PVC C900 DR 18 restrained pipe inserted in the casing as described on the Drawings. Casing pipe shall be installed with a minimum cover of 48".
- C. Casing pipe may be bored or jacked, and payment shall be per foot of casing actually installed. Jetting or wet boring will not be permitted.
- D. Sewer mains crossing City or County Highways shall be open cut, unless otherwise shown on the Drawings. Compaction and pavement replacement shall be as specified in the PIPELINE EXCAVATION AND BACKFILL Section.
- E. Following construction on highway right-of-way, Contractor shall be responsible for dressing, shaping, and re-seeding as required to return the highway ditches, shoulders, and ditch back slopes to a condition as close as possible to original condition before the beginning of construction operations.
- F. It shall be the responsibility of the Contractor to notify the right-of-way owner's field engineer before doing any work within the right-of-way.

3.15 AS-BUILT DRAWINGS

- A. At the completion of the job, and prior to the request of Final Payment, the Contractor shall furnish the Engineer As-Built drawings for the entire project. The drawings shall show the locations and elevations of all manhole tops and inverts, locations of all service laterals and their depths, and the locations, type and size of all pipes and casings. As-Built drawings shall

be to scale and neatly drawn.

- B. The Contractor agrees to indemnify the Owner, the Engineer, its agents, representatives, etc., and hold them harmless from any work performed by the Contractor or its subcontractors, outside of the easements shown on the drawings.

3.16 PAYMENT

- A. No separate payment will be made for the work of this Section, except as may be specifically set forth in the Bid Schedule. The cost of the work of this Section, and all costs incidental thereto, except the work which may be specifically set forth in the Bid Schedule, shall be included in the price bid for the item to which the work pertains.

END OF SECTION

**SECTION 33 35 00
PROCESS VALVES AND APPURTENANCES**

PART 1 GENERAL

1.1 SCOPE

- A. The work to be done under this Section of the Specifications consists of furnishing all materials and performing all labor necessary for the complete construction of the valves, as indicated on the Contract Drawings and/or specified.
- B. Valves herein are for chemical, reuse water and process. Refer to other Sections for potable water and plumbing valves.

1.2 GENERAL

- A. All materials used in the construction shall be new and unused when delivered to the site and shall be subject to inspection by the Engineer before installation.

1.3 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 01 78 23 Operation and Maintenance Data
- C. Section 01 45 34 Product Delivery Storage and Handling
- D. Section 09 91 00 Painting

1.4 SUBMITTALS

- A. The following information shall be submitted for review in accordance with Section 01 33 00:
 - 1. Submit valve manufacturer's catalog data, descriptive literature, and assembly drawings. Show dimensions, materials of construction by specification reference and grade, linings, and coatings.
 - 2. Submit manufacturer's affidavit of compliance with referenced standards.
- B. Submit Warranty and Certification Form per Section 01 33 00.
- C. Submit Operation and Maintenance Manuals in accordance with Section 01 78 23.
- D. Test Reports to be Submitted:
 - 1. Copies of all test results, as specified in Part 3 of this Section.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle, and store the equipment in accordance with Section 01 45 34.

1.6 WARRANTY

- A. The manufacturer shall warrant in writing all equipment against defects in materials and workmanship for a period of 12 months from the date of substantial completion. Within this 12-month period, any defective or malfunctioning equipment, component, or accessory shall be repaired or replaced upon notice at no additional cost to the Owner.
- B. Refer to Section 01 70 00 for additional information.

PART 2 PRODUCTS

2.1 GENERAL

- A. Valves are identified by both type and style.
 - 1. The type and style of valve to be used for each application is indicated on the Drawings.
- B. General Valve Requirements
 - 1. Select such that it is suitable for the intended service.
 - 2. Use the following in metal pipelines unless otherwise shown on the Drawings or as specified:
 - a. Two-inch diameter and smaller:
 - (1) All brass or bronze except for the handwheel.
 - (2) Screwed or soldered ends.
 - b. Two and one-half inches in diameter and larger
 - (1) Iron body, bronze mounted.
 - (2) Flanged or mechanical joint ends for valves 4-inches in diameter and larger.
 - (3) Screwed connections may be used for smaller valves.
 - 3. Make valve the same size as connecting piping. Drawings indicate nominal size unless otherwise noted.
 - 4. Provide end connections that are compatible with connecting piping.
 - a. Cast flanges and mechanical joint bells at right angles to the casting axis.
 - b. Drill and shop coat with a rust preventive compound prior to shipment.
 - c. Provide a union adjacent to all valves with screwed or soldered connections to

facilitate removal.

5. Open counterclockwise.
 6. Equip non – rising stem valves with a suitable position indicator.
 7. Provide rising stem valves with a clear stem guard that is calibrated to indicate stem position.
 8. Connect extension stems to valves using bronze couplings. Size to withstand all stresses without deformation. Use a minimum safety factor of six.
 - a. Fabricate and install stems to operate valve without binding.
 9. Provide the manufacturer’s name and valve size on the body or bonnet of the valve. Use
 - a. Cast letters, or
 - b. Provide permanently attached plate with information stamped in raised letters.
- C. Furnish valves complete with operators, bonnets, extension stems, floor stands, operating wrenches, and all other appurtenances necessary for them to perform as designed. Mount actuators and appurtenances in the factory and ship as a unit.
1. Manual operators
 - a. Provide a handwheel for conveniently accessible valves.
 - b. Provide a chainwheel operator for all manual valves greater than 6 feet above the finished floor or working surface.
 - (1) Extend the chain to within 4 feet of the floor or working surface.
 - (2) Secure chain using hooks fastened to walls or other parts of the structure. Locate hooks so that the chain does not obstruct access ways.
 - c. Size handwheels and chainwheels and provide actuator gearing to limit the maximum operating force to 80 pounds. Include floor stands, floor boxes, and extended actuators where shown on the Drawings.
 - d. Include stem extensions, valve boxes, position indicators, and Tee wrenches for buried valves.
 - (1) Provide 2-inch square AWWA operating nut.
 - (2) Locate operating nut no more than 12 inches below grade.
 2. Automatic operators
 - a. Comply where shown on the Drawings.

2.2 2.2 BALL VALVES FOR HOT/COLD AND COMPRESSED AIR

- A. Size: ¼ inch to 3 inch for hot and cold water or compressed air service
- B. Body: Forged brass
- C. Ball: Chrome plated brass
- D. Stem: Nickel plated brass
- E. Seat: Virgin PTFE
- F. End Connections:
 - 1. Threaded up to 3 inch
 - 2. Soldered up to 2 inch
- G. Actuator
 - 1. Provide type as specified in the attached valve schedule.
 - 2. One-quarter turn to open or close.
- H. Manufacturers
 - 1. Jamesbury, Series 300
 - 2. Or equal

2.3 PVC BALL VALVES

- A. Size: ½ inch to 4- inch true union PVC ball valves
- B. Design Standard
 - 1. ASTM D2467.
- C. Body, ball, and stem:
 - 1. PVC conforming to ASTM D1784, Classification 12454-B
- D. Seat:
 - 1. Teflon
- E. End Connections:
 - 1. True union

2. Socket

F. Actuator:

1. One-quarter turn to open or close.

G. Manufacturers

1. NIBCO
2. Hayward
3. Or Equal

2.4 DIAPHRAGM VALVE

A. Type: PVC weir type diaphragm valve

B. Size: 4 inch

C. Body and Bonnet

1. Molded of solid thermoplastic.
2. PVC conforming to ASTM D1784, Type I, cell classification 12454-A
3. CPVC conforming to ASTM D1784, Type IV, cell classification 23447.

D. Diaphragm: EPDM backed Teflon

E. Stem: Stainless Steel with adjustable position indicator.

F. End Connections:

1. Flanged
2. Conforming to ANSI B16.5

G. Actuator: Provide the type indicated in the attached valve schedule.

H. Manufacturers

1. Hayward
2. TVI Thermoplastic Valves, Inc.
3. Or equal

2.5 AIR /VACUUM AND COMBINATION VALVES

- A. Air release and vacuum break valve shall be of the compact single chamber design with solid cylindrical HDPE control floats housed in a tubular stainless-steel body with epoxy powder coated cast iron or steel ends secured by stainless steel tie rods. The valve shall have an integral orifice mechanism, which shall operate automatically to limit transient pressure rise induced by closure to twice valve rated working pressure. The intake orifice shall be equal to the nominal size of the valve. The flat face or the control float seating against a nitrile rubber O-ring housed in a dovetail groove circumferentially surrounding the orifice shall affect large orifice sealing. The seating and unseating of a small orifice nozzle on a natural rubber seal affixed into a control float shall control discharge of the pressurized air. The nozzle shall have a flat seating land surrounding the orifice so that damage to the rubber seat is prevented. All components shall be easily replaced. Connection to valve inlet shall be flanged.
- B. The valve shall be either Vent-O-Mat series RBX or Vent-Tech Model WTR. No substitution permitted.

2.6 PRESSURE RELIEF VALVES

- A. Size ½ inch thru 2 inches
- B. Outlet pressure range: 0 to 2 psi
- C. Inlet pressure Range: 20 to 40 psi
- D. Design flow: 0 to 10 gpm
- E. E.Manufacturers
 - 1. GA Industries, Inc. Fig. 667-D
 - 2. Ross Valve Manufacturing Co., Inc.
 - 3. Cla-Val

2.7 REDUCED PRESSURE BACKFLOW PREVENTER

- A. Size: 2-1/2 inch to 10 inch
- B. Design Standard: AWWA C511
- C. Body: Cast iron conforming to ASTM A126
- D. Valves
 - 1. Main valve: bronze conforming to ASTM B61. Make seats and springs replaceable.
 - 2. Differential relief valve: bronze conforming to ASTM B61 with 316 stainless steel trim. Make seats and springs replaceable.

- 3. Isolation valves: NRS gate valves (GV-1 or 2 as appropriate).
- E. End Connections: Flanged conforming to ANSI B16.1, Class 125.
- F. Coatings and Linings: Fusion bonded epoxy on the interior and exterior.
- G. Miscellaneous
 - 1. Pipe relief chamber to drain.
 - 2. Provide test cocks for in-line testing.
- H. Manufacturers
 - 1. Cla-Val
 - 2. Hersey
 - 3. Or equal

2.8 MUD VALVES

- A. Size: 4 inch to 12 inch
- B. Body: Iron
- C. Mounting: Bronze
- D. Flange: Drilled for Class 125, ANSI 16.1
- E. E.Seat: Resilient
- F. Stem:
 - 1. Non-rising with stainless steel extensions.
 - 2. Fit with 2-inch operating nut.
- G. Valve Box:
 - 1. Provide a valve box cast into the concrete floor above the mud valve. Include valve box cover.
 - 2. Provide integral, bronze guides in the bottom of the valve box.
- H. Stem Guides:
 - 1. Provide adjustable, split sleeve, bronze mounted stem guides.
 - 2. Space at no more than ten (10) foot centers.

- I. Anchor Bolts: Stainless Steel
- J. Manufacturers
 - 1. Troy
 - 2. Clow
 - 3. Waterman Industries Inc.
 - 4. Or equal

2.9 GLOBE BODIED FLOW CONTROL VALVE

- A. Flanged bodied globe valve with electric actuator suitable for use with polyaluminum chloride.
- B. Materials - PVDF
- C. Stem seal – PTFE
- D. Linear flow characteristics
- E. Cv of 4.0
- F. Electric actuator for use with 120- volt AC power
 - 1. Responds to 4-20 mA set point signal for flow control from SCADA system.
 - 2. Provides 4-20 mA position signal for input to SCADA system
 - 3. Furnished with open/close limit switches for input to control panel and SCADA system
 - 4. Provision for manual override
- G. Control Panel
 - 1. Provide with NEMA 4X FRP control panel
 - 2. Provisions for local off remote selector switch with remote position output for use with SCADA system
 - 3. Provisions for open stop close selector switch
 - 4. Provision for valve open close indicator lights. When not fully open or closed both lights to be on.
- H. Manufacturer

1. Valve
 - a. Asahi/America
 - b. Approved equal
2. Operator
 - a. RTK
 - b. Approved equal

2.10 SWING CHECK VALVE

- A. Swing Check Valves shall be per AWWA C508 and include bottom mounted buffer to permit free opening, but positive non-slam closure of the disc. The oil hydraulic buffer shall make contact with the disc during the final 10% of closure to control the disc until shut-off in a manner to prevent slam and water hammer.
- B. The buffer rod shall be 303 stainless steel per ASTM A582. The final closure is to be adjustable by means of a color-coded micrometer type control valve. Control valve to have a locking set screw to secure final setting.
- C. The oil reservoir shall be 316 stainless steel per ASTM A240. Hydraulic hoses are to be S.A.E. certified.
- D. The body shall be ASTM A126 Class B cast iron. End connections shall be flanged class 125/150 per ANSI B16.1. Valves 8" and larger shall have a drain plug located on the bottom of the valve.
- E. The body seat shall be 316 stainless steel per ASTM A276 with an O-ring seal and locked into place with stainless screws.
- F. The disc and arm shall be ASTM A536 ductile iron. The disc shall be attached to the disc arm with a double clevis hinge to assure self-leveling and even load distribution upon closure, minimizing seat wear. Disc shall have an independent adjustable full open disc stop. The disc arm, valve body or cover is not used as the disc stop. Disc seat shall be nitrile butadiene (NBR) and field replaceable without the use of special tools.
- G. The pivot shaft shall be one-piece 303 stainless steel per ASTM A582, protruding through the valve body with a lever and weight mounted on one side. The pivot shaft shall have an integral retainer to prevent axial shaft movement. The pivot shaft shall have O-ring seals on both sides of the shaft. Braided type packing is not acceptable.
- H. Valve is to be tested by the manufacturer as a complete assembly, including the bottom buffer, per AWWA C508.
- I. Check Valves to be APCO Model CVS-6000B as manufactured by DeZurik.

2.11 RUBBER FLAPPER CHECK VALVES

- A. The check valve shall conform to the design, materials of construction, testing and laying length required by AWWA C508 (latest revision).
- B. The valve shall have integral flanged connections that are faced, drilled and of the thickness required by ANSI/ASME B16.1 Class 125.
- C. The body shall have its seat on a 45-degree angle to minimize closure time. There shall be a bottom threaded port to permit installation of a backflow device. The cover shall be domed and have a threaded port to permit the installation of the visual position indicator.
- D. The flexible disc shall have been cycle tested by an independent laboratory to a minimum of 1 million cycles as required by AWWA C508 without evidence of deterioration, damage or wear and seal drop tight upon the conclusion of testing.
- E. The valve body and cover shall be rated for 250 PSI and made from ductile iron conforming to ASTM A536 Grade 65-45-12.
- F. The flexible disc shall be the only moving part and made from precision molded Nylon reinforced Buna-N rubber with an integral O-ring seating surface. An alloy steel plate shall be imbedded in the rubber to provide rigidity.
- G. Cover bolts, nuts, studs, and pipe plugs shall be Type 316 stainless steel. Valves 10-size and larger shall have a minimum of 2 lifting eye-bolts.
- H. The interior and exterior ferrous surfaces of the valve shall be shop coated with minimum 6 mil NSF-61 certified 2-part epoxy. Rubber flapper swing check valves shall be GA Industries Figure 200, VAG USA, LLC Mars, PA USA

2.12 PLUG VALVES

- A. Plug valves shall be of the eccentric non-lubricated, manually operated type, and be designed for the use and working pressure intended.
- B. Valves shall have flanged ends or mechanical joint ends, as shown on the Drawings. Valve body shall be of semi-steel.
- C. Seats shall have a welded-in overlay of not less than 90% pure nickel on all surfaces which will contact the plug face.
- D. The plug shall be totally encapsulated with Buna-N rubber.
- E. Plug stem bushing shall be of stainless steel, and permanently lubricated type.
- F. Valves shall have a 2" square operating nut, with worm gear actuator and open LEFT.
- G. Valves placed in a valve box shall have a handwheel operator.

- H. Plug valves shall be manufactured by DeZurik, Homestead, GA Industries or approved equal.

2.13 SEWAGE AIR RELEASE VALVE

- A. The sewage air release & vacuum break valve shall consist of all stainless-steel fabricated body.
- B. Connection to the valve inlet shall be facilitated by flanged ends conforming to ANSI B16.1 Class 125 or Class 250 Standards.
- C. Valves shall respond to the presence of air/gas by discharging it through the small orifice at any pressures within a specified design range, i.e., 7 psi to 150 psi and shall remain leak tight in the absence of air.
- D. Valves shall react immediately to pipeline drainage or liquid column separation to allow unobstructed air intake at the lowest possible negative internal pipeline pressure.
- E. The sewage air release valves shall be Vent-O-Mat Model No. 050RGX1021, DeZurik/APCO ASU, Vent Tech Model SZG or A.R.I. Model D-020, with 2-inch inlet size.

2.14 GATE VALVES

- A. These valves shall be non-rising stem design, ductile iron body, bronze mounted with compression resilient seat manufactured in accordance with AWWA Standard C-515. Valves shall be designed for a minimum working pressure of 250 psi (except where plans call for a higher-pressure rating) and shall have 2" square operating nuts, except in meter vaults where handwheels shall be installed. The wedge shall be constructed of ductile iron fully encapsulated with EPDM rubber. Valves shall have non rising stems, shall open when turned to the left and shall meet AWWA Specifications. The valves shall have a flange connection conforming to ANSI B 16.1 when flanges are shown on the plans.
- B. Restrained valve ends shall employ a boltless positive joint restraint equal to the Flex-Ring joint. Friction style restrainers, which point load the adjoining pipe, will not be allowed.
- C. Gate valves shall be Series 2500 Flex-Ring RW Ductile Iron Resilient Wedge Gate Valve as manufactured by American Flow Control or approved equal.

2.15 VALVE BOXES

- A. Valve boxes shall be provided for all buried valves. Valve boxes for valves shall be approved standard cast iron, adjustable-shaft boxes having a minimum shaft diameter of 5-1/4 inches. The casting shall be coated with two coats of coal tar pitch varnish. The lids of all boxes shall bear the word "Water" or the letter "W". Boxes shall be equal to Vulcan Pattern VVB-4. Valve boxes shall be flush with the final grade after grading and / or paving.
- B. Valve extension stems shall be constructed with standard valve operating nut, 4-1/2" diameter x 1/4" steel guide plate, 1-1/4" square solid steel stem, and standard operating wrench coupling with four 3/8" set screws. The material shall be galvanized. The extension stem must be

capable of surviving a torque test to 1000 ft-lb without failure. Extension stem shall be terminated two feet from finished grade.

- C. The valve box top and lid shall be constructed of ductile iron.

2.16 VALVE MARKER (NIC)

- A. One concrete valve marker shall be furnished and set at each line valve. The marker shall be made of 3000 psi concrete and shall be four (4) feet long and 4" on each side, with #4 reinforcing bars as shown on the detail.

2.17 ACCESSORIES

A. Floor Boxes

1. Provide for each valve shown on the Drawings with an extended operating nut.
 - a. Mount flush with the top of the slab and make the length of the box equal to the slab thickness.
 - b. Use bushing type to support stem at the floor and preserve stem alignment.
 - c. Include cover to protect the operating nut.
2. Manufacturer:
 - a. Clow
 - b. Or equal.

B. Floor Stands

1. Cast iron construction.
2. Design for handwheel operator, gear operator or motor operator as shown on the Drawings. Provide floor stand bracket where necessary to locate floor stand where shown on the Drawings.
3. Use indicating type for non-rising stem applications. Provide clear stem covers with graduations to show valve position for rising stem applications.
4. Manufacturer:
 - a. Clow
 - b. Mueller or Equal

C. Extension Stems and Guides

1. Size for the maximum valve torque.
2. Use stem guides to limit the stem L/R ratio to less than or equal to 200.
 - a. Cast iron construction.
 - b. Bronze bushed at the stem support.
 - c. Adjustable in two directions at right angles in a plane perpendicular to the stem.
 - d. Secure with 304 stainless steel angle bolts.
 - e. Manufacturer
 - (1) Clow
 - (2) Mueller
 - (3) Or equal.

D. Chain Wheel Operators

1. Provide galvanized or cadmium plates wheels, guides, and chains.
2. Include chain guides to prevent the chain from slipping off of the wheel.
3. Size chain as recommended by the valve manufacturer.
4. Provided by the valve manufacturer.

2.18 BUTTERFLY VALVES

- A. Unless otherwise shown or specified, butterfly valves shall be of the resilient seated, tight-closing type and shall conform in all respects to the applicable material and dimensional requirements of AWWA C504. Wafer-type butterfly valves in sizes 24 inches and larger shall conform to all general requirements of AWWA C504 except laying length. Butterfly valves shall operate from fully open to fully closed with a 90-degree rotation of the valve stem.
- B. Valves shall be designed for the working pressures and/or pressure class designations shown on the drawings or specified in these Specifications. If a working pressure or pressure rating is not given, the following requirements shall apply:

Service	AWWA	Pressure Rating
Low Pressure Air		25 psi – 16 fps
Wastewater of Sludge		150 psi – 16 fps

Potable or Plant Water

150 psi – 16 fps

- C. Wafer-type valves shall have a pressure rating of not less than 150 psi. Valves shall be drip-tight and bubble-tight at rated pressure differential across the valve in both directions
- D. Valve body shall be 1-piece, constructed of cast iron conforming to ASTM A126, Class B. Diameter of the opening shall be not less than the diameter of the corresponding pipe size. Unless otherwise specified, valve body shall be of the short-body style in accordance with Table 3 of AWWA C504. This requirement shall not apply to wafer-type valves. No part of the valve internals shall extend beyond the valve ends when the valve is in the closed position. Short-body valves shall have 125-pound flanged ends per ANSI B16.1. Wafer-style valves shall be designed to fit between 125-pound flanges per ANSI B16.1.
- E. Disc shall be cast bronze conforming to ASTM B 143, Alloy 1A, cast iron conforming to ASTM A48, Class 40, Ni-resist ductile iron conforming to ASTM A 439, Type D2. When used in wastewater or raw water, disc shall be streamlined with no exterior ribbing or openings.
- F. Shafts shall be polished stainless steel conforming to ASTM A276, Type 304 or Type 316. All keys and pins used in securing valve disc to shafts shall be stainless steel or Monel.
- G. Valve seat shall be of 1-piece, molded synthetic rubber, Buna-N (Hycar) for wastewater and Buna-N or neoprene for air. Where temperatures exceed 180 degrees F, EPDM or Viton seats shall be used. Retaining rings, if used, shall be stainless steel. The method of mounting valve seat shall conform to applicable requirements of AWWA C504, Section 3.5. Valve seats in sizes 24 inches and larger shall be field replaceable without necessity of shipping, burning, or cutting. Seats secured with retaining rings shall be fully adjustable. Metal seat mating surfaces shall be smoothly contoured and polished 18-8 stainless steel or Monel. Alloy cast iron will not be acceptable as a seat-mating surface. Sprayed or plated seat mating surfaces will not be acceptable.
- H. Shaft seals shall be O-ring or self-adjusting chevron packing of Buna-N or neoprene. Shaft seals shall conform to the requirements of AWWA C504 and shall be of a design that allows replacement of the seal without removing the valve shaft. Alternately, pull-down packing is acceptable if the packing is adjustable and replaceable without removing valve operator.
- I. Valve bearings shall be self-lubricating, sleeve-type bearings of corrosion resistant materials. Bearing load shall not exceed 2,500 psi. Valves 24 inches in size and larger shall be provided with an adjustable, 2-way thrust bearing to center the disc in the valve and allow the valve to be installed with the valve stem vertical. Bearing shall be easily accessible for adjustment.
- J. Where the valve is installed, adjacent to a fitting, flow meter, another valve, or similar items, a spool piece or adaptor coupling shall be furnished as a spacer so that valve disc does not interfere with operation of the adjacent meter or valve or contact cement linings on pipe or fittings.
- K. Valve shall be furnished with a lever operator, rotary manual operator, electric motor operator, or pneumatic cylinder operator as shown on the Drawings. Unless otherwise shown

of specified, a lever operator shall be furnished on valves 6 inches and smaller, and a rotary manual operator shall be furnished on valves 8 inches and larger. Extension stem and floor stand shall be furnished, where shown or required.

- L. Butterfly valves shall be as manufactured by DeZurik or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install valves as shown on the Contract Drawings and in accordance with manufacturer's requirements.
- B. Install all valves and appurtenances in accordance with the manufacturer's instructions, referenced AWWA standards and the Contract Documents.
- C. Close valve ends using caps, plugs or wooden flange covers to prevent dirt, building materials or other foreign matter from entering.
- D. Leave no more than two threads exposed on a completed threaded connection. Use Teflon tape joint sealer when making the connection.
- E. Install plug valves and butterfly valves such that the valve operating stem is horizontal, and the seat is as shown on the Drawings.
 - 1. If no seat position is shown, flow shall produce a seating pressure.
 - 2. Make the plug open toward the highest portion of the valve.
- F. Support all valves as shown on the Drawings and in accordance with manufacturers recommendations.
- G. Locate valves such that they are readily accessible for maintenance. Provide access doors in finished walls or enclosed ceilings.
- H. Provide a line size ball valve or gate valve upstream of each solenoid valve, in-line flow switch or similar control device. Use the same construction materials as the connecting pipeline.

3.2 FIELD PAINTING

- A. Field prepare and paint required surfaces as specified in Section 09 91 00.

END OF SECTION

**SECTION 33 39 00
SANITARY UTILITY SEWERAGE STRUCTURES**

PART 1 GENERAL

1.1 SCOPE

- A. The work to be done under this Section of the Specifications consists of furnishing all materials and equipment and performing all labor necessary for the complete construction of manholes and wet well including all appurtenances as indicated on the Contract Drawings and/or specified.

1.2 GENERAL

- A. All materials used in the construction shall be new and unused when delivered to the site and shall be subject to inspection by the Engineer before installation.

1.3 RELATED SECTIONS

- A. Section 01 33 00 Submittals
- B. Section 31 23 00 Pipeline Excavation and Backfill

PART 2 PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

- A. Manholes shall have flexible pipe connectors manufactured in accordance with ASTM C923. Manholes shall have eccentric type of manhole cone.
- B. Precast manholes shall consist of precast reinforced concrete riser section, eccentric top section and a base section conforming to detail shown on the Contract Drawings. Precast manhole sections shall be manufactured in accordance with ASTM C478, as amended to date, and these Specifications. Concrete shall have a minimum compressive strength of 4,000 psi when tested in accordance with ASTM C39, as amended to date. Steel reinforcements shall be as specified in ASTM C478, as amended to date. Wall and bottom section shall have a minimum thickness of five inches (5").
- C. Base sections for precast manholes shall have a bottom poured monolithically with the walls. Base section shall be furnished with inside diameter of 4 feet as required. Base sections shall be furnished with a minimum height of 24 inches for pipes having a diameter of 8, 10 or 12 inches and a minimum height of 36 inches for pipes having a diameter of 15 or 18 inches. Minimum height for 5 or 6-foot diameter base sections shall be 48 inches regardless of pipe size. Base sections with 5 or 6 foot inside diameters shall be reduced to 4 foot inside diameter by means of an adapter ring or transition top. The openings in the base section for the accommodation of the pipe shall be cast to closely conform to job conditions and shall provide a minimum clearance of three inches (3") between the inside bottom of the base and outside bottom of the pipe barrel.

- D. The riser sections shall be furnished in a minimum of six inch (6") increments and shall be four feet (4') in diameter with, (a) tongue and groove joint to be sealed with approved butyl rubber or bitumastic material, similar to "E-Z Stik" as manufactured by Concrete Supply Company. The gasket joint shall be thoroughly cleaned of all loose materials and brushed with an approved epoxy to give a smooth surface free of any honeycomb.
- E. In the event that the manhole has to be altered after delivery to the job site, the Contractor may, with permission of the Engineer, connect the pipe to the manhole with a collar of mortar and brick. The opening between the pipe and manhole shall have a minimum clearance of one inch (1") and shall be filled from the inside of the manhole with a non-shrink grout.
- F. Repaired and patched sections will not be acceptable unless each individual section so repaired or patched shall have first been inspected and approved by the Engineer, for repair and patching at the manhole plant. Repairs to and patching of O-ring grooves and shoulders WILL NOT BE permitted.
- G. Absorption shall not exceed 6 percent when determined in accordance with ASTM C497, as amended to date.
- H. An inspection, by an independent testing laboratory approved by the Engineer, of the manufacturer's plant and product will be required to assure conformity of the precast manholes to these Specifications, and the minimum requirements of ASTM C478, as amended to date. Each section of precast concrete manhole shall be stamped with the laboratory's stamp. Each stamped section shall indicate the laboratory's configuration that it was accepted in accordance with applicable ASTM Specifications. A copy of such reports will be furnished to the Engineer with submittal of shop drawings for approval. Job site inspection shall be visual for shape, uniformity and density.

2.2 MANHOLES AND CASTINGS - GENERAL

- A. Manholes shall be precast concrete manholes and shall be located as shown on the Drawings. All manholes shall be 48" inside diameter, unless noted otherwise, and shall be installed level, true and plumbed.
- B. Where the difference in the invert elevation of two or more sewers intersecting in one manhole is 2' or more, a drop manhole shall be constructed. Drop manholes shall be similar in construction to the standard manhole except that a drop connection of pipe and fittings of the proper size and material shall be constructed outside the manhole as detailed on the Drawings.
- C. Where the difference in invert elevation of two or more sewers intersecting in one manhole is less than 2-feet, the invert shall be filleted to prevent deposition of solids.
- D. Pipe to manhole connection shall be made with a mechanically compressed flexible joint system. The joint system shall consist of an internal expanding band which clamps and seals a neoprene boot to opening in wall of manhole and an external band which contracts around

the boot to clamp and seal to the pipe. Flexible Joint Connections shall be "Kor-n-seal", as manufactured by National Pollution Control System, Inc., Nashua, New Hampshire, or approved equal.

2.3 MANHOLE CASTINGS

- A. All castings shall be made accurately to the required dimensions and shall be sound, smooth, clean and free of blisters and other defects. Defective castings which have been plugged or otherwise treated shall be rejected. The contact surfaces between the cover and its corresponding supporting ring in the frame shall be machined so that the cover will rest on the ring for the full perimeter of the contact surfaces. Castings shall be thoroughly cleaned and, before rusting begins, shall be painted with a bituminous coating so as to present a smooth finish, tough and tenacious when cold, but not tacky nor with any tendency to scale. There shall be no holes or perforations in the covers.
- B. Manhole castings shall consist of cast iron frames and 23-1/4" diameter covers. Castings shall be Class II, weighing at least 350 and 460 pounds, as detailed on the Contract Drawings. Manhole covers must be set neatly in the frames with contact edges machined for even bearing and tops flush with the tops of the frames. They shall have sufficient corrugations to prevent slipperiness and be marked in large letters GRAVITY SEWER". Covers shall have two (2) pick holes about 1-1/2" wide and 1" deep with 5/8" undercut all around.
- C. Manhole frames and covers shall be bolt down type with four stainless steel bolts 1/2" in diameter.
- D. Manhole steps shall be cast iron, 10" x 10" minimum size, having corrugated treads, or approved equal. Payment for manhole steps shall be included in the unit price bid for manhole.

2.4 INVERTS

- A. Manhole inverts shall be constructed of cement mortar and shall have the same cross-section as the invert of the sewers which they connect. The manhole invert shall be carefully formed to the required size and grade with gradual and uniform changes in sections and shall be made to a true curve with as large a radius as the size of the manhole will permit.

2.5 MANHOLE COATINGS

- A. Manholes requiring coating shall be coated with one (1) prime coat of Tnemec Series 218 and two (2) finish coats of Tnemec Series 104, 8 to 10 mils dft, or approved equal.

PART 3 EXECUTION

3.1 STAKING AND GRADING

- A. The Engineer shall be responsible for providing benchmarks. The Contractor shall set offset stakes for line and grade.

- B. The Contractor shall be responsible for providing laser beam equipment and using this equipment to grade and align all sewer lines between manholes. The Engineer will provide a list of benchmark elevations from which the Contractor may work.

3.2 MANHOLE INFILTRATION TEST

- A. Each manhole shall be tested for watertightness.
- B. All connecting piping shall be plugged and manhole filled with water, allowed to stand for one (1) hour, and then refilled. If measurable water level drop occurs after a second one-hour period, the Contractor shall repair the leakage and re-test at no additional cost to the Owner.

3.3 VACUUM TESTING OF MANHOLES

- A. Test Method: Each manhole shall be vacuum tested in accordance with ASTM C1244-94.
- B. Plug Lift Holes: All lift holes shall be plugged with approved non-shrink grout.
- C. NO grout will be placed in the horizontal joints before testing.
- D. Pipes Entering Manhole: All pipes entering the manhole shall be plugged, taking care to securely brace the plugs from being drawn into the manhole.
- E. The test head shall be placed at the inside of the top of the cone section and the seal inflated in accordance with the manufacturer's recommendation.
- F. Vacuum Requirements: A measured vacuum of 10-inches of mercury shall be established in the manhole. The time for the vacuum to drop to 9 inches of mercury shall be recorded.
- G. Leakage: Acceptance standards for leakage shall be established from the elapsed time for a negative pressure change from 10 inches to 9 inches of mercury. The maximum allowable leakage rate for a 4-foot diameter manhole shall be accordance with the following:

Manhole Depth	Minimum Elapsed Time for a Pressure Change of 1 Inch Hg
10 feet or less	60 seconds
>10 feet but <15 feet	75 seconds
>15 feet but <25 feet	90 seconds

- H. Test Failure: If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn. Re-testing shall proceed until a satisfactory test is obtained.
- I. Test Equipment: Vacuum test equipment shall be equal to that of P.A. Galzier, Inc., Worcester, MA.

END OF SECTION

**SECTION 40 05 14
PLASTIC PROCESS PIPING**

PART 1 GENERAL

1.1 SUMMARY

- A. Provide under this specification all labor, equipment, and materials required to install and test: PVC SDR 21, Schedule 40, Schedule 80, CPVC plastic and PVC tubing, including valves, unions, fittings, couplings, adapters, and accessories as shown on contract drawings and/or specified suitable for the intended service.
- B. Contract drawings are schematic in nature and are not necessarily complete. Provide all piping, fittings, and accessories necessary for the proper operation of the equipment and services requiring such piping.

1.2 REFERENCES

- A. ASTM (American Society for Testing and Materials):
- B. D-1784: Standard Specification for Rigid Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl Chloride (CPVC) Compounds
- C. D-1785: Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120
- D. D-2466: Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40
- E. D-2467: Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
- F. D-2672: Standard Specification for Joints for IPS PVC Pipe using Solvent Cement
- G. D-2855: Standard Practice for Making Solvent Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings
- H. F-1498: Standard Specification for Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings
- I. F-402: Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
- J. F-437: Standard Specification for Threaded Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80
- K. F-441: Standard Specification for Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe, Schedules 40 and 80

- L. ASME/ANSI (American Society of Mechanical Engineers / American National Standards Institute):
- M. B16.5: Flanges and Flanged Piping
- N. B1.20.1: National Pipe Thread Taper - Pipe Thread Dimensions
- O. NSF/ANSI (National Sanitation Foundation/American National Standards Institute):
- P. Standard 14: Plastic Piping Systems Components and Related Materials
- Q. Standard 61: Drinking Water Systems Components – Health Effects

1.3 SYSTEM DESCRIPTION

- A. Piping shall be suitable for use with the following services:
 - 1. Non-potable water,
 - 2. Potable water,
 - 3. Polymer,
 - 4. Sodium Aluminate.

1.4 QUALITY ASSURANCE

- A. The manufacturer must have adequate equipment and quality control facilities to ensure that each extrusion of pipe is uniform in texture, dimensions, and strength. Test and inspect all pipe for all requirements of the latest ASTM and Commercial Standard tests and provide certified copies of test reports for each shipment to the Engineer prior to installation of pipe.
- B. For each length of pipe and fitting, mark each piece with the following data:
 - 1. Nominal Size
 - 2. Type and grade of material and ASTM standard
 - 3. SDR, class, or schedule rating
 - 4. Manufacturer
 - 5. National Sanitation Foundation's seal of approval
- C. Install all new materials.

1.5 SCHEDULING

- A. Coordinate all work.

1.6 RELATED WORK

- A. Valves and Appurtenances in Section 33 35 00.
- B. Operation and maintenance manuals included in Section 01 78 23.
- C. Submittals Section 01 33 00.

1.7 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01 33 00, copies of all materials required to establish compliance with this Section. Submittals shall include the following:
 - 1. Piping layouts as required and material schedule.
 - 2. Descriptive literature cut sheets and/or catalogues.
 - 3. Operation and maintenance materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. PVC piping shall be as manufactured by United States Plastic Corporation or approved equal.
- B. PVC tubing shall be NYLOBRADE, braid-reinforced PVC hose as manufactured by New Age Industries, Inc. or approved equal.

2.2 PVC AND CPVC PIPING

- A. General:
 - 1. Provide Schedule 80 pipe and fittings, unless noted otherwise.
 - 2. Furnish materials in full compliance to following material specifications:
 - a. PVC: Type 1, Grade 1 (12454-B) Polyvinyl Chloride per ASTM D1784.
 - b. CPVC, Type IV, Grade 1, Chlorinated Polyvinyl Chloride per ASTM D178 and F441.
 - c. Manufacture pipe, fittings and valves from materials that have been tested and approved for conveying potable water by the National Sanitation Foundation (NSF).
- B. Joints:
 - 1. Pipe 2 IN and less to be solvent welded.

2. Pipe larger than 2 IN may be either flanged or solvent welded unless shown otherwise on Drawings.
3. Provide joint solvent cement specifically formulated for use with the chemicals being transported. Provide IPS 724 solvent cement or equal.

C. Fittings:

1. PVC: ASTM D2467 PVC socket type fittings having the same pressure and temperature rating as the pipe.
2. CPVC: ASTM D1784 CPVC socket type fittings having the same pressure and temperature rating as the pipe.

D. Flanges/Unions:

1. Furnish flanges and unions at locations shown on Drawings.
2. Provide either flanges or unions at valves, penetrations through structures and equipment connections.
3. For pipe larger than 2 IN, provide 150 LB socket type PVC or CPVC flange.
4. For pipe 2 IN and less, provide socket type PVC or CPVC union with O-rings.
5. Use flat, full faced gaskets at flanged connections.
 - a. Furnish heavy hex head bolts, each with one heavy hex nut, ASTM F593 Type 316 stainless steel.
6. Use spacers supplied by pipe manufacturer when mating raised-faced flanges to other flanges.

E. Flexible Couplings:

1. Provide flexible couplings at locations shown on the Drawings and required for pipe flexibility and expansion/contraction purposes.
2. Unless otherwise specified, provide rubber expansion joints as manufactured by General Rubber Corporation or equal.

2.3 PVC TUBING

- A. PVC tubing shall be made from non-toxic raw materials that conform to Food and Drug Administration (FDA) standards. It shall be NSF 61 listed. It shall have a Tensile Strength of 2500 psi.
- B. Braid Reinforced Clear PVC Tubing shall be NSF Listed for potable water (NSF-61). The open mesh polyester braiding permanently encapsulated in walls of clear, flexible PVC

tubing. The interior shall be smooth permitting flow, the tubing shall be clear to see visually flow, and tubing shall be corrosion and abrasion resistant with flexibility similar to rubber. The tubing shall have the following Physical Properties:

Hardness, Shore A ± 5	80
Tensile Strength, psi	2500
Elongation at Break, %	300
Brittle Temperature	-50°F
Max. Operating Temperature	175°F
Max. Operating Temp. for NSF	140°F

PART 3 EXECUTION

3.1 INSTALLATION

- A. Employ installation and pipe support practices and solvent welding in compliance with manufacturers recommendations.
- B. Testing
 - 1. PVC tubing and piping shall be hydraulically tested to a maximum of 150% of the designed working pressure.

3.2 SUPPORTS

- A. Unless noted otherwise, continuously support PVC piping at liquid temperatures in excess of 100 degrees F.
- B. Support PVC and CPVC piping per manufacturers design and engineering guidelines.

3.3 REPAIR/RESTORATION

- A. Repair all defective work.

3.4 FIELD QUALITY CONTROL

- A. Provided documentation of all testing.

3.5 CLEANING

- A. Clean all piping upon completion of installation.

END OF SECTION

**SECTION 40 05 24
STEEL PIPE**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Contractor shall provide and install steel pipe, fittings, and appurtenances.

1.2 QUALITY ASSURANCE

- A. All work specified herein shall conform to or exceed the requirements of the latest version of applicable portions of the following standards:
1. Steel pipe thickness: AWWA C200
 2. Steel pipe flanges and fittings: AWWA C207 and AWWA C208
 3. Installation of buried steel pipe: AWWA C604
 4. Field welding of steel: AWWA C206
 5. Cathodic protection: AWWA D104
 6. Steel Pipe – A Guide for Design and Installation: AWWA M11
- B. Qualifications:
1. All steel pipe and fittings shall be furnished by suppliers who are fully experienced, reputable, and qualified in the manufacture of the materials to be furnished.
 2. The pipe and fittings shall be manufactured, and, installed in accordance with established industry practices and methods and shall comply with these specifications as applicable.
 3. Use only certified welders when required.

1.3 SUBMITTALS

- A. Shop Drawings: Submit shop drawings of pipe and fittings in accordance with the requirements of the Contract Documents, the requirements of Section 01 33 00 of this specification, and the following supplemental requirements as applicable:
1. Certified Dimensional Drawings of all pipe, specials, and fittings.
 2. Layout drawings for all aboveground piping systems showing the following as a minimum:
 - a. Bill of materials with piece identification number and description of each pipe and fitting.

- b. Scaled and dimensioned plan, section, and detail views of each piping system with the fittings, couplings, joints, and other equipment to be supplied.
 - c. Locations of all anchors, supports, hangers, saddles, straps, and other accessories. Identify the type by catalog number or shop drawing detail number.
 - d. Wall and floor penetrations with description of sleeves, castings, sealants, escutcheons, and other accessories as applicable.
 - e. Orientation of valves and valve operators, if applicable
3. Laying schedule and marking diagrams for all buried piping systems showing the following as a minimum:
- a. Bill of materials with piece identification number and description of each pipe and fitting.
 - b. Location and direction of lay of each pipe and fitting.
 - c. Pipe station and invert elevation at all changes in grade or horizontal alignment.
 - d. All elements of curves and bends, both in horizontal and vertical alignment.
 - e. Limits of each reach of restrained joints, and/or of concrete encasement.

1.4 DELIVERY, STORAGE AND HANDLING

- A. All pipes shall be shipped and stored at the Project site in accordance with manufacturer's recommendation and the section entitled "Delivery, Storage and Handling" of these Specifications
- B. The Contractor shall exercise extra care when handling lined and galvanized pipe. Damage to the lining coating will render it unfit for use and shall require replacement.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Steel pipe ASTM A53, Type E or S.
- B. Unless otherwise specified or shown, steel pipe 6 inches and smaller shall be screwed, Schedule 40. Galvanized pipe for 6 inch and less must be approved for use in the specific application by the Engineer.
- C. Steel pipe for process piping in sizes 3 inches through 6 inches shall be welded, Schedule 40. Steel pipe in sizes 8 inches or larger shall be welded, Schedule 20 exposed, Schedule 40 buried.
- D. Flanges shall be forged steel or slip on. ANSI B16.5.

- E. Bolts shall be zinc plated. Nuts shall be heavy hex nuts zinc plated.
- F. Gaskets shall be of red rubber 1/16-inch thick, conforming to ANSI B16.21. Gaskets for piping operating at temperatures in excess of 150° F shall be soft corrugated metal.
- G. Hot dip galvanize (for pipe less than 6 inches in diameter) in accordance with the requirements of ASTM A153. Hot dipped galvanized pipe shall not be painted unless noted otherwise. Exposed carbon steel piping shall be field primed and painted in accordance with the requirements of the section entitled “Painting” of these Specifications.

2.2 COATINGS

- A. Buried piping shall be furnished with a coal tar enamel coating or cold-applied, plastic tape wrap coating as described herein.
- B. Coal tar enamel coatings shall conform to the requirements of AWWA C203. Cold-applied plastic tape wrap coatings shall comply with the requirements of AWWA C209 and C214.
- C. The manufacturers of the coated pipe and field coating materials shall provide the Engineer with written certifications that the pipe coating systems conform to all applicable requirements of AWWA C203, C209, C210, or C214m, as appropriate.

PART 3 EXECUTION

3.1 INSPECTION AND TESTING

- A. All pipes shall be inspected and tested at the foundry.
- B. The Owner shall have the right to have any or all piping, fittings or special castings inspected and tested by an independent testing agency at the foundry or elsewhere. Such inspection and testing will be at the Owner's expense.
- C. The Contractor shall mark as rejected material and immediately remove from the Project site, all pipe lengths showing cracks in pipe or damaged lining. Damaged lining shall be defined as lining that appears to be separated from the pipe wall over extensive areas, excessive hair line fractures, or lifted edges or separated segments visible to the eye.

3.2 INSTALLATION

- A. All exposed piping shall be firmly anchored and supported by pipe supports or anchors.
- B. Joining methods
 - 1. Screwed fittings:
 - a. Thread and couple (T/C)
 - b. To meet ANSI B2.1 requirement

- c. Furnish factory made T/C ends
- d. Field cut and thread
- e. Leave not more than 3 pipe threads exposed at branch
- f. Ream pipe to remove burrs before assembly
- g. Use Teflon tape on male thread in mating joints.

2. Flanges:

Facing method

- a. Insert slip on flange
- b. Assure tolerances
- c. Test flange after welding to pipe to for true face to face conditions and reface if necessary.

Joining method

- d. Leave 1/8 to 3/8 inch of flange bolts projecting beyond face of nut after tightening.
- e. Coordinate drilling of flanges and flanges on valves, pumps, equipment, and tanks.
- f. Do not over stress bolts.

3. Welding:

- a. Perform welding in accordance with AWWA C206.
- b. For flange attachment use methods in AWWA C207.
- c. Welding of all process piping shall conform to ANSI B31.3
- d. Welding of utility piping less than 125 psi shall conform to ANSI B31.9.
- e. Welding of utility piping over than 125 psi shall conform to ANSI B31.1.
- f. Provide caps, tees, elbows, manufactured for welding.
- g. Weldolet is allowed on pipe 5 inches and larger provided all slag is removed from the interior of the pipe.
- h. Use long radius welding elbows for expansion loops and bends.

- i. Use long radius reducing welding 90 degree bends when size changes are required.
- C. Offsets, transitions, and changes in direction in pipes shall be made as required to maintain proper headroom, slope, etc.
- D. A liberal number of unions and/or flanged joints shall be used to permit the ready removal of any section. Unions shall be installed in all piping connections to equipment, to regulating valves, and wherever necessary to facilitate the dismantling of pipeline and removal of valves and other items requiring maintenance. Flanges on equipment may be considered as unions.
- E. The interior of all piping shall be free from obstructions and protrusions. All burrs shall be removed from the inside and outside edges of all cut pipe by reaming. Cutting shall be done in such a manner so as to leave a smooth end at right angles to pipe threads. Tool marks and unnecessary pipe threads shall be avoided. Cuttings and other foreign material shall be removed from the inside of the pipe prior to installation.
- F. Unless otherwise shown on the Drawings, piping laid underground shall have a minimum cover over the top of the pipe as follows:
 1. Located in Roadway: 48 inches
 2. Located in Other Paved Areas: 36 inches
 3. Water, Gas, and Drain Piping,
 - a. 4-inch I.D. and larger: 30 inches
 4. Water, Gas, and Drain Piping,
 - a. 3 -inch I.D. and smaller: 24 inches
 5. Located under Building: 6 inches
- G. Suitable galvanized steel pipe sleeves of adequate inside diameter shall be provided where piping or tubing passes through walls and floors of buildings and structures. Inside diameter of sleeve shall be approximately ½-inch larger than outside diameter of pipe or insulation. A welded steel plate waterstop with a minimum dimension 4 inches larger than outside diameter of sleeve shall be furnished for use in underground walls. Sleeves shall be built into the concrete or masonry wall or floor. Under no circumstances will blocking out or breaking of walls be permitted for later insertion. After installation of piping, space between the pipe and the sleeve shall be caulked air and watertight.
- H. After installation, the interior of all piping shall be cleaned as necessary to remove flux, slag, scale, rust, dirt, oil, and other foreign material. As piping is installed, open ends shall be covered or plugged as necessary to prevent the entrance of foreign matter and to maintain the required cleanliness.

- I. All piping installed above or underground shall be installed in accordance with manufacture's recommendation.
- J. Changes in pipe size shall be made using reducing fittings, not brushings. If centerline elevation is not specified, use eccentric reducers in horizontal piping. On liquid lines, eccentricity shall be down with top of pipe level. On vapor and gas lines, eccentricity shall be up with bottom level.

3.3 FIELD TESTING

- A. After all piping has been placed and backfilled between the joints, each run of newly laid pipe, or any valved section thereof, shall be tested by the Contractor in the presence of the Engineer, and tests shall be continued until all leaks have been made tight to the satisfaction of the Engineer.
- B. All piping carrying liquids under pressure shall be subjected to a hydrostatic gauge pressure of 150 percent of the maximum expected operating pressure of 150 psig, whichever is greater, based on elevation of the lowest point of the section under test, corrected to the elevation of the pressure gauge. All piping carrying compressed air shall be subjected to a hydrostatic gauge pressure of at least 150 percent of the maximum expected operating pressure of 150 psig, whichever is greater. The above pressures shall be maintained for a minimum of 2 consecutive hours. No leakage will be allowed. Leakage may be determined by loss of pressure, soap solution, or other methods approved by the Engineer.
- C. Process piping, designed in accordance with ANSI B16.3 or ANSI B16.4, shall be tested in accordance with the requirements contained therein.
- D. The Contractor shall take all precautions necessary to protect any equipment that might be damaged by the pressures used in the tests. Delicate equipment shall be valved off, removed, or otherwise protected.
- E. All piping shall be securely anchored and restrained against movement prior to application of test pressures. Prior to the pressure test, pipe laid in trenches shall be partially backfilled adequately to secure the pipe during the test. All joints, fittings and valves will be left open where possible. All exposed pipe, fittings, valves, and joints shall be carefully examined during the pressure test.
- F. Before applying the specified test pressure during a test using water as the pressurizing medium, all air shall be expelled from the pipe. If hydrants, blowoffs, or air release valves are not available at high places, the Contractor shall make the necessary taps at points of highest elevation before the test is made and insert pugs after the test has been completed.
- G. Subject welded joints to hammer tests while under pressure.

- H. Any leakage developing during the test shall be corrected at the Contractors expense by tightening, replacing packing or gaskets, or replacing defective portions of the piping system. No caulking will be permitted. If the defective portion cannot be located, the Contractor, at his expense, shall remove and reconstruct as much of the original work as necessary to obtain a piping system tested without leakage.
- I. After all tests on any section have been completed to the satisfaction of the Engineer, the Contractor shall carefully clean, blow out, and drain the line of all water to prevent freezing of the same. The Contractor shall also demonstrate to the satisfaction of the Engineer that any and all lines are free from obstruction and foreign material.
- J. The Contractor shall bear complete cost of the tests, including set up, labor, temporary piping, blocking, gauges, bulkheads, water, air, soap solutions, and other materials required to conduct the tests.

3.4 FIELD PAINTING

- A. Following installation and testing, all exposed piping shall be field primed and painted in accordance with requirements of section 09 91 00 of these Specifications and per manufacturer recommendations.

3.5 DISINFECTION

- A. Following installation and testing, potable water lines shall be disinfected in keeping with regulatory requirements.

END OF SECTION

**SECTION 40 05 25
STAINLESS STEEL PIPE**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Provide stainless steel pipe and fittings with appurtenances for low pressure air supply piping.

1.2 QUALITY ASSURANCE

- A. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.
 - 1. A single manufacturer shall provide all pipe, fittings and appurtenances.
 - 2. The manufacturer shall be responsible for the design, construction and proper operation of all components.
- B. Comply with applicable standards including, but not limited to the most recent edition of the following:
 - 1. ANSI B16.5 – Pipe Flanges and Flanged Fittings.
 - 2. ANSI B16.9 – Factory Made Wrought Steel Butt welding Fittings.
 - 3. ANSI B16.11 – Forged Fittings, Socket Welding and Threaded.
 - 4. ANSI B36.19 – Stainless Steel Pipe.
 - 5. AWS D1.6/D1.6M – Structural Welding Code; Stainless Steel.
- C. Design to provide satisfactory performance under the specified operating conditions.
- D. Inspections
 - 1. Visually inspect pipe and fittings at time of delivery and just prior to lowering items into the trench for installation.
 - a. Do not use defective materials.
 - b. Immediately remove rejected material from the project site.

1.3 SUBMITTALS

- A. Comply with Section 01 33 00.
- B. Include the following information:

1. Manufacturer's catalog information and engineering data that describes each type of pipe, fitting, coating, and lining provided. Include:
 - a. Specifications.
 - b. Mill test certificates.
 - c. Certified test reports.
2. Installation and repair procedures.
3. Shop drawings:
 - a. Fabrication drawings for shop fabricated piping.
 - b. Layout drawings for each piping system showing the following as a minimum:
 - (1) Pipe material, class, grade, joint type, coating system and lining system.
 - (2) Reinforcing details
 - (3) Joint and gasket dimensions
 - (4) Anchors, supports, hangers, saddles, straps, and other accessories. Identify the type by catalog number or shop drawing detail number.
 - (5) Fittings, couplings, joints, and joint harnesses.
 - (6) Centerline elevations.
 - (7) Location, size, and type of anchor bolts.
 - (8) Wall and floor penetrations. Include sleeves, castings, sealant, and other accessories.
 - (9) Miscellaneous details required for a complete and functional installation.
 - c. Laying schedules for underground piping systems. As a minimum, identify the following:
 - (1) Pipe invert station and elevation at each grade and alignment change.
 - (2) Pipe length as measured along the centerline.
 - (3) Limit of each reach of pipe thickness class and joint restraint system. Include design calculations.
 - (4) Location of valves and other mechanical equipment.
 - (5) Details of special piping and fittings.
 - (6) Test pit information as indicated on the drawings and as required by the Owner's project manager or designee.

C. Certified Test Reports:

1. Certify compliance with AWWA and ASTM standards and these specifications for all pipe and fittings.

2. Unless noted otherwise, no pipe or fittings will be accepted until the required certificates are submitted and approved by the Owner's project manager or designee.

D. Pipeline Inspections and Tests:

1. Submit detailed plan for testing pipeline sections at least 30 days prior to testing. Include:
 - a. Test procedures.
 - b. Locations for necessary equipment and materials.
 - c. Date and duration of tests.
2. Test records with a certificate of satisfactory completion signed by both Contractor and Owner's project manager or designee. Include the following:
 - a. Test date.
 - b. Identify of pipeline being tested or re-tested.
 - c. Pipeline material.
 - d. Test fluid or gas.
 - e. Test pressure.
 - f. Remarks:
 - (1) Identify types and location of leaks.
 - (2) Identify types of repairs.
 - g. Contractor's certification that the measured leakage rate conforms to these specifications.

E. Signature of Owner's project manager or designee witnessing the test.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, handle, and store the equipment in accordance with Section 01 45 34.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Douglas Brothers.
- B. Felker Brothers Corporation.
- C. Or equal.

2.2 PIPE

- A. Design:
 1. Less than three inches diameter: Seamless.

2. Three inches diameter and greater:
 - a. Electrically welded or seamless.
 - b. Do not use spiral welding.
- B. Material:
 1. Type 304 SS.
 2. No. 1 mill finish or better.
- C. Diameter: As shown on the Drawings. The diameter shown is the nominal outside diameter.
- D. Wall Thickness:
 1. Size to meet the fabrication, installation, and service conditions shown or specified.
 2. Use Schedule 5S.
- E. Joints:
 1. Provide flanges at valves, equipment connections, strainers, instrument connections, where dismantling may be required, and other locations shown on the Drawings.
 - a. 150 pound raised face flanges.
 - b. Weld - neck.
 - c. Conform to ANSI B16.5; and ASTM A182, Grade F-316L.
 2. Use shop welded joints for all other connections.
 3. Gaskets:
 - a. Use spiral wound, Type 316 stainless steel strip with flexible graphite filler, and carbon steel centering ring suitable for use with 150 pound raised face flange.
 4. Bolts and Nuts: Type 304 stainless steel.

2.3 FITTINGS

- A. Use same material as pipe.
- B. Fittings 2-1/2 inches and larger:
 1. Butt weld using the same material, schedule, and thickness as the pipe.
 2. Use long radius 90 degree elbows where shown.
 3. Use tapered, cone type reducers.

4. Use standard, commercially available tees, crosses, laterals, and wyes of the socket weld and butt weld type.

2.4 IDENTIFICATION

- A. Identify all pipe and fittings with the following:
 1. Manufacturer's name.
 2. Date of manufacture.
 3. Design operating pressure and temperature.
 4. Type of service.
 5. Manufacturer's part number, as applicable.

PART 3 EXECUTION

3.1 FABRICATION AND HANDLING

- A. Avoid contact of any ferrous metal with stainless steel.
 1. Use tools dedicated for stainless steel.
 2. Handle using nylon slings and alloy chains, cable or straps.
 3. Store on racks constructed of non-ferrous metal or line with rubber.
- B. Clean and descale welded items per ASTM A380 and as follows:
 1. Passivate by immersion in a pickling solution consisting of minimum 6 percent nitric acid and 3 percent hydrofluoric acid.
 2. Use temperature and retention time sufficient to remove oxidation and ferrous contamination without etching the surface.
 3. Rinse completely with clean water.
 4. Ensure there is no staining or streaking from iron or other surface contaminants on the ready to be shipped items.
- C. Ensure stainless steel makers are free of harmful metal or metal salts such as zinc, lead, copper or sulfur.
- D. Shop fabricate pipe using circumferential welding of mill pipes.
 1. Limit longitudinal seams to a maximum of two per section.
 2. Provide girth seams not less than six feet apart, except at fittings and specials.

E. Fabrication tolerances.

1. Make pipe ends perpendicular to the longitudinal axis. Remove all burrs.
2. Roundness: $\pm 1/16$ inch.
3. Straightness:
 - a. Conform to ASTM A530.
 - b. Do not exceed maximum deviation of $1/8$ inch per 10 foot length.
4. Make all edges true. Do not leave a shoulder on the inside of the pipe.

3.2 WELDING

A. Complete all welding in the manufacturer's shop. Field welding may be used at wall penetrations and when approved by the Owner's project manager or designee.

B. Weld Examination:

1. Use inspectors qualified to at least Level II in accordance with ASNT SNT-TC-1A.
2. Conform to ASME Boiler Test Code, Section V.
3. Visually examine all welds, Category D Fluid Service in accordance with ASME B31.3
4. Examine at least 10 percent of all welds using liquid penetrant examination.
 - a. If defects are detected, examine all welds using this procedure.
 - b. Remove all penetrant test materials by flushing, washing, or wiping clean with appropriate solvents.

C. Shop Quality Control and Inspection:

1. Maintain a quality control program.
2. Document at least the following per Section IX of the ASME Code:
 - a. Welding procedure specification and procedure qualification record.
 - b. Welder/Welding Operator performance qualification record.
 - c. Detailed procedures and test results relative to weld examinations.
 - d. Dimensional tolerances.
 - e. Verification of materials used to fabricate pipe and fittings. Make traceable to original heat numbers.
 - f. Passivation. Include pickling and cleaning of all stainless steel fabrication welds.

3.3 INSTALLATION

- A. Install all pipe and fittings in accordance with the instructions of the manufacturer, these specifications and the approved shop drawings.
- B. Prior to placing the pipe into service, wash the interior with water to ensure all contaminants are removed.
- C. The use of pickling paste applied to field weld joints will be allowed. The pickling paste shall be used in conformance with the manufacturer's recommendations, at a minimum, the following procedure must be followed, allow the weld to cool, degrease area with a cleaner to remove organic contamination, apply pickling paste (avoid direct sunlight applications), allow the paste time to react per the manufacturer's recommendations, rinse with water and capture all rinse water then neutralize prior to disposal.

END OF SECTION

**SECTION 40 05 59
ALUMINUM STOP GATES**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment and incidentals required to install and ready for operation aluminum stop gates as shown on the Contract Drawings and as specified herein.

1.2 SUBMITTALS

- A. Provide the following information to confirm compliance with the specification in addition to the submittal requirements specified in Section 01 30 00.
 - 1. Complete description of all materials including the material thickness of all structural components of the frame and slide.
 - 2. Installation drawings showing all details of construction, details required for installation, dimensions and anchor bolt locations.
 - 3. Maximum bending stress and deflection of the slide under the maximum design head.
 - 4. The location of the company headquarters and the location of the principle manufacturing facility. Provide the name of the company that manufactures the equipment if the supplier utilizes an outside source.
- B. Provide O & M Manuals – Section 01 78 23.

1.3 QUALITY ASSURANCE

- A. Qualifications
 - 1. All of the equipment specified under this Section shall be furnished by a single manufacturer with a minimum of 20 years' experience designing and manufacturing water control gates. The manufacturer shall have manufactured water control gates for a minimum of 100 projects.
 - 2. The specification is based on the 500 Series Aluminum Stop Gate manufactured by Whipps.

PART 2 EQUIPMENT

2.1 GENERAL

- A. Gates shall be as specified herein and have the characteristics and dimensions shown on the Contract Drawings. Refer to the gate schedule.

- B. Leakage shall not exceed 0.1 gpm/ft of wetted seal perimeter in seating head and unseating head conditions.
- C. The gate shall utilize self-adjusting seals. Gates that utilize adjustable wedges or wedging devices are not acceptable.
- D. All structural components of the frame and slide shall be fabricated of aluminum having a minimum thickness of 1/4-inch and shall have adequate strength to prevent distortion during normal handling, during installation and while in service.
- E. All welds shall be performed by welders with AWS certification.
- F. Finish: Mill finish on aluminum. All aluminum in contact with concrete shall be field coated by the CONTRACTOR with a heavy coat of bitumastic paint. Welds shall be cleaned to provide a uniform finish.
- G. Materials:

Components

Frame Guides and Invert
Slide and Stiffeners
Anchor Studs, Fasteners and Nuts
Invert Seal
Seat/Seal and Facing

Materials

6061-T6 Aluminum
6061-T6 Aluminum
Stainless Steel, Type 316, ASTM A276
Neoprene ASTM D-2000 or EPDM
Ultra-High Molecular Weight Polyethylene ASTM D4020

2.2 FRAME

- A. The frame guides and invert member shall be constructed of extruded aluminum with a minimum thickness of 1/4-inch.
 - 1. Frame design shall allow for embedded mounting or mounting directly to a wall with stainless steel anchor bolts and grout. Mounting style shall be as shown on the Contract Drawings.
 - 2. A rigid aluminum invert member shall be provided across the bottom of the guides. The invert member shall be of the flush bottom type.

2.3 SLIDE

- A. The slide and reinforcing stiffeners shall be constructed of aluminum plate with a minimum thickness of 1/4-inch.
 - 1. The slide shall not deflect more than 1/360 of the span or 1/16 inch, whichever is smaller, under the maximum design head.
 - 2. Reinforcing stiffeners shall be welded to the slide and mounted horizontally.

3. An aluminum lifting handle shall be welded to the top of the slide. Stop gates with widths in excess of 24 inches shall be provided with dual lifting handles.

2.4 SEALS

- A. All gates shall be provided with a self-adjusting seal system to restrict leakage in accordance with the requirements listed in this specification.
 1. All gates shall be equipped with UHMW polyethylene seat/seals to restrict leakage and to prevent metal to metal contact between the frame and slide.
 2. All stop gates shall be provided with a resilient seal to seal the bottom portion of the gate. The seal shall be attached to the invert member of the frame, or the bottom of the slide and it shall be held in place with stainless steel attachment hardware.
 3. The seal system shall be durable and shall be designed to accommodate frequent operation without loosening or suffering damage.
 4. All seals must be bolted or otherwise mechanically fastened to the frame or slide. Arrangement with seals that are force fit and/or held in place with adhesives are unacceptable.
 5. The seals shall be mounted so as not to obstruct the water way opening.
 6. Gates that utilize rubber “J” seals or “P” seals are not acceptable.

2.5 ANCHOR BOLTS

- A. Anchor bolts shall be provided by the gate manufacturer for mounting the gates.
 1. Quantity and location shall be determined by the gate manufacturer.
 2. If epoxy type anchor bolts are provided, the gate manufacturer shall provide the studs and nuts.
 3. Anchor bolts shall have a minimum diameter of 1/2-inch.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation of the gates and appurtenances shall be done in a workmanlike manner. It shall be the responsibility of the Contractor to handle, store and install the equipment specified in this Section in strict accordance with the manufacturer's recommendations.
- B. The contractor shall review the installation drawings and installation instruction prior to installing the gates.
- C. The gate assemblies shall be installed in a true vertical plane, square and plumb.

- D. The contractor shall fill the void in between the gate frame and the wall with non-shrink grout as shown on the installation drawing and in accordance with the manufacturer's recommendations.

3.2 FIELD TESTING

- A. After installation, all gates shall be field tested in the presence of the Engineer and Owner to ensure that all items of equipment are in full compliance with this Section. Each gate shall be cycled to confirm that they operate without binding, scraping, or distorting.

END OF SECTION

**SECTION 40 24 00
PIPING SPECIALTIES**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Provide those piping specialties and miscellaneous accessories specified herein, shown on the Contract Documents or required for a complete and functional piping system.
 - 1. Required specialty items are not necessarily shown on the Drawings.
 - 2. Provide items required by code or standard industry practice. Also provide those items necessary to ensure the piping system operates as required.
 - 3. Locate specialty items where shown on the Drawings or as required to ensure they are accessible for control and maintenance.
- B. Related sections specified elsewhere:
 - 1. Submittals – Section 01 33 00.
 - 2. O & M Manuals – Section 01 78 23.

1.2 1.2 QUALITY ASSURANCE

- A. Comply with applicable portions of Section 01 40 00.
- B. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.
- C. Comply with applicable standards.
- D. Design to provide satisfactory performance under the specified operating conditions.

1.3 SUBMITTALS

- A. Comply with Section 01 33 00. Include the following information:
 - 1. Manufacturer's catalog information that describes each item provided. Include:
 - a. Specifications
 - b. Catalogue information including descriptive literature.
 - c. A complete bill of materials that identifies all materials of construction.
 - 2. Special shipping, storage, protection, and handling instructions.

3. A list of manufacturer's recommended parts required to maintain the equipment for a period of one year, with current price information.
4. A list of special tools, materials, and supplies furnished with the equipment for use prior to and during startup, and for future maintenance.
5. Manufacturer's installation instructions.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle, and store the equipment in accordance with Section 01 45 34.
- B. Handle components with equipment designed to prevent damage. Protect finishes, coatings, lubrication, etc.
- C. Store components off the ground. Protect from dirt and moisture and prevent foreign material from entering the ends.

1.5 USE OF OTHER THAN FIRST NAMED MANUFACTURER

- A. Comply with Section 01631 if manufacturers other than those first named below for each item are provided.

PART 2 PRODUCTS

2.1 WALL CASTINGS

- A. Use wherever shown on the Contract Drawings and for all pipes 4-inches in diameter and larger passing through reinforced concrete walls with liquid on one side and a personnel area on the other side.
 1. Construct castings of cast iron or ductile iron.
 - a. Comply with ANSI A21.11, A21.15 or A21.51 as appropriate.
 - b. Provide double cement lining per ANSI A21.4.
 2. Use same diameter and wall thickness as the connecting piping.
 3. Provide flanges for interior connections and mechanical joint or push-on bells for exterior connections unless otherwise shown on the Drawings.
 4. Include water stop flange.
- B. Make the casting length as shown on the drawings or as required to make the piping connection, whichever is longer.
 1. Do not use flanges set flush with the wall face unless approved by the Engineer.

2. If flush mounted casting is used, provide taps for bolts. Do not use studs.
- C. Install castings integral with the reinforced concrete wall. Do not box out the concrete so that the casting can be installed at a later date.
- D. Manufacturers
 1. American Cast Iron Pipe Company
 2. U. S. Pipe and Foundry
 3. Or approved equal.

2.2 PIPE SLEEVES

- A. Use where shown on the Drawings or where approved by the Engineer.
 1. Construct sleeves of minimum schedule 40 steel conforming to ASTM A53.
 2. Include a continuously welded flange to prevent water migration and anchor the sleeve into the wall or floor.
 3. Hot dip galvanizes the sleeve assembly after fabrication. Conform to ASTM A123.
 4. Size the sleeve to pass both the pipe and insulation (where required). Use full thickness insulation and carry it completely through the sleeve. Also accommodate the mechanical sealing system specified below.
 5. Use core drilled holes in existing walls rather than sleeves.
- B. Seal the opening between the pipe and the sleeve with a modular mechanical sealing system. Caulking is not acceptable.
 1. The sealing system shall consist of interlocking synthetic rubber links designed to completely seal the annular space between the pipe and the sleeve.
 - a. Seal against a head of 40 feet of water without leaks.
 - b. Provide fire rated service where necessary.
 2. Use 316 stainless steel fasteners and corrosion resistant pressure plates under each bolt head.
- C. Manufacturers
 1. Thunderline Corporation.
 2. Or approved equal.

2.3 FLANGE FILLERS

- A. Construct of cast or ductile iron. Comply with ASTM A48 or A536 as applicable.
- B. Provide flat, beveled or reducing flanges as required by the piping system.
- C. Face both sides and drill flanges to comply with ANSI B16.1, Class 125.
- D. Provide extra length bolts to make the piping connection.

2.4 MECHANICAL COUPLINGS

- A. Provide where shown on the Drawings and where required to facilitate pipe disassembly and the removal of valves and other equipment.
 - 1. Size to match the outside diameter of the pipe ends to be joined. Allow at least ½-inch space between adjacent pipe ends to accommodate thermal expansion and contraction.
 - 2. Use transition couplings to join pipes of different outside diameters.
 - 3. Restrain all couplings in pressure piping as shown on the Drawings. Design to resist the force developed by the test pressures specified.
 - 4. Use fusion bonded epoxy lined and coated steel middle rings and followers. Comply with AWWA C213.
 - 5. Nuts and bolts
 - a. Zinc plated
 - b. High strength steel per AWWA C111 when used with cast iron and ductile iron couplings.
 - c. Type 304 stainless steel for submerged applications.
- B. Manufacturers
 - 1. Dresser
 - 2. Smith-Blair
 - 3. Or approved equal.
- C. Model Numbers

<u>Coupling Type</u>	<u>Dresser</u>	<u>Smith-Blair</u>
Flexible Coupling – Steel	38	411
Flexible Coupling – Ductile Iron	38 or 153	411

Transition Coupling	162	413
Flanged Coupling Adaptor – Steel	128	913
Flanged Coupling Adaptor – DIP	127 or 128	912

2.5 SERVICE SADDLES

A. Construction

1. Ductile iron body conforming to ASTM A536. Provide fusion bonded epoxy coating for maximum corrosion protection. For PVC pipes, use Ford style brass saddle.
2. Use double bale type with bales, nuts and washers constructed of ASTM A108 carbon steel, electro-galvanized per ASTM B633.
3. Provide Buna N gasket.
 - a. Comply with NSF 61.
 - b. Seal up to the full pressure rating of the pipe on which it is installed.

B. Manufacturers

1. Dresser, Style 291.
2. Smith-Blair, Series 313 or 366.
3. Or approved equal.

2.6 QUICK DISCONNECTS

A. Provide a quick-connect coupling for the dry, pebble or granular type quicklime fill piping as shown on the Drawings.

1. Select and size to mate with male end coupling used by the lime supplier. Connection shall be leak free.
2. Provide dust cap. Secure dust cap to the coupler.

B. Manufacturers

1. OPW Engineered Systems
2. Ever-tite couplings by American Packing and Gasket Co.
3. Or approved equal.

2.7 INSULATING FLANGES, COUPLINGS, AND UNIONS

- A. Provide to prevent galvanic corrosion when two dissimilar metals are connected.
 - 1. Use screwed or soldered joint for piping 2-inches in diameter and smaller. Use flanged joint with bolt insulators and a dielectric gasket or an insulating coupling for pipelines 2-1/2 inches in diameter and larger.
 - 2. Select working pressure to be compatible with piping system.
- B. Manufacturers
 - 1. Epco Sales, Inc.
 - 2. Capital Insulation Unions
 - 3. Smith-Blair
 - 4. Romac Industries, Inc.
 - 5. Or approved equal.

2.8 ESCUTCHEON PLATES

- A. Provide where exposed pipes pass through walls, partitions, floors, or ceilings in a finished area.
 - 1. May be one piece or split and stamped or solid as applicable.
 - 2. Use chrome plated brass or stainless steel for interior walls, partitions, and ceilings.
 - 3. Use rough chrome plated cast brass or cast nickel bronze alloy for floors and exterior walls.

2.9 PIPE MARKING TAPE

- A. Use detectable tape to mark the location of all underground utilities. Use for non-metallic pipe buried PVC.
 - 1. Use solid aluminum foil encased in a protective, high visibility, inert polyethylene plastic jacket.
 - 2. Color: Comply with APWA Uniform Color Code for Temporary Marking of Underground Utility Locations.
 - 3. Minimum size: 12-inches wide and 5.5 mils thick
 - 4. Identify the type of utility on the tape in minimum 1-inch high, permanent black lettering imprinted continuously over entire length.

5. Joining clips: Tin or nickel coated. Provided by tape manufacturer.

B. Manufacturers:

1. Reef Industries – Terra “D”
2. Allen – Detectatape
3. Or approved equal.

2.10 EXPANSION JOINTS/FLEXIBLE PIPING CONNECTION

A. For ductile iron pipe:

1. Size as shown on Drawings.
2. Red Valve, General Rubber, or equal.
3. Flanged ends with inner tube, body and outer cover. Flanges to be ANSI B 16.5, Class 150 lb.
4. Body constructed of fabric and rubber compounds reinforced with steel wire.
5. Three arch design. Arch to be filled on all lines except NPW applications.
6. Retaining rings to be 304 stainless steel.
7. Provide joint control units. Number and size of rods and gusset plate shall be in accordance with the manufacturer’s recommendations. Control units to be 304 stainless steel.

2.11 WASHDOWN HOSE

- A. Hose shall be 1" I.D. reinforced rubber discharge hose. The hose shall provide high resistance to abrasion, aging and weathering. All hose materials shall be mildew and moisture resistant. Hoses shall remain flexible under all conditions. Hose couplings shall be compatible with supply connection and nozzles. Couplings adapters shall be provided where necessary. Hose shall be Goodyear Plicord, Eaton or equal. Epcos Sales, Inc.
- B. Nozzles: Each hose shall be provided with a nozzle. Nozzles shall be rugged brass of the combination fog and straight stream type. The nozzle stream shall be adjustable for washing tank walls. The nozzle shall have stream-shaping teeth for even flow distribution.
- C. Hose Reels: Hose reels shall be provided for each hose. Hose reels shall be provided with a hand crank. The hose reel shall be capable of containing the entire length of hose specified. Hose reels shall be Coxreels Model 1175-6-100 or equal. Contractor to mount hose reel to wall or slab.

2.12 PIPE SADDLE

- A. Saddle shall be a double strap saddle with brass body, brass straps and grade 60 nitrile rubber (Buna-N) gaskets. Saddles shall be Ford Meter Box Company Style 202B or equal.

2.13 WATER METER

- A. Provide a Sensus OMNI C2 or equal water meter consisting of two basic assemblies: the main case and the measuring chamber. The measuring chamber assembly includes the floating ball impeller with a coated titanium shaft, hybrid axial bearings, integral flow straightener, and an electronic programmable register with protective bonnet. The main case is made from ductile iron with an approved NSF epoxy coating. Main case shall be equipped with a high-pressure O-ring, testing port and an AWWA compliant strainer.
- B. Magnetic Drive: Meter registration is achieved by utilizing a fully magnetic pickup system. This is accomplished by the magnetic actions of the embedded rotor magnets and the ultra-sensitive register pickup probe. The only moving component in water is the floating ball impeller.
- C. Measuring Element: The hydro-dynamically balanced impeller floats between the bearings. The floating ball technology allows the measuring element to operate virtually without friction or wear, thus creating extended upper and lower flow ranges.
- D. Strainer: The AWWA compliant “V” shaped strainer uses a stainless steel screen along with floating ball technology. A removable strainer cover shall be provided to allow access to the screen for maintenance.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install each of the items specified above, including appurtenances, in accordance with the instructions of the manufacturer and in accordance with the Contract Documents.
- B. List additional requirements, if applicable.

END OF SECTION

**SECTION 40 72 13
MAGNETIC FLOWMETER**

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

- A. The Contractor shall furnish all labor, equipment and materials required to install, test and place into satisfactory operation, all 4-wire magnetic flow meters and signal converters listed below:
 - a. Post Equalization Flow to Filters.
- B. Meter size: 10 inch diameter, flanged.
- C. Meter quantity: 1

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)

1.3 RELATED WORK

- A. Testing & Startup are included in Section 01 79 00.
- B. Manufacturer services and training included in Section 01 79 01.
- C. Operation and maintenance manuals included in Section 01 78 23.
- D. Delivery, Storage and Handling is included in Section 01 45 34.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 00, Submittals, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following information:
 - 1. General arrangement drawings showing materials, details of construction, dimensions, and connections.
 - 2. Complete equipment performance data including where applicable:
 - 3. Wiring diagram and calibration procedures.
 - 4. List of recommended spare parts broken down into parts for the first year of operation.
 - 5. Copies of all test results, as specified in Part 3 of this Section.
 - 6. Submit the Equipment Warranty and Certification Form as specified in

Section 01 33 00.

7. Field-testing procedures.
8. Submit manufacturers certificate of installation per Section 01 33 00.
9. Descriptive Brochures
10. Operation and maintenance manuals as specified in Section 01 78 23.

1.5 WARRANTY

- A. The Manufacturer of the equipment shall warrant for one (1) year from date of startup that all equipment he provides will be free from defects in material and workmanship.

1.6 SUBMITTALS

- A. Submit product data.

1.7 MAINTENANCE AND TEST EQUIPMENT

- A. Spare Parts
 1. Miscellaneous Spare Parts
 - a. One year's supply of items recommended by the Manufacturer of the equipment for each component.
 2. The spares shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity, and temperature.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Krohne
- B. Rosemount

2.2 MAGNETIC FLOWMETER

- A. Electromagnetic flowmeter shall operate on electromagnetic induction principle and give an output signal directly proportional to the liquid rate of flow.
- B. Each meter shall have a stainless steel metering tube and a non-conductive liner suitable for the liquid being metered. End connections shall be steel flanged for sizes 1/2" and greater, ANSI Class 150#, for meter sizes up to 24" and AWWA Class B or D for meters larger than 24". The housing shall be epoxy coated steel, welded at all joints. Bolted coil enclosures shall not be acceptable.

- C. The field coils of the meter shall be supplied with a precisely adjusted bi-polar direct current.
- D. There shall be no electronic components on the primary flow head. Coil drive power shall be supplied by a remote signal converter. Output signal from the primary shall be fed through 'DS' proprietary cable supplied with the meter to the signal converter.
- E. Electrode material shall be Hastelloy C and compatible with the process fluid.
- F. Liner material will be hard rubber suitable for service in applications that include sludge and abrasive matter. Liner material shall be NSF approved for installation in potable water.
- G. The instrument shall be manufactured in an ISO 9001 approved facility.
- H. The meter shall be provided with 316 stainless steel corrosion resistant grounding rings. Grounding electrodes shall not be acceptable.
- I. Meter shall be rated for prolonged submergence, NEMA 6P.
- J. Meter calibration shall be performed by a direct volumetric comparison method. A calibration certificate shall accompany each meter. Calibration facility shall be certified to .04% accuracy and be traceable to national standards.
- K. The meter shall be Krohne Model Enviromag 2000 or Rosemount, ABB equal.

2.3 SIGNAL CONVERTER/TRANSMITTER:

- A. The Magnetic Flowmeter Converter shall be remotely mounted and provide precisely controlled and regulated, bipolar DC primary field excitation pulses at a keyed frequency of 1/6, 1/16, or 1/32 of line frequency digitally selectable. It shall convert the primary flowmeter signal into a 4-20 mA DC and pulse output directly proportional to the flow rate.
- B. Converter shall be rated for 120 VAC operation.
- C. The full scale measuring range shall be a direct digital input in gpm and fully adjustable over a range from 1.0 to 40 ft/sec.
- D. Each converter shall contain self-diagnostics, automatic data integrity checking, and be completely interchangeable with other converters of the same type without need for recalibration. No auxiliary test meter or primary simulator shall be required for commissioning, zeroing, or interchanging of flow meter/converter.
- E. Each converter shall contain the following features as standard equipment:
 - 1. Simultaneous analog output (750-ohm load) and a scaled pulse output.
 - 2. Adjustable damping of analog signal from 0.2 to 99 seconds.
 - 3. Low flow cutoff.

4. Forward/reverse flow measurement capabilities
 5. Integral rate of flow indicator and (2) 8-digit LCD totalizers
 6. Capability of testing analog and frequency outputs.
 7. Ten-year data retention without the need for auxiliary power.
 8. Engineering units for display and programming; flow and total shall be user programmable in any engineering unit of measure.
 9. HART
 10. All adjustments and changes to the above features shall be by direct digital input.
 11. Repeatability shall be 0.1% of rate.
 12. 4-20mA Output
- F. Accuracy of the system (Primary Flow Head and Converter) shall be:
1. Meter sizes 3/8" - 24" +/- 0.4% of actual flow rate (for velocities of 1.3 - 40 ft/sec)
 2. Meter sizes 28" - 40" +/- 0.5% of actual flow rate (for velocities of 0.8 - 40 ft/sec)
- G. The enclosures shall be rated NEMA 4X.
- H. Provide a 50-foot signal cable for meters (FE-SP2A & FE-SP2B) in the sludge pump station. Provide a 15-foot signal cable / coil power cable for all others.
- I. The instrument shall be manufactured in an ISO 9001 approved facility.
- J. Stainless Steel Tags: Provide stainless steel identification tags on primary flow head and signal converter. Attach tags with stainless steel wire or screws.
- K. The signal converter shall be Krohne model IFC100 or equivalent.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Devices with displays mounted outside shall be mounted facing north, if possible. Install sun shield/shade over unit such that the sun does not directly shine on the LCD/LED display and the unit itself is not in the sun.

3.2 START-UP SERVICE

- A. Provide manufacturer's Field Service Technician. Technician shall calibrate instruments, check all installed equipment, perform initial start-up, make all tests, adjustments and related

items as required to ensure that the flow meters are performing and operating as specified and required, and train operators in daily operational procedures, O & M, trouble shooting, and computer operations.

- B. Field Service Technician will verify installation is in accordance with Drawings, Specifications and as instructed by manufacturer. The technician will schedule site visits at scheduled points of construction completion, coordinated with Contractor, to ensure proper installation of equipment, structures and facilities. Technician will coordinate with other manufacturers Field Service Technicians as required.
- C. Field Service Technician will instruct Owner's personnel in operational, maintenance and troubleshooting procedures.

3.3 CERTIFICATION OF INSTALLATION

- A. Upon completion of the installation, the manufacturer shall furnish a certificate of compliance detailing that the instruments and materials have been installed and calibrated in accordance with the manufacturer's instructions.
- B. An operational and maintenance manual shall be provided in accordance with 01 78 23.

END OF SECTION

**SECTION 40 72 14
ULTRASONIC LEVEL TRANSMITTER (4 WIRE)**

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

- A. The Contractor shall furnish all labor, equipment and materials required to install, test and place into satisfactory operation, the ultrasonic level transmitters listed below:
 - 1. FIT-7000 / FE-7000
 - a. Montana Flume
 - b. RAS Flow from Clarifiers
 - 2. FIT-0850 / FE-0850
 - a. Plant Effluent Flow
 - b. Parshall Flume

1.2 QUALITY ASSURANCE

- A. The equipment and materials to be furnished under this Contract shall be new and of first quality.
- B. The manufacturer of each piece of equipment shall be responsible for furnishing, supervising installation, testing, calibration and start-up of the systems.
- C. The manufacturer shall verify that the level transmitters being furnished are compatible with the intended chemicals.

1.3 SUBMITTALS

- A. Submit product data.

1.4 SPARE PARTS

- A. One complete set of spare parts as recommended by manufacturer for each installation shall be furnished.

1.5 WARRANTY

- A. A period of one (1) year commencing upon equipment acceptance by the OWNER and Engineer.
- B. The warranty shall cover all equipment, components and systems provided with each control system.

- C. The warranty shall provide for replacement and/or repair of faulty or defective components at no cost to the OWNER during the WARRANTY period.
- D. Where deemed necessary, the manufacturer will be responsible for the labor of removal and reinstalling the defective or faulty components without cost to the OWNER.

PART 2 PRODUCTS

2.1 ULTRASONIC LEVEL – 4 WIRE

- A. Type: Microprocessor based ultrasonic level transmitter. Unit shall have input or output filter capability.
- B. Sensor: Sensors shall have minimum 26 foot range, unless noted otherwise, and shall be supplied with sufficient cable length for arrangement indicated. Sensor shall have a NEMA 4X (minimum) enclosure. Unit shall be supplied with automatic temperature compensation as required below. Sensor face material shall be Kynar or Teflon as required.
- C. Accuracy: ± 1.0 percent of calibrated range or better for ranges greater than 25-inches (with temperature compensation).
- D. Output: Isolated 4-20 mADC into loop loads of 0 to 500 ohms (minimum), two (2) Form “C” Relay Contacts rated at 5A, 250 VAC, non-inductive.
- E. Enclosure: NEMA 4X, polycarbonate or fiberglass.
- F. Power Supply: 120 VAC
- G. Mounting: Handrail
- H. UV Protection: Provide a rubber flap over LCD display to protect from sunlight
- I. The transmitter shall include algorithms for a parshall flume, v-notch weir, and palmer bowlus flume.
- J. The transmitter shall include Hart protocol.
- K. Stainless Steel tags.
- L. Acceptable Manufacturers: Pulsar, Endress Hauser, or Siemens-Milltronics.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Devices shall be installed in accordance with Manufacturer’s instructions.
- B. Instrument Tagging: Provide stainless steel tag with loop numbers on sensor & transmitter.

3.2 START-UP SERVICE

- A. Provide manufacturer's Field Service Technician (certified, factory trained) for a minimum of one 4-hour day on site. Field Service Technician shall calibrate instruments, check all installed equipment, perform initial start-up, make all tests, adjustments and related items as required to ensure that the flow meters are performing and operating as specified and required, and train operators in daily operational procedures, O & M, trouble shooting, and computer operations.
- B. Field Service Technician will verify installation is in accordance with Drawings, Specifications and as instructed by manufacturer. The technician will schedule site visits at scheduled points of construction completion, coordinated with Contractor, to ensure proper installation of equipment, structures and facilities. Technician will coordinate with other manufacturers Field Service Technicians as required.
- C. Field Service Technician will instruct Owner's personnel in operational, maintenance and troubleshooting procedures.

3.3 CERTIFICATION OF INSTALLATION

- A. Upon completion of the installation, the manufacturer shall furnish a certificate of compliance detailing that the instruments and materials have been installed and calibrated in accordance with the manufacturer's instructions.
- B. An operational and maintenance manual shall be provided in accordance with 01 70 00.

END OF SECTION

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**SECTION 40 72 15
LEVEL SWITCH – FLOAT**

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

- A. The Contractor shall furnish all labor, equipment and materials required to install, test and place into satisfactory operation, all float switches listed below:
 - 1. LSH-0441
 - a. Digester 1 High Level
 - 2. LSH-0442
 - a. Digester 2 High Level

1.2 SUBMITTALS

- A. Submit product data.

1.3 SPARE PARTS

- A. Provide 1 spare float switch with 50-foot cable. The spare shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity, and temperature.

PART 2 PRODUCTS

2.1 LEVEL SWITCH - FLOAT

- A. Type: Submersible coated 316 stainless steel, polypropylene, or polyethylene body; non-mercury switch contact rated 4 amps at 120 VAC; normally open, normally closed, or Form C (N.O. and N.C.) contact configuration as indicated. Mercury float switches are not acceptable.
- B. Cable: Minimum 18-gauge, 300 volts (minimum) rated; heavy-duty type SOW or equivalent. Provide sufficient length for mounting at the elevations indicated. See mechanical drawings for elevations.
- C. Cable length: Field coordinate with installation with mounting height. See mechanical drawings for mounting height.
- D. The Contractor shall ensure mounting is in accordance with the manufacturer's recommendations.
- E. Acceptable Manufacturers: Equal to Warrick Series M, Anchor Scientific.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Junction Box: Provide NEMA 4X stainless steel junction box, mounted near the switch, for terminating vendor supplied cable and discrete control wiring to control panel.
- B. The Contractor shall ensure mounting is in accordance with the manufacturer's recommendations.
- C. The Contractor shall install at level shown on the contract documents.
- D. Instrument Tagging: Provide stainless steel identification tag.
- E. Secure floats at junction box with stainless steel supporting kellum grips/stainless steel wire.

3.2 FIELD QUALITY CONTROL

- A. Tests and Calibration
 - 1. Perform continuity and insulation resistance tests on instrumentation conductors.

3.3 CERTIFICATION OF INSTALLATION

- A. Upon completion of the installation, the manufacturer shall furnish a certificate of compliance detailing that the instruments and materials have been installed and calibrated in accordance with the manufacturer's instructions.
- B. An operational and maintenance manual shall be provided in accordance with 01 70 00.

END OF SECTION

**SECTION 40 72 17
SUBMERGED LEVEL TRANSMITTER**

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

- A. The Contractor shall furnish all labor, equipment and materials required to install, test and place into satisfactory operation, the ultrasonic level transmitters listed below:
 - 1. PE-0441
 - a. Digester 1 Level
 - 2. PE-0442
 - a. Digester 2 Level

1.2 QUALITY ASSURANCE

- A. The equipment and materials to be furnished under this Contract shall be new and of first quality.
- B. The manufacturer of each piece of equipment shall be responsible for furnishing, supervising installation, testing, calibration and start-up of the systems.
- C. The manufacturer shall verify that the level transmitters being furnished are compatible with the intended chemicals.

1.3 SUBMITTALS

- A. Submit product data.

1.4 SPARE PARTS

- A. One complete set of spare parts as recommended by manufacturer for each installation shall be furnished.

1.5 WARRANTY

- A. A period of one (1) year commencing upon equipment acceptance by the OWNER and Engineer.
- B. The warranty shall cover all equipment, components and systems provided with each control system.
- C. The warranty shall provide for replacement and/or repair of faulty or defective components at no cost to the OWNER during the WARRANTY period.

- D. Where deemed necessary, the manufacturer will be responsible for the labor of removal and reinstalling the defective or faulty components without cost to the OWNER.

PART 2 PRODUCTS

2.1 SUBMERGED LEVEL TRANSMITTER

- A. Instrument Function: Level Measurement
- B. Instrument Description: Submerged Level Transmitter - Wastewater
- C. Power Supply: 24 Vdc Loop Powered
- D. Signal Output: 4 to 20 milliamperes into 0 to 550 ohms
- E. Process Connection: Submerged, suspended
- F. Product Requirements:
 - 1. Sensor/Transmitter: Minimum 3" large diameter diaphragm with 316 Stainless Steel housing and separate suspension cable. FM Approved for Class I Division 1 when used with approved barrier. Accuracy of 0.25% of full scale and operating temperature from -40°F to 185°F. Provide cable length to reach remote mounted transmitter or junction box without splicing.
 - 2. Manufacturers:
 - a. Blue Ribbon Corp. Model BC001.
 - b. Delta Controls Corp. Model 566Y.
 - c. Endress+Hauser FMB53.
 - d. Siemens Model A1000i.
 - e. Accepted equal.
- G. Execution:
 - 1. Installation: Install in accordance with manufacturer's instructions.
 - 2. Manufacturer to provide sensor/transmitter, full length cables.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Devices shall be installed in accordance with Manufacturer's instructions.

3.2 START-UP SERVICE

- A. Provide manufacturer's Field Service Technician (certified, factory trained) for a minimum of one 4-hour day on site. Field Service Technician shall calibrate instruments, check all installed equipment, perform initial start-up, make all tests, adjustments and related items as required to ensure that the sensor is performing and operating as specified and required, and train operators in daily operational procedures, O & M, trouble shooting, and computer operations.
- B. Field Service Technician will verify installation is in accordance with Drawings, Specifications and as instructed by manufacturer. The technician will schedule site visits at scheduled points of construction completion, coordinated with Contractor, to ensure proper installation of equipment, structures and facilities. Technician will coordinate with other manufacturers Field Service Technicians as required.
- C. Field Service Technician will instruct Owner's personnel in operational, maintenance and troubleshooting procedures.

3.3 CERTIFICATION OF INSTALLATION

- A. Upon completion of the installation, the manufacturer shall furnish a certificate of compliance detailing that the instruments and materials have been installed and calibrated in accordance with the manufacturer's instructions.

END OF SECTION

**SECTION 43 11 33
ROTARY POSITIVE DISPLACEMENT BLOWERS**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install complete, ready for operation and field-test three (3) new rotary positive displacement blowers and appurtenances, as shown on the Drawings and as specified herein.
- B. The entire blower package and its components shall comply with all applicable safety and environmental regulations.
- C. Blowers in this section are designed for use as aerobic digester blowers. Refer to Section 46 53 53 for rotary positive displacement blowers for the SBR system.
- D. Blower control will be from the SBR panel. Refer to operational control in this Section and Section 46 53 53.

1.2 RELATED WORK

- A. Testing & Startup are included in Section 01 79 00.
- B. Manufacturer services and training included in Section 01 79 01.
- C. Miscellaneous metals are included in Section 05 10 00.
- D. Field painting is included in Section 09 91 00.
- E. Operation and maintenance manuals included in Section 01 78 23.
- F. Delivery, Storage and Handling is included in Section 01 45 34.
- G. Valves, except as otherwise specified herein, are included in Section 33 35 00 - Valves and Appurtenances.
- H. Electrical work, except as otherwise specified herein, is included in Division 26.
- I. Sequential Batch Reactor System Section 46 53 53.

1.3 SUBMITTALS

- A. Submit the following per Section 01 33 00:
 - 1. Drawings with dimensions, elevations and details.
- B. Certified general arrangement drawings showing materials, details of construction, dimensions, and connections.

1. Complete Blower Performance Data including:
 - a. RPM
 - b. Capacity – scfm and icfm
 - c. Discharge pressure
 - d. dB(A) noise pressure level
 - e. Maximum gear tip speed and rotor tip speed (fpm)
 - f. HP required at rated capacity and pressure.
 - g. Rated maximum pressure rise of blowers.
2. Spare parts
3. Descriptive Brochures
4. Weight
5. Installation Instructions
6. Performance Curves
7. Motor Data
8. Instrumentation and controls
9. Valves
10. ISO-1217 Performance Test Results Slip test results are unacceptable as an alternate. Manufacturer must provide documented results for the purchased machines. Typical or average data is not acceptable.
11. Declaration of Conformity, per Machinery Directive 2006/42/EC, Annex II, No.1 A.
 - a. Identify any special handling requirements.
 - b. Field-testing procedures.
 - c. Submit manufacturers certificate of installation per Section 01 33 00.
 - d. Operation and maintenance manuals included in Section 01 78 23.

1.4 QUALITY ASSURANCE

A. Qualifications

1. Package shall be Aerzen Generation 5 Delta Blower Model GM 35S. Regardless of manufacturer, the package will be produced by the manufacturer of the blower stage, to ensure single source responsibility for blower performance and compatibility of associated accessories.
2. The equipment 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.
3. The blower(s) shall be covered by a warranty for 24 months from date of commissioning, or a maximum of 30 months from date of shipment.
4. The performance data and manufacturing methods shall achieve a Declaration of Conformity, per Machinery Directive 2006/42/EC, Annex II, No.1 A.

1.5 BLOWER PERFORMANCE CRITERIA

A. Quantity of Machines	3
B. Design Inlet Temperature	100 °F
C. Site Elevation	960 feet above sea level
D. Design Inlet Pressure	14.2 psia
E. Design Relative Humidity (%)	80 %
F. Design Flow	1083 scfm per machine/1244 icfm
G. Minimum Turndown	204 scfm per machine
H. Design Discharge Pressure	6.9 psig (at max ws)
I. Brake Horsepower (Max)	53.5 BHP
J. Motor Size (Max)	75 Hp
K. Speed	Variable
L. Free Field Noise Guaranteed	72 dB(A) at 1 meter (at design point)

1. Package BHP to include pressure loss through a clean inlet filter / silencer, pressure loss of the exhaust silencer and check valve.
2. Package Performance shall be guaranteed to ISO 1217 with a tolerance is +/- 5% on volume flow and +/- 5% on package horsepower. Manufacturer of blower must provide data for purchased machine.
3. Sound data shall be from an ISO 2151 method of measurement, in an ISO 3745 qualified

test facility. Sound data shall be compliant with a Declaration of Conformity assessment standard.

1.6 DELIVERY, STORAGE AND HANDLING

- A. All equipment shall be completely factory assembled, skid mounted, crated, and delivered to protect against damage during shipment.
- B. All exposed flanges shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- C. All equipment delivered to the site shall be stored as specified in accordance with the manufacturer's instructions.

1.7 MAINTENANCE

- A. Spare Parts
 - 1. Furnish the following spare parts for each blower package specified:
 - a. Complete set of matched V-belts
 - b. One filter element
 - c. Volume of oil change for first service interval
 - 2. Spare parts shall be properly bound and labeled for easy identification without opening the packaging.

PART 2 PRODUCTS

2.1 GENERAL

- A. Blower packages shall be designed to minimize the life-cycle costs and maximize plant reliability. The design and the selection of the components shall be based on a minimum useful life of 15 years and a Mean Time Between Overhauls of 5 years of continuous operation. Bearing life must be submitted by manufacturer of service life, based on specified conditions.
- B. No special foundations shall be required. The blower packages will be installed directly on a concrete slab without grouting the base frame. There shall only be 4 easily accessible anchor points.
- C. Blower Casing:
 - 1. The blower casing shall be of one-piece construction, with separate side plates that are bolted and pinned to the housing.

2. Materials shall be close-grained cast iron ASTM A48 suitably ribbed to prevent distortion under the specified operating conditions.
3. Minimum blower casing pressure rating shall be 36 psig.
4. Inlet and outlet shall be flanged connections.
5. The casing shall incorporate a proven means of pulsation cancellation which achieves 90% of better reduction in vibration. Systems without a means of pulsation cancellation shall not be accepted.
6. The vibration level as measured at the blower casing, in the X/Y planes of the bearings, shall not exceed $\frac{1}{2}$ "/ sec RMS when operating at the specified maximum operating pressure and speed in the actual blower package.

D. Factory Testing:

1. Each blower stage shall be factory tested in accordance with ISO 1217 performance test to verify flow and brake horsepower at blower maximum conditions. A slip test shall not be acceptable, nor is average data for the manufactured size.
2. The acceptance criteria are +5% tolerance on power and –5% tolerance on flow regardless of the size of the machine.

E. Rotors:

1. Each rotor shall be of the “stiff” design with first lateral critical speed at least 120% of the maximum allowable operating speed.
2. The rotors shall be of the straight, three-lobe type, and shall operate without rubbing or liquid seals or lubrication.
3. Rotor/shaft shall be one single piece. Cast, hollow rotors shall be capped, dust tight. Open rotors are not acceptable.
4. The rotors shall be statically and dynamically balanced per ISO1940/ANSI S2.19 G6.3.

F. Bearings:

1. Each rotor/shaft shall be supported by anti-friction bearings and fixed to control the axial location of the rotor/shaft in the unit.
2. Regardless of theoretical bearing life calculations, the bearings shall be sized for a minimum expected life of 5 years between overhauls. Calculated bearing life shall be submitted, based on specified operating conditions.

G. Timing Gears:

1. The rotors shall be timed by a pair of single helical AGMA 12 quality gears with

hardened and ground teeth: minimum AGMA service factor of 1.70. Spur cut gears are unacceptable.

2. Gears shall be mounted on the shafts with a tapered interference fit and secured by a locknut. Pinned gears are unacceptable.

H. Seals:

1. Seal shall be designed to prevent lubricant from leaking into the air stream as well as to prevent oil from leaking out of the machine.
2. Four rotary piston ring shaft seals, an oil slinger and an O-ring seal shall be provided at the point where the shaft passes through the side plates.
3. Further provision shall be made to vent the rotor side of the oil seal to atmosphere to eliminate any possible carry-over of lubricant into the air stream.

I. Lubrication:

1. The timing gears and the bearings shall be splash lubricated. Grease lubrication shall not be acceptable.

J. Oil Sight Glass:

1. A recessed oil sight glass must be provided on each oil sump.
2. Protruding sight glasses shall not be acceptable.

K. Painting:

1. Painting shall be per supplier's standard meeting the following criteria:
 - a. Except for machined sealing and machined mounting surfaces, the package shall be painted dark blue.
 - b. Aluminum, stainless steel, and brass shall not be painted.
 - c. The supplied motor shall not be over sprayed and will be supplied with the motor manufacturer's standard protection and paint color.
 - d. Painted Cast Iron and Carbon Steel shall be Alkyd Resin Primer and Final coat with a total dry film thickness of 70µm. Surface preparation SSPC10 or better.
 - e. Sound enclosure shall be powder-coated polyester base total dry film thickness 80µm.
 - f. Galvanized components shall only be painted with appropriate surface preparation.

2.2 BLOWER ACCESSORIES

A. Inlet Filter / Silencer:

1. Each package shall be supplied with one combination inlet filter silencer.
2. The inlet filter silencer shall be mounted directly to the inlet flange of the blower.
3. The filter media efficiency must meet the requirements of ASHRAE 52.2 MERV7 50-70% @3-10 microns corresponding to EN779 G4.
4. The silencer portion shall be located upstream of the inlet filter.
5. Filter and silencer performance losses shall be included in the blower performance calculation.
6. The filter element shall be designed to trap dirt on the inside so that upon changing, dirt does not fall into the machinery. Filters where dirt accumulates on the external surface of the filter will not be permitted.

B. Base Frame / Discharge Silencer:

1. Each package shall be supplied with one combination base frame / discharge silencer.
2. The silencer shall be a chamber type design for maximum sound attenuation and shall not use fibrous or absorption materials of any kind. Internal absorption material has been shown to degrade and internally foul diffusers and will not be permitted.
3. The silencer shall be fabricated of a single shell of pressure vessel quality steel with continuous welds.
4. The silencer shall be subject to a pressure test for tightness and strength at a minimum of 1.65 times the maximum blower operating pressure.
5. The silencer shall have a machined inlet connection where the discharge flange of the blower stage bolts directly to, with no intermediary pieces. Threaded connection between the compressor stage and the discharge silencer is subject to leakage and misalignment and will not be permitted.
6. Discharge silencer performance losses shall be included by the blower vendor in the blower performance calculation. This is another reason why the blower accessories must be supplied by the manufacturer of the blower stage.
7. The base frame shall be constructed from welded carbon steel or cast iron that shall be designed to maintain alignment of the blower internal components and the drive during operation.
8. The base frame shall be designed to resist distortion while being installed on vibration isolating mounts.

9. The blower manufacturer shall supply a stainless-steel grounding lug fully welded to the base.

C. Flexible Connectors:

1. Each package shall be connected to the plant piping via flexible connector(s) located downstream of the discharge silencer.
2. Flexible connectors shall prevent the transmission of noise and vibrations from the blower package into the piping.
3. Flexible discharge connectors shall be Proco Style 240, Type EE, EPDM, with a standard ANSI flange discharge connection, rated for 300 °F at 20 psig.

D. Electric Motor:

1. Each package shall be supplied with a WEG manufactured TEFC motor that shall operate on 460 Volts, 3 Phase, 60 Hertz current, 1800 RPM.
 - a. Torque NEMA B
 - b. Temperature Rise Class B
 - c. Dust tight enclosures (Severe Duty)
 - d. Class F inverter rated insulation with Class H applied varnish.
 - e. 3:1 constant torque
 - f. All cast iron construction, including frame, end bells, conduit box and fan cover.
 - g. NPT threaded and gasketed F3 top mounted conduit box.
 - h. Copper windings
 - i. Regreasable bearings, positive pressure lubrication system with automatic drawn plugs – pressure compensated (Frame sizes 254T and larger).
 - j. All frame sizes shall be NEMA standard, suitable for overhung belt drive and with the conduit box location on top of the motor. IEC frame motors shall not be allowed.
2. The motor shall be mounted on a pivoting base to provide automatic tensioning of the belts.
3. The motor nominal rating after any corrections for ambient conditions shall be 10% above the maximum operating BHP.
4. The motor shall have a 1.15 service factor.

5. Motors shall be equipped with an Aegis ring to mitigate the effects of stray motor currents.
6. Blower manufacturer shall be responsible for coordinating the starting torque requirement of the blower and the motor.

E. V-Belt Drive:

1. Each package shall be supplied with a V-belt drive that shall be of the high-capacity type, oil and heat resistant. Drive shall be designed for a minimum service factor of 1.4 times operating power (BHP), or 1.1 times the motor nameplate Hp, whichever is larger to allow a minimum of 1.4-service factor based on the maximum blower BHP.
2. Belt tensioning shall be automatic without the use of any devices or interaction on the part of the operator. Neither slide rails nor load-adjusting springs shall be used.
3. Sheaves shall be dynamically balanced regardless of the operating speed.

F. Belt Guard:

1. The belt drive shall be guarded in compliance with OSHA regulations.
2. Portions of the guard shall be easily removable allowing for belt inspection and replacement.
3. Guard material shall be perforated carbon steel.

G. Vibration Isolators:

1. Each package shall be supplied with vibration isolating feet with a minimum efficiency of 80%.
2. Blower manufacture shall be responsible for attenuating noise and vibration in the blower package such that no special installation base shall be required, nor shall any additional measures be required to reduce vibrations from the blower package being transmitted to the base or the piping.

H. Pressure Safety Valve:

1. Each package shall be supplied with a single pressure safety valve on the discharge side of the blower mounted downstream of the discharge silencer and upstream of the check valve.
2. The safety valve shall be set to protect the blower from exceeding its maximum pressure rating and shall be sized to pass 100% of the design flow.
3. The safety valve shall be field adjustable, spring loaded, and have a certificate of conformity to PED.

4. The pressure relief valve shall be housed by the sound enclosure and shall relieve into a segmented section of the sound enclosure.
5. The valve shall be manufactured by Aerzen.

I. Check Valve:

1. Each package shall be supplied with one check valve that shall be installed on the discharge line.
2. The check valve shall be of the full-bore low pressure-drop, flapper type design with a steel body, and steel flap embedded in EPDM with full-contact seal.
3. The valve shall be removable without disturbing the piping. Pressure losses produced by the check valve shall be included in the blower performance calculation. Check valves requiring installation in the discharge piping shall not be considered unless installation cost of the external valve is included in supplier's proposal.
4. The valve shall be manufactured by Aerzen.

J. Instrumentation:

1. Each package shall be supplied with the following instrumentation:
 - a. Inlet Vacuum Gauge (4" Gauges)
 - (1) Aerzen standard gauge with 4" dial and scale from 0 to -40 inches of water column.
 - (2) Gauge to function as a filter maintenance indicator.
 - b. Discharge Pressure Gauge (4" Gauges)
 - (1) Aerzen model 32-0053-02 with 4" dial and scale from 0 to 20 psig.
 - (2) The pressure gauge shall have a stainless-steel case.
 - (3) Gauge shall be dry (no fill) with no pulsation snubber required.
 - c. Discharge Temperature Gauge / Switch (4" Gauges)
 - (1) Aerzen standard gauge with 4" dial and scale from 32°F to 397°F
 - (2) NEMA 4 enclosure, 5A @ 250volt, SA 28 SPDT microswitch
 - (3) UL & CSA approved.

- K.** Each blower shall receive its initial oil filling at the factory, the synthetic oil shall be rated for a minimum of 16,000 hrs.

L. Acoustical Sound Enclosure:

1. Each package shall be supplied with a sound enclosure covering the entire blower package.
2. The enclosure shall provide suitable protection for outdoor installation under the specified site conditions (wind load and snow load).
3. The enclosure shall be designed so as to be able to install them side-by-side with all maintenance done from the front or back of the package.
4. Details shall be as follows:
 - a. Panels shall be made of galvanized steel sheet, powder coated in a light reflecting, blue color per RAL 5001. The skid shall be of the same color.
 - b. The enclosure and the blower package shall both be mounted on a skid / oil-drip pan designed for meeting environment protection standards and for easy transportation and installation.
 - c. A grounding strap shall be installed between the blower base and the package skid to bypass any vibration isolating mounts.
 - d. Quick release panels, each less than 50 lb. (as mandated by MSHA) must provide easy and quick access for routine maintenance of the blower and the package components.
 - e. Enclosure Cooling Fan:
 - (1) A high efficiency blower shaft driven ventilation fan shall provide ventilation and cooling integral to the sound enclosure.
 - (2) Cooling fan shall be sized for sufficient heat removal from the sound enclosure, even when the blower is operated with a VFD.
 - f. Electrical components, instrumentation and instrument connections shall not be mounted or interface with moving panels of the sound enclosure.
 - g. Both blower oil sumps shall be piped to a common fill and drain, located at the front of the package for easy maintenance. An oil level indicator shall be mounted on the outside of the enclosure, which gives an accurate oil level indication while the blower is in operation. All oil lines to be hydraulic hose with fittings. No plastic tubing with compression fittings is allowed.

2.3 BLOWER CONTROL DESCRIPTION

- A. Each blower shall be controlled by the Aqua Aerobics Control Panel. Refer to Section 46 53 53 of these Specifications.
- B. Provide individual blower run, off and fault SCADA signals.

C. The Aqua Aerobics Control Panel will be modified to include:

1. Individual digester blower HOA “HAND- OFF- AUTOMATIC” selector switches.
2. Programmable cycle timer for each blower within the PLC.
3. Individual blower “run” and “fault” indication lights.
4. Start-Stop Pushbuttons for each blower.
5. Programming to allow operator interface through the HMI for blower operation and level set points.

D. Automatic Operation

1. Blower will not be allowed to Automatically operate when digester basin is below “blower off “ set point. This set point is 2 feet of water in the basin.
2. Place the selected blower HOA selector switch in AUTO. Blower 1 is dedicated to Digester 1; Blower 3 is dedicated to Digester 2 and Blower 2 is swing blower.
3. Using the HMI on the Aqua Control Panel, enter the number of blower cycles the selected blower is desired to run per 24 hour, the cycle duration in hours and time between cycles, and then enter the digester number (1 or 2) the blower will serve.
4. Push the start pushbutton to begin the blower cycle.
5. In Automatic, the blower will operate on the cycle timer. If at any time the level in the digester the blower is serving reaches “blower off level” the blower will automatically stop. Once the digester level exceeds blower off level plus a preset deadband, the blower will automatically re-start.
6. The blower will continue to operate until a blower “fault” occurs or until the HOA is placed in OFF.

E. Hand Operation

1. Place the selected blower HOA selector switch in HAND. Blower 1 is typically dedicated to Digester 1; Blower 3 is typically dedicated to Digester 2 and Blower 2 is swing blower.
2. Push the start pushbutton to start the required blower.
3. The selected blower will continue to operate regardless of level until such time as the Stop pushbutton is pushed or a blower “fault” occurs.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The Manufacturer shall conduct a coordination conference call with the Contractor and Design Engineer to review the integration and installation requirements of the equipment after the Submittal documentation has been approved and prior to installation of the equipment.
- B. The Contractor shall install the blowers in accordance with the Manufacturer's written instructions.
- C. The Contractor shall make all electrical and process connections to the blower package prior to the arrival of the manufacturer's representative.
- D. The Contractor shall complete and return the Manufacturer's installation check list prior to having a Manufacturer's representative come onsite.
- E. Representatives of the blower manufacturer shall verify and adjust blower and motor alignment.

3.2 FIELD TESTING

- A. After installation of all equipment has been completed and as soon as conditions permit, the manufacturer shall provide one (1) trip for a total of two (2) 8-hour days to verify the installation and conduct an acceptance test under actual operating conditions.
 - 1. The Manufacturer shall perform a physical check of the blower installation, perform safety checks, power up the equipment and perform functional testing.
 - 2. The functional test shall consist of 4 hours of operation of each blower with vibration, temperature, and pressure readings as well as motor amp readings taken and recorded at 60-minute intervals.
 - 3. The Manufacturer shall provide operations and maintenance training to the plant personnel. The training shall consist of 1 hour of classroom training using the Operation and Maintenance Manual for reference and 2 hours of hands-on training of the blower package.
- B. If required, Contractor shall make any changes, at his own expense, to the installation that may be necessary to assure satisfactory operation. Contractor shall be held liable for changes needed in the installation.
- C. Manufacturer shall provide a written field test / start up report after completion of testing.

END OF SECTION

**SECTION 43 23 13
SELF PRIMING CENTRIFUGAL PUMP**

PART 1 GENERAL

1.1 SCOPE

- A. This specification section covers the proposed grit pump. Provide a control panel for this pump.

1.2 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 01 78 23 Operating and Maintenance Data
- C. Section 26 00 00 Electrical
- D. Section 31 23 00 Excavation & Fill for Pipeline.
- E. Section 31 23 34 Excavation & Fill for Structures
- F. Section 33 31 00 Sanitary Utility Sewerage Piping
- G. Section 33 35 00 Process Valves and Appurtenances
- H. Section 33 39 00 Sanitary Utility Sewerage Structures

1.3 APPROVED SUPPLIERS

- A. Pumps and controls to be supplied by Gorman Rupp or approved equal.
- B. The basis of design for this project is Gorman Rupp T4A71S-B series.

1.4 SUBMITTALS

- A. The following information shall be submitted for review in accordance with Section 01 33 00:
 - 1. Submit pump manufacturer's catalog data, descriptive literature, and assembly drawings. Show dimensions and materials of construction by specification reference.

PART 2 PRODUCTS

2.1 PUMP DESIGN

- A. General
 - 1. Pump shall be horizontal, self-priming centrifugal type, designed specifically for

handling raw, unscreened, domestic sanitary sewage and grit. Pump solids handling capability per the performance criteria below.

2. The pump shall be mounted on a vertical V-Belt Base suitable for a 10 HP motor, 460V/3Phase/60Hz power, suitable to operate in Class1 Division 2 Group D environment. Pump and motor will be skid mounted.

2.2 MANUFACTURER

- A. Pump shall be Gorman Rupp T-Series, T4A71S-B or equal.

2.3 PERFORMACE

- A. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage and grit.
- B. Pumps shall have a 4” suction connection, and 4” discharge connection. The pump shall be selected to perform under the following operating conditions:

a. Basis of Design	Gorman Rupp
b. Maximum RPM	1150
c. Duty Point, gpm	250 gpm at 37 feet TDH
d. Solids Passage	3 inch solid
e. Minimum Pump Efficiency	45 % at duty point
f. Outlet Size, inches	4-inches, minimum
g. Motor Horsepower, HP	10 HP, minimum
h. Motor Voltage, volts	460 V
i. Motor Frequency, Hz	Constant
j. Phase, Poles	3 Phase, 4
k. Casing Heater	Required

2.4 MATERIALS AND CONSTRUCTION FEATURES

- A. Pump shall be mounted on a fabricated steel base consisting of pump, motor, V-belt drive unit, and belt guard.
- B. The pump motor shall be horizontal, TEFC, type, with normal starting torque and low starting current characteristics, suitable for operation on 460 volt, 3 phase, 60 Hz electrical service. The motor shall be non-overloading over the entire operating range of the pump. The motor shall be of NEMA design cast iron frame with copper windings.

- C. Power shall be transmitted from the motor to the pump using a V-belt drive assembly. The drive assembly must be selected to establish proper pump speed to meet the specified operating conditions. The drive assembly shall have a minimum of two belts and provide a safety factor of no less than 1.0 (BHP to motor HP). Computation of safety factors shall be based on performance data published by the drive manufacturer, and copies of drive selection computations shall be included as part of the submitted data for approval by the engineer.
- D. Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or combination of materials consisting of expanded, perforated, or solid sheet metal. Expanded or perforated openings shall not exceed 1". The guard shall be manufactured to permit complete removal from the pump unit without interference with any unit component.
- E. Pump shall be mounted on a fabricated steel base consisting of pump, motor, V-belt drive unit, and belt guard.
- F. The pumps and exposed steel framework shall be cleaned with an industrial grade chemical cleaner. The prime coat shall be a zinc base synthetic primer and the finish coat shall be an automotive grade acrylic enamel.
- G. Pump casing and seal plate shall be hard iron.
- H. Bearing Housing shall be grey cast iron No 30.
- I. Removable cover plate shall be grey cast iron No 30.
- J. Replaceable wear plate shall be steel No 1018.
- K. Impeller shall be hard iron and pass a 3 inch solid.
- L. Pump shall have an integral suction check valve. The suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect the pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the cover plate opening, without disturbing the suction piping. The sole function of the check valve shall be to save energy by eliminating the need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.
- M. Pump shall be provided with a thermostat mounted to the exterior of the volute casing, and a 750 watt 115-volt electric heater inserted into the interior of the volute using a dedicated port. The heater shall be energized at 43+/-3 degrees F to provide heat to the casing and eliminate the possibility of freezing. Heater probes that must be installed through a pump drain port shall not be acceptable.

2.5 CONTROL PANEL

- A. Provide a separate control panel for the pump.
- B. Control panel enclosure:

1. Enclosure shall be a 14 gauge, NEMA 4X rated enclosure manufactured from 316 stainless steel. The enclosures shall be a free-standing type with a minimum depth of 12”, sized to adequately house all the components.
2. The control panel door gasket shall be rubber composition with a retainer to assure a positive weatherproof seal. The door shall open a minimum of 180 degrees.
3. All control switches, indicator lights, elapsed time meters, duplex receptacle, and other operational devices shall be mounted on the external surface of the panel.
 - a. Provide indicator lights on the control panel for the following:
 - (1) Pump On
 - (2) Pump Off
 - (3) Pump Fail
4. The panel power distribution shall include necessary components and be completely wired stranded copper conductors rated at 90 degrees. All conductor terminations shall be as recommended by the device manufacturer.
5. Circuit breakers shall be heavy duty thermal magnetic or motor circuit protectors similar and equal to Square D Type FAL. Each motor breaker shall be adequately sized to meet the pump motor operating characteristics with minimum interrupting capacity of 35,000 A R.M.S. symmetrical at 480 volts. The control circuit shall be controlled by heavy duty breakers.
6. Circuit breakers shall be indicating type, providing “on-off-trip” positions of the operating handle. When the breaker is tripped automatically, the handle shall assume a middle position indicating “trip.”
7. Thermal magnetic breakers shall be quick-make and quick-break on manual and automatic operation and have inverse time characteristics secured through the use of bimetallic tripping elements supplemented by a magnetic trip.
8. Breakers shall be designed so that an overload on one pole automatically trips and opens all legs. Field installed handle ties shall not be accepted.
9. The motor starter shall be installed inside the control panel.
10. Each complete suppression unit shall be UL listed as a secondary surge arrestor and bear CSA certification and meet ANSI/IEEE C62-11-1987; suitable for indoor and outdoor applications; suitable for use in service entrance location; meet requirements of NEC Article 280; rated at 650V phase-to-ground maximum.
11. Control transformers shall be provided to produce the 120 VAC and/or 24 VAC for control circuits. Transformers shall be fused on the primary and secondary circuits. The secondary circuits shall be grounded.

12. A line voltage rated, adjustable phase monitor shall be installed to sense low voltage, loss of power, reverse phase, and loss of phase. Control circuit shall de-energize upon sensing any of the faults and shall automatically restore service upon return to normal power.
13. Include dry contact for “Pump Run”, “Pump Fail.”
14. Include HAND-OFF selector switch. When placed in HAND the pump will run continuously until the selector switch is placed in OFF. If motor overheats, an alarm indication light “Pump Fails” will illuminate on the control panel.
15. A final, “As built” drawing encapsulated in mylar shall be attached to the inside of the front door. A list of all legends shall be included.
16. All component parts in the control panel shall be permanently marked and identified as they are indicated on the drawing. Marking shall be on the back plate adjacent to the component. All control conductors shall be identified with wire markers at each end, as close as practical to the end of the conductor.
17. All panels shall be tested to the power requirements as shown on the plans to assure proper operation of all components.
18. The manufacturer shall be a UL listed shop for industrial control systems.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The pumping unit shall be leveled, plumbed, and aligned into position to fit the piping by the Contractor. Installation procedures shall be as recommended by the pump manufacturer.
- B. The pump base shall be grouted after initial fitting and alignment but before final bolting of the connection piping. After final alignment and bolting, pump connection shall be tested for applied stress by loosening the flange bolts. If any movement or opening of the joints is observed, piping shall be adjusted to ensure that piping stresses are not transmitted to the pump flanges.

3.2 MANUFACTURER’S FIELD SERVICES

- A. Refer to Section 01 79 01.
- B. The Manufacturer's field service technician shall check the installation of the equipment, assist in the start-up, and provide training on the maintenance of the equipment. A minimum of two (2) trips, and a total of two (2) days on the site shall be provided, exclusive of travel time.

3.3 FIELD TESTS

- A. Refer to Section 01 79 00.
- B. Complete System Commissioning and Training. Refer to Sections 01 79 00 and 01 79 01.
- C. If the performance of any part of the system does not meet the requirements specified, corrective measures shall be taken, and equipment shall be removed and replaced with equipment that satisfies the conditions specified. All expenses associated with field testing, including any corrective action, shall be borne by the Contractor.

END OF SECTION

**SECTION 43 23 15
DUPLEX SKID MOUNTED SELF-PRIMING CENTRIFUGAL PUMP**

PART 1 GENERAL

1.1 SCOPE

- A. Contractor shall furnish and install one factory built above ground, automatic pump station. The station shall be complete with all equipment specified herein; factory assembled in a fiberglass reinforced polyester resin enclosure.
- B. In addition to the station enclosure, principle items of equipment shall include two horizontal, self-priming, centrifugal sewage pumps, V-belt drives, motors, internal piping, valves, motor control panel, automatic liquid level control system, and internal wiring.
- C. The duplex station to serve as plant drain pump station.

1.2 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 01 78 23 Operating and Maintenance Data
- C. Section 09 91 00 Painting
- D. Section 26 00 00 Electrical
- E. Section 31 23 00 Excavation & Fill for Pipeline.
- F. Section 31 23 34 Excavation & Fill for Structures.
- G. Section 33 31 00 Sanitary Utility Sewerage Piping
- H. Section 33 35 00 Process Valves and Appurtenances
- I. Section 33 39 00 Sanitary Utility Sewerage Structures

1.3 APPROVED SUPPLIERS

- A. Pumps and controls to be supplied by Gorman Rupp or approved equal.
- B. The basis of design for this project is Gorman Rupp V series.

1.4 SUBMITTALS

- A. The following information shall be submitted for review in accordance with Section 01 33 00:
 - 1. Submit pump manufacturer's catalog data, descriptive literature, and assembly

drawings. Show dimensions and materials of construction by specification reference.

PART 2 PRODUCTS

2.1 PUMP DESIGN AND MOTOR

A. General

1. Pump shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage and grit. Pump solids handling capability per the performance criteria below.
2. The pump shall be mounted on a vertical V-Belt Base suitable for a 20 HP motor, 460V/3Phase/60Hz power. Pumps, piping, motors and enclosure will be skid mounted.

2.2 MANUFACTURER

- A. Pump shall be Gorman Rupp or equal.
- B. In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source). The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

2.3 PERFORMANCE

- A. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall have 4" suction connection, and 4" discharge connection. Each pump shall be Gorman-Rupp Model V3A60-B to perform under following operating conditions:

- | | |
|--------------------------------------|--------|
| 1. Capacity (GPM) | 500 |
| 2. Total Dynamic Head, (FT) | 75 |
| 3. Maximum Repriming Lift, (FT) | 22 |
| 4. Total Discharge Static Head, (FT) | 56 |
| 5. Pump Speed, (RPM) | ≤ 2000 |
| 6. Solids Passage, (Inch) | 2.5 |
| 7. Number of Pumps | 2 |
| 8. Motor size (HP) | 20 |

- B. Utility Power Requirements

1. Site power furnished to pump station shall be 3 phase, 60 hertz, 480 volts, maintained within industry standards. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

C. Pump Performance Certifications

1. Solids Handling Capability
 - a. All internal passages, impeller vanes, and recirculation ports shall pass a 2.5” spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer’s certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.

D. Reprime Performance

1. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.
2. Pump must reprime 10 vertical feet at the specified speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test set-up:
 - a. A check valve to be installed downstream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.
 - b. A length of air release pipe shall be installed between pump and the discharge check valve. This line shall be open to atmosphere at all times duplicating the air displacement rate anticipated at a typical pump station fitted with an air release valve.
 - c. The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal run, a 90 degree elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.

- d. Impeller clearances shall be set as recommended in the pump service manual.
 - e. Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.
 - f. Liquid to be used for repriming test shall be water.
- E. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be prepared and forwarded to the customer.

2.4 STATION ENCLOSURE

- A. The station enclosure shall contain and protect all pumps, interior piping, valves and associated controls. Enclosure shall incorporate the following design and service features:
- B. Access panels must be supplied on all sides. Location and size shall permit access for routine maintenance functions such as pump and motor inspection, drive belt adjustment, and pump clean-out. Non-hinged panels shall be secured with stainless steel tamper-proof hardware.
- C. A continuous hinge and latch shall be installed on at least two access panels. The hinged panels shall allow easy access to the electrical controls for frequent adjustments and inspections. A two-point mechanical latch assembly shall secure the panel at top and bottom. Latch handle locks shall be match keyed, requiring only one key to open all access panels.
- D. A vent in one access panel shall allow free air flow for enclosure ventilation.
- E. The complete station enclosure, less base, must be completely removable after disengaging reusable hardware. After disassembly, no portion of the enclosure (except electrical service entrance) shall project above the base surface to interfere with maintenance or endanger personnel.
- F. Disassembly and removal of the enclosure shall require no more than two people working without assistance of lifting equipment.
- G. Station enclosure shall be manufactured of molded reinforced orthophthalic polyester resins with a minimum of 30% fiberglass, and a maximum of 70% resin. Resin fillers or extenders shall not be used.
- H. Chopped glass fibers of 1 1/4 inch average length shall be sprayed and rolled. Major design consideration shall be given to structural stability, corrosion resistance, and watertight integrity. Polyester laminates provide a balance of mechanical, chemical, and electrical properties to insure long life. They must be impervious to micro-organisms, mildew, mold, fungus, corrosive liquids, and gases which are expected to be present in the environment surrounding the wet well. All interior surfaces of the housing shall be coated with a polyester resin-rich finish providing maintenance-free service, abrasion resistance, and protection from sewage, greases, oils, gasoline, and other common chemicals.

- I. Outside surfaces of the enclosure shall be coated with gel-coat pigmented resin to insure long maintenance-free life and UV protection. Color used shall de-emphasize the presence of dirt, grease, etc.
- J. Station base shall be constructed of pre-cast; reinforced concrete encapsulated in a fiberglass mold. The design shall resist deformation of the structure during shipping, lifting, or handling. Base shall incorporate drainage provisions, and an opening sized to permit installation of piping and service connections to the wet well. After installation, the opening shall serve as a grout dam to be utilized by the contractor. The base shall incorporate anchor bolt recesses for securing the complete station to a concrete pad (supplied by the contractor) in accordance with the project plans.

2.5 DRAIN KIT

- A. Pumps are to be supplied with a drain kit for ease of maintenance. The kit shall contain 10' length of reinforced plastic hose with a female quick connect fitting at one end, and factory installed drain fittings in each pump. Fittings include a stainless steel pipe nipple, stainless steel bushing, stainless steel ball valve and aluminum male quick connect fitting.

2.6 VALVES AND PIPING

A. Check Valve

- 1. Each pump shall be equipped with a full flow type check valve capable of passing a 3" spherical solid. Valve shall be constructed with flanged ends and fitted with an external lever and torsional spring. Valve seats shall be constructed of stainless steel, secured to the body to ensure concentricity, sealed by an O-ring, and shall be replaceable. The valve body shall be cast iron incorporating a clean-out port large enough to allow removal and/or replacement of the valve clapper without removing valve or piping from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings. Shaft nut shall have double O-rings which shall be easily replaceable without requiring access to interior of valve body. All internal hardware shall be stainless steel. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

B. Plug Valve

- 1. A 3-way plug valve must allow either or both pumps to be isolated from the force main. The plug valve shall be non-lubricated, tapered type. Valve body shall be cast iron with flanged end connections drilled to 125 pound standard. The drip-tight shutoff plug shall be mounted in stainless steel bearings and shall have a resilient facing bonded to the sealing surface. Valve shall be operated with a single lever actuator providing lift, turn, and reseal action. The lever shall have a locking device to hold the plug in the desired position.

C. Automatic Air Release Valve

1. An automatic air release valve shall be furnished for each pump designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming cycle or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visual indication of valve closure and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.
2. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric-reinforced neoprene or similar inert material.
3. A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service.
4. Valves shall be field adjustable for varying discharge heads.
5. Connection of the air release valves to the station piping shall include stainless steel fittings.

2.7 GAUGE KIT

- A. A gauge kit shall be supplied for each pump. Suction pressure must be monitored by a glycerin-filled compound gauge, and discharge pressure by a glycerin-filled pressure gauge. Gauges to be at least 4 inches in diameter, graduated in feet water column. Rated accuracy shall be 1% of full scale reading. Compound gauge shall be graduated -34 to +34 feet water column minimum. Pressure gauge to be graduated 0 to 140 feet water column minimum.
- B. Gauges are to be factory mounted on a resilient panel with frame assembly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless steel fittings, including a shutoff valve for each gauge line at the point of connection to suction and discharge pipes.

2.8 PIPING

- A. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.
- B. Pipe and flanges shall be threaded, and suitable thread sealant applied before assembling flange to pipe.
- C. Bolt holes shall be in angular alignment within 1/2 degree between flanges. Flanges shall be faced with a gasket finish having concentric grooves a minimum of 0.01 inch deep by approximately 0.03 inch wide, with a minimum of three grooves on any given surface spaced a maximum of 1/4 inch apart.

2.9 SUPPORTS

- A. Contractor must insure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.

2.10 DRIVE UNIT

- A. Motors
 - 1. Pump motors shall be 20 HP, 460 volt, 3 phase, horizontal ODP, 1,800 RPM, NEMA design B with cast iron frame with copper windings, induction type, with class F insulation and 1.15 Service Factor for normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified.
 - 2. Motors shall be tested in accordance with provisions of ANSI/IEEE Std. 112, Method B.

2.11 DRIVE TRANSMISSION

- A. Power to pumps transmitted V-belt drive assemblies. The sheave/belt combination shall provide the speed ratio needed to achieve the specified pump operating conditions.
- B. Each drive assembly shall utilize at least two V-belts providing minimum a combined safety factor of 1.5. Single belt drives or systems with a safety factor of less than 1.5 are not acceptable. Computation of safety factors shall be based on performance data published by the drive manufacturer.
- C. Precise alignment tolerances of the drive assemblies shall be achieved by means of a belt/sheave laser alignment system resulting in the reduction of vibration, accelerated wear, and premature failure.
- D. The pump manufacturer shall submit power transmission calculations which document the following:
 - 1. Ratio of pump/motor speed.
 - 2. Pitch diameter of driver and driven sheaves.
 - 3. Number of belts required per drive.
 - 4. Theoretical horsepower transmitted per belt, based on vendor's data.
 - 5. Center distance between pump and motor shafts.
 - 6. Arc-length correction factor applied to theoretical horsepower transmitted.
 - 7. Service factor applied to established design horsepower.

8. Safety factor ratio of power transmitted/brake horsepower required.
- E. Pump drives to be enclosed on all sides by a guard constructed of fabricated steel or combination of materials including expanded, perforated, or solid sheet metal. No opening to a rotating member shall exceed 1/2 inch.
 1. Guards must be completely removal without interference from any unit component and shall be securely fastened and braced to the unit base.
 2. Metal to be free from burrs and sharp edges. Structural joints shall be continuously welded. Rivet spacing on panels shall not exceed five inches. Tack welds shall not exceed four inch spacing.
 3. The guard shall be finished with one coat of gray W.R. non-lift primer and one coat of orange acrylic alkyd W.R. enamel in accordance with section 3, Color Definitions of ANSI 253.1: Safety Color Code for Marking Physical Hazards.

2.12 FINISH

- A. Pumps, piping, and exposed steel framework shall be cleaned prior to painting. Exposed surfaces to be coated with one coat gray W.R. non-lift primer and one coat white acrylic alkyd W.R. enamel. Paint shall be low VOC, alkyd based, high solids, semi-gloss white enamel for optimum illumination enhancement, incorporating rust inhibitive additives. The finish coat shall be 1.0 to 1.2 MIL dry film thickness (minimum), resistant to oil mist exposure, solvent contact, and salt spray. The factory finish shall allow for over-coating and touch up after final installation.

2.13 ELECTRICAL CONTROL COMPONENTS

- A. The pump station control panel will be tested as an integral unit by the pump station manufacturer. The control panel shall also be tested with the pump station as a complete working system at the pump station manufacturer's facility.
- B. All control switches, indicator lights, elapsed time meters, duplex receptacle, and other operational devices shall be mounted on the external surface of the panel.
 1. Provide indicator lights on the control panel for the following:
 - a. Pump On
 - b. Pump Off
 - c. Pump Fail
 2. Provide status contacts for RUN, STOP, ALARM for use with the SCADA system.

2.14 PANEL ENCLOSURE

- A. Electrical control equipment shall be mounted within a common NEMA 1 stainless steel,

DUPLEX SKID MOUNTED SELF-PRIMING CENTRIFUGAL PUMP

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dead front type control enclosures. Doors shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on removable steel back panels secured to enclosure with collar studs.

- B. All control devices and instruments shall be secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; self-tapping screws shall not be used to mount and component. All control devices shall be clearly labeled to indicate function.

2.15 BRANCH COMPONENTS

- A. All motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electrical Code Article 409. the lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and may be rated less than the minimum required short circuit rating.
- B. Circuit Breakers and Operating Mechanisms
 - 1. A properly sized heavy duty circuit breaker shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering.
 - 2. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlock able operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.
- C. Motor Starters
 - 1. An open frame, across-the-line, NEMA rated magnetic starter with under-voltage release, and overload protection on all three phases, shall be furnished for each pump motor. Starters of NEMA size and above shall allow addition of at least two auxiliary contacts. Starters rated "O", "OO", or fractional size are not acceptable. Power contacts to be double-break type made of cadmium oxide silver. Coils to be epoxy molded for protection from moisture and corrosive atmospheres. Contacts and coils shall be easily replaceable without removing the starter from its mounted position. Each starter shall have a metal mounting plate for durability.
- D. Overload Relay
 - 1. Overload relays shall be solid-state block type, having visual trip indication with trip-free operation. Electrically resetting the overload will cause one (1) normally open and

one (1) normally closed isolated alarm/control contact to reset, thus re-establishing a control circuit. Trip setting shall be governed by solid-state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features include phase loss protection, selectable jam/stall protection and selectable ground fault protection.

2. A reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the door.

2.16 CONTROL CIRCUIT

- A. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.
- B. Pump mode selector switches shall permit manual start or stop of each pump individually or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be oil-tight design with contacts rated NEMA A300 minimum.
- C. Pump alternation shall be integral to the liquid level controller. Provisions for automatic alternation or manual selection shall also be integral to the liquid level controller.
- D. Six digit elapsed time meter (non-reset type) shall be connected to each motor starter to indicate total running time of each pump in "hours" and "tenths of hours". An integral pilot light shall be wired in parallel to indicate that the motor is energized and should be running.
- E. A duplex ground fault receptacle providing 115 VAC, 60 Hz, single phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal-magnetic circuit breaker.
- F. The lift station shall be equipped with a 3 KVA stepdown transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door. and a padlock able operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.
- G. Conduit
 1. Factory installed conduit shall conform to following requirements:
 - a. All conduit and fittings to be UL listed.
 - b. Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.

- c. Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
- d. Conduits shall be sized according to the National Electric Code.

H. Grounding

- 1. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.
- 2. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).

I. Equipment Marking

- 1. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:
 - a. Equipment serial number
 - b. Control panel short circuit rating
 - c. Supply voltage, phase and frequency
 - d. Current rating of the minimum main conductor
 - e. Electrical wiring diagram number
 - f. Motor horsepower and full load current
 - g. Motor overload heater element
 - h. Motor circuit breaker trip current rating
 - i. Name and location of equipment manufacturer
 - j. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.
- 2. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above, the device.

2.17 LIQUID LEVEL CONTROL

A. Float Switches

1. Consists of four (4) float switches to control the operation of pump motors. Mercury-free float switches, NEMA 4X junction box, high water alarm circuit, and float switch anchor with PVC chain.
2. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be oil tight design with contacts rated NEMA A300 minimum.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.
- B. Suction pipe connections are vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in the wet well. Discharge from air release valve shall be piped back to the wet well per manufacturer instructions.
- C. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.
- D. After all anchor bolts, piping and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.
- E. Field paint all non-factory coated piping, valves and supports.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Refer to Section 01 79 01.
- B. The Manufacturer's field service technician shall check the installation of the equipment, assist in the start-up, and provide training on the maintenance of the equipment. A minimum of two (2) trips, and a total of two (2) days on the site shall be provided, exclusive of travel time.

3.3 FIELD TESTS

- A. Refer to Section 01 79 00.
- B. Complete System Commissioning and Training. Refer to Sections 01 79 00 and 01 79 01.
- C. If the performance of any part of the system does not meet the requirements specified, corrective measures shall be taken, and equipment shall be removed and replaced with equipment that satisfies the conditions specified. All expenses associated with field testing, including any corrective action, shall be borne by the Contractor.

END OF SECTION

**SECTION 43 24 00
CENTRIFUGAL CHOPPER PUMP**

PART 1 GENERAL

1.1 SCOPE

- A. The work to be done under this Section consists of furnishing all material and equipment and performing all labor necessary to install new wastewater pump as indicated on the Contract Drawings and/or as specified herein.
- B. This specification section covers the chopper pump located at the vacuum truck receiving station transfer pit. Controls for the pump are included in this Section.

1.2 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 01 78 23 Operating and Maintenance Data
- C. Section 26 00 00 Electrical
- D. Section 31 23 00 Excavation & Fill for Pipeline.
- E. Section 31 23 34 Excavation & Fill for Structures.
- F. Section 33 31 00 Sanitary Utility Sewerage Piping
- G. Section 33 35 00 Process Valves and Appurtenances
- H. Section 33 39 00 Sanitary Utility Sewerage Structures

1.3 APPROVED SUPPLIERS

- A. Pump and controls to be supplied by Hayward Gordon, Trillium Flow Technologies or approved equal.
- B. The basis of design for this project is Hayward Gordon.

1.4 SUBMITTALS

- A. The following information shall be submitted for review in accordance with Section 01 33 00:
 - 1. Submit pump manufacturer's catalog data, descriptive literature, and assembly drawings. Show dimensions and materials of construction by specification reference.

1.5 REQUIREMENTS

A. Transfer Pump

1. Provide one (1) centrifugal chopper wastewater pump. Pump will be a centrifugal chopper design of heavy-duty construction intended for services requiring a combined chopping and pumping action on fluids with entrained solids.
2. Pump shall be suitable to pump unscreened fibrous wastewater solids including grit and sand.

PART 2 PRODUCTS

2.1 PUMP DESIGN AND CONSTRUCTION

A. The pump shall be selected to meet the following criteria:

Capacity	300 gpm
Suction Head, Min	1.25 feet
Min. Discharge Size	4 inch
Min, Suction Size	6 inch
Max. Pump RPM	1050 at duty point
Pump Drive	Fixed speed V-belt with OSHA V-belt guard
Pump Mounting	Horizontal
Base	Steel base plate
Seal Type	Mechanical, Flushless
TDH	17 feet
NPSH	33.2 feet
Motor RPM	1800 max
Motor HP	5.0 max
Motor Voltage	460, 3 phase
Motor Type	Inverter duty rated, TEFC, 182T

2.2 MATERIALS OF CONSTRUCTION

- A. Casing: The pump casing will be constructed of ASTM A48 Class 30 Cast Iron or ASTM A536. Flanged suction and discharge connections shall conform to the requirements of ANSI B16.1, Class 125. Casings with 4" or larger discharge diameter shall have an inspection port with removable cover to allow access to the casing passage. An inspection port shall also be provided in the suction spool piece to allow access to the front of the impeller and cutter bars. The casing backplate shall have spiral cutting groove on the surface that is in close clearance to the rear of the impeller. The casing shall be a clamp type design, with integrally cast feet to allow removal of the power frame for maintenance without disturbing the suction or discharge piping.
- B. Impeller: The pump impeller shall be an open type with sharpened vane edges incorporated into the rear of the impeller which provides cutting action against the backplate spiral groove, preventing fouling behind the impeller. Primary chopping/conditioning of materials shall be

accomplished by the action of the sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings with a set clearance between the impeller and cutter bar of .010" to .015" on pumps with less than 14" diameter impellers or .020" to .030" on pumps with 14" diameter or larger impellers. Impeller shall be constructed of ASTM A148 hardened steel (Rockwell C 60) and shall be dynamically balanced. The impeller shall be keyed to the shaft and the axial clearance at the front and rear of the impeller shall be externally adjustable.

- C. Cutter Bar: The casing will be fitted with a replaceable, externally adjustable suction plate with integral cutter bars constructed of ASTM A148 hardened steel to minimum Rockwell C 60 or T1 alloy Rockwell C60. The surface of the suction plate facing the impeller shall have multiple radial cutting slots to prevent binding of material between it and the impeller vanes. Pumps with 15" or larger impeller diameters shall have separately replaceable cutter bars independent of the main suction cover.
- D. Deflector Nut: The impeller shall be secured to the shaft using a deflector nut made from 410 Stainless Steel hardened to 400 BHN, designed protrude in front of the cutter bars and deflect stringy materials and prevent binding.
- E. Upper Cutter: The area behind the impeller shall be protected from fouling by the cutting and expulsion action of sharpened vane edges sweeping across spiral grooves in the casing backplate.
- F. Shaft & Sleeve: The shaft will be constructed of 4140 carbon steel, protected through the seal area by 316 SS sleeve where mechanical seals are specified. An O-ring between sleeve and shaft will prevent pumped fluid from leaking along the shaft.
- G. Bearings: Radial bearings on all sizes of pump shall be cylindrical roller type to withstand high radial loads during chopping. Axial thrust in both directions shall be taken up by double row angular contact thrust bearings on pumps with less than 14" diameter impellers or by higher capacity double row tapered roller bearings for pumps with 14" diameter or larger impellers. The bearing lives are to be rated for a minimum of 100,000 hrs. L10 life, based on calculated loads due to hydraulic thrust encountered at the duty point, as well as other mechanical loading due to belt drives or shaft and impeller weight.
- H. Bearing Housing: The bearing frame shall be A48 Class 30 cast iron and should be fitted with grease nipples for grease lubrication or with an oil level sight gauge, vent and drain plugs for oil lubrication. The axial thrust bearing shall be contained in a separate housing mounted within the power frame to allow for external axial adjustment of the impeller clearance. The bearing frame shall be removable for servicing without disturbance of the suction or discharge piping.
- I. Seal Type: Flushless mechanical seal system designed to require no clean water flushing. System to consist of the stuffing box portion of the seal housing having a tapered opening of no less than 20° to promote the expulsion of solids back into the pumped flow. The seal shall be front loading and of the cartridge type with Viton O-rings, silicon carbide faces or tungsten carbide rotating with silicon carbide stationary face and 316SS metal parts. The cartridge

seal shall be pre-assembled and pre-tested so that no seal settings or adjustments are required. Any springs used to push the faces of the seals together must be shielded from the pumped fluid to prevent binding or hang-up of the seal. A separate oil chamber shall not be required for the mechanical seal.

- J. Pump and Motor Base: Horizontal. The pump and motor base shall be fabricated from steel, designed to provide rigid support of the pump and foot mounted motor. The 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 FRP or metal OSHA guards are required. If metal guard is utilized provide suitable holes or eyes for lifting.

2.3 PUMP CONTROL PANEL

- A. Provide one local control panel.
- B. A complete control panel shall be provided for mounting and shall be completely wired and ready for field connection of power, control/sensory and alarm wiring. The control panel shall be NEMA 4X stainless-steel. The panel shall be mounted in the location shown on the Drawings.
- C. Power supply to the control panel will be 480 Volt, 3 Phase, 3 Wire, 60 Hz. The control panel shall be equipped with main three phase circuit breakers interlocked with the door handle. For each pump motor provide an individual motor circuit protector (MCP) and motor starter with overload protection and manual reset rated for the pump horsepower. A 480V/120Volt control circuit transformer with primary and secondary fuses shall be included. Control design shall provide for automatic and manual operation. All field connections shall be by means of terminals. The panel shall have but not be limited to the following components:
 - 1. One (1) Hand/Off/Automatic selector switches.
 - 2. One (1) Start and one (1) Stop pushbutton (for Hand Mode only).
 - 3. Pump RUN and Pump OFF indicator lights.
- D. The pump operation in automatic to be interlocked with the operation of the septage receiving station.

2.4 PUMP OPERATION

- A. Local Manual
 - 1. In this mode the operator will start/stop the pump using the “Hand” position of the H-O-A switch and by pressing the start pushbutton at the control panel the pump shall START. By depressing the stop pushbutton, the pump will STOP. Hand mode is intended for maintenance.
- B. Local Automatic

1. In this mode the operator will place the pump in “Automatic” position using the H-O-A switch on the pump control panel. The pump will be interlocked with the operation of the septage receiving station as described below.

C. Remote Pump Interlock Operation with Septage Receiving Station

1. To utilize the remote transfer pumping equipment to feed the septage receiving station, open the associated inlet valve at the septage receiving station and close the septage receiving equipment inline plug valve adjacent to the cam lock connection.
2. From the septage receiving control panel, place the grinder, auger in AUTO position. Place the transfer pump in AUTO at its local control panel. When the START pushbutton is depressed on the septage receiving control panel, a command signal will automatically START the transfer pump. During periods when the macerator is reversing, the pump will automatically STOP and then START again with the return of operation of the macerator. If the macerator is in FAIL condition, the pump shall automatically STOP.
3. When the STOP pushbutton on the septage receiving control panel is depressed, a command will be sent to automatically STOP the pump.
4. If the E-STOP pushbutton is depressed at the local septage receiving station control panel, the transfer pump will automatically STOP.

2.5 SHOP TESTING

A. Pumps shall be factory tested as follows:

1. Each pump and motor shall be factory tested prior to shipment. Witness testing is not required.
2. Controls shall be factory tested and documentation of the test shall be submitted.
3. Equipment shall not be shipped until all the test results are received and approved.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The pumping unit shall be leveled, plumbed, and aligned into position to fit the piping by the Contractor. Installation procedures shall be as recommended by the pump manufacturer.
- B. The pump base shall be grouted after initial fitting and alignment but before final bolting of the connection piping. After final alignment and bolting, pump connection shall be tested for applied stress by loosening the flange bolts. If any movement or opening of the joints is observed, piping shall be adjusted to ensure that piping stresses are not transmitted to the pump flanges.

3.2 MANUFACTURER’S FIELD SERVICES

- A. Refer to Section 01 79 01.
- B. The Manufacturer's field service technician shall check the installation of the equipment, assist in the start-up, and provide training on the maintenance of the equipment. A minimum of two (2) trips, and a total of two (2) days on the site shall be provided, exclusive of travel time.

3.3 FIELD TESTS

- A. Refer to Section 01 79 00.
- B. Complete System Commissioning and Training. Refer to Sections 01 79 00 and 01 79 01.
- C. If the performance of any part of the system does not meet the requirements specified, corrective measures shall be taken, and equipment shall be removed and replaced with equipment that satisfies the conditions specified. All expenses associated with field testing, including any corrective action, shall be borne by the Contractor.

END OF SECTION

**SECTION 43 25 00
SUBMERSIBLE WASTEWATER PUMPS**

PART 1 GENERAL

1.1 SCOPE

- A. The work to be done under this Section consists of furnishing all material and equipment and performing all labor necessary to install new submersible wastewater pumps as indicated on the Contract Drawings and/or as specified herein.
- B. This specification section covers variable speed post equalization submersible pumps. Controls panel for the pumps are included in this section.

1.2 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 01 78 23 Operating and Maintenance Data
- C. Section 26 00 00 Electrical
- D. Section 31 23 00 Excavation & Fill for Pipeline
- E. Section 31 23 34 Excavation & Fill for Structures
- F. Section 33 31 00 Sanitary Utility Sewerage Piping
- G. Section 33 35 00 Process Valves and Appurtenances
- H. Section 33 39 00 Sanitary Utility Sewerage Structures

1.3 APPROVED SUPPLIERS

- A. Pumps and controls to be supplied by Xylem, Homa or approved equal.
- B. The basis of design for this project is Xylem.

1.4 SUBMITTALS

- A. The following information shall be submitted for review in accordance with Section 01 33 00:
 - 1. Submit pump manufacturer's catalog data, descriptive literature, and assembly drawings. Show dimensions and materials of construction by specification reference.

1.5 REQUIREMENTS

- A. POST EQUALIZATION PUMPS (EQ PUMPS)

1. Provide three (3) submersible non-clog wastewater pumps.
2. The power cable shall be sized according to NEC and ICEA standards and also meet with P-MSHA Approval. The installed pump shall be supplied with a mating cast iron discharge connection. Each pump shall be fitted with lifting chain or stainless-steel cable. The working load of the lifting system shall be 50% greater than the pump unit weight.
 - a. Basis of Design Flygt Model NP 3153 LT3 416
 - b. Maximum RPM 1765
 - c. VFD Required
 - d. Outlet Size, inches 8-inches, minimum
 - e. Motor Horsepower, HP 15 HP, maximum
 - f. Motor Voltage, volts 460 V
 - g. Motor Frequency, Hz 60 Hz, Variable speed
 - h. Phase, Poles 3 Phase, 4
 - i. Number of Pumps 3
3. Duty Point Table for Single Pump Operation

Duty Point	GPM	TDH, feet	Speed, Hz	Pump Efficiency
Primary	1084	25	60	72
Condition 1	941	24	57	NA
Condition 2	1111	14	47	NA

PART 2 PRODUCTS

2.1 PUMP DESIGN

- A. The pump shall be automatically and rigidly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet well. Sealing of the pumping unit to the discharge connection shall be accomplished by machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring, or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor.

2.2 PUMP CONSTRUCTION

- A. Major pump components shall be of gray cast iron, ASTM A48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
- B. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
- C. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease, or other devices shall be used.

2.3 COOLING SYSTEM

- A. Each unit shall be provided with an adequately designed cooling system. Thermal radiators integral to the stator housing cast in one unit are acceptable. Where water jackets alone or in conjunction with radiators are used, separate circulation shall be provided. Cooling media channels and ports shall be non-clinging by virtue of their dimensions. Provision for external cooling and flushing shall be provided as necessary.

2.4 CABLE ENTRY SEAL

- A. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary, using the same entry seal. The cable entry junction chamber and motor shall be separated by a terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

2.5 MOTOR

- A. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%.
- B. All units with variable speed operation, the motor shall be inverted duty rated in accordance

with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of pins, bolts, screws, or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable. The motor shall be designed for continuous duty while handling pumped media of up to 104°F. The motor shall be capable of no less than 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

- C. The motor service factor (combined effect of voltage, frequency, and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of $\pm 10\%$. The motor shall be designed for continuous operation in up to a 40°C ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.
- D. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the control panel without the need of any splices. The outer jacket of the cable shall oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.
- E. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out.

2.6 BEARINGS

- A. The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a single ball type bearing to handle radial loads. The lower bearing shall be a two-row angular contact ball bearing to handle the thrust and radial forces. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve.

2.7 MECHANICAL SEAL

- A. Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing.

Mounting the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

- B. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.
- C. The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.
- D. A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.
- E. Seal lubricant shall be FDA Approved, nontoxic.

2.8 PUMP SHAFT

- A. The pump and motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be stainless steel, ASTM A479 S43100-T. Shaft sleeves will not be acceptable.

2.9 IMPELLER

- A. The impeller shall be of (ASTM A-48, Class 35B gray iron or ASTM A-532 (Alloy III A) 25% chrome cast iron) dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impellers shall be locked to the shaft, held by an impeller bolt, and shall be coated with alkyd resin primer.

2.10 VOLUTE/SUCTION COVER

- A. The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each

impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of (ASTM A-48, Class 35B gray iron or ASTM A532 (Alloy III A) 25% chrome cast iron) and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

2.11 PROTECTION

- A. Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm. A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule and inspection.
- B. The thermal switches and float switch shall be connected to a Mini CAS control and status monitoring unit. The Mini CAS unit shall be designed to be mounted in the pump control panel.
- C. Provide watertight cables for thermal switches and leak sensor. The cables shall be of adequate length to reach the control panel without splicing.

2.12 CONTROL PANELS

- A. Provide and install one common control panel for the pumps.
- B. Control panel enclosure:
 - 1. Enclosure shall be a 14 gauge, NEMA 4X rated enclosure manufactured from 304 stainless steel. The enclosures shall be a free-standing type with a minimum depth of 12", sized to adequately house all the components. The door gasket shall be rubber composition with a retainer to assure a positive weatherproof seal. The door shall open a minimum of 180 degrees.
 - 2. A polished, aluminum dead front shall be mounted on a continuous aircraft type hinge. It shall contain cutouts for mounted equipment, and provide protection of personnel from live, internal wiring. Cutouts for breaker handles shall be provided to allow operation of breakers without entering the compartment. All control switches, indicator pilot lights, elapsed time meters, duplex receptacle, and other operational devices shall be mounted on the external surface of the dead front. The dead front shall open a minimum of 150 degrees to allow access to equipment for maintenance. A 3/4" break shall be formed around the perimeter of the dead front to provide rigidity.
 - 3. The back plate shall be manufactured of 12-gauge steel and be finished with a primer coat and two (2) coats of baked on, white enamel. All hardware mounted to the subpanel shall be attached with machine thread, tapped holes. Sheet metal screws are not acceptable. All devices shall be permanently identified.
 - 4. The panel power distribution shall include necessary components and be completely wired stranded copper conductors rated at 90 degrees. All conductor terminations shall

be as recommended by the device manufacturer.

5. Circuit breakers shall be heavy duty thermal magnetic or motor circuit protectors similar and equal to Square D Type FAL. Each motor breaker shall be adequately sized to meet the pump motor operating characteristics with minimum interrupting capacity of 35,000 A R.M.S. symmetrical at 480 volts. The control circuit shall be controlled by heavy duty breakers.
6. Circuit breakers shall be indicating type, providing “on-off-trip” positions of the operating handle. When the breaker is tripped automatically, the handle shall assume a middle position indicating “trip.”
7. Thermal magnetic breakers shall be quick-make and quick-break on manual and automatic operation and have inverse time characteristics secured through the use of bimetallic tripping elements supplemented by a magnetic trip.
8. Breakers shall be designed so that an overload on one pole automatically trips and opens all legs. Field installed handle ties shall not be accepted.
9. Motor starters or variable frequency drives shall be installed in their respective control panels. For VFD drive see electrical specification.
10. Include:
 - a. On-time delay relays to prevent multiple pumps from starting simultaneously.
 - b. Voltage monitor.
 - c. Ethernet/IP interface to transmit information to the plant SCADA.
11. Emergency High Level Alarm: Provide float-type level sensor for emergency high level.
12. The control system shall include, but not be limited to, the ancillary equipment listed below.
13. The alarm light shall be a weatherproof, shatterproof, red light fixture with a 40-watt bulb to indicate alarm conditions. The alarm light shall be turned on by the alarm relay.
14. Each complete suppression unit shall be UL listed as a secondary surge arrestor and bear CSA certification and meet ANSI/IEEE C62-11-1987; suitable for indoor and outdoor applications; suitable for use in service entrance location; meet requirements of NEC Article 280; rated at 650V phase-to-ground maximum.
15. Control transformers shall be provided to produce the 120 VAC and/or 24 VAC for control circuits. Transformers shall be fused on the primary and secondary circuits. The secondary circuits shall be grounded.

16. A line voltage rated, adjustable phase monitor shall be installed to sense low voltage, loss of power, reverse phase, and loss of phase. Control circuit shall de-energize upon sensing any of the faults and shall automatically restore service upon return to normal power.
17. For the control panel include dry contacts for “Pump #1 Fail”, “Pump #2 Fail”, “Pump #3 Fail”, “High- High Level Alarm”, “Pump #1 Run”, “Pump #2 Run”, “Pump #3 Run”.
18. A final, “As-built” drawing encapsulated in mylar shall be attached to the inside of the front door. A list of all legends shall be included.
19. All component parts in the control panel shall be permanently marked and identified as they are indicated on the drawing. Marking shall be on the back plate adjacent to the component. All control conductors shall be identified with wire markers at each end, as close as practical to the end of the conductor.
20. All panels shall be tested to the power requirements as shown on the plans to assure proper operation of all components. Each control function shall be activated to check for proper indication.
 - a. Level Control System: Pump starts, and discharge shall be controlled by a submersible transducer provided by the pump manufacturer. The controller shall be SC2000—44E as manufactured by MPE Electronics, Apopka, Florida or equal. The level transducer shall be provided to control the operation of the pumps under normal operation. A high, high-high and low-level float control type system shall be installed as a backup to the transducer system. The float system shall take over operation of the pumps in the event the transducer system fails. Floats shall incorporate simple relay circuit, 24 volts.
 - b. Pump Monitor Relay: The MINI-CAS pump monitor relay shall provide motor over temperature and seal leakage alarms in one unit for Xylem Flygt submersible pumps equipped with FLS or CLS sensors. The MINI-CAS shall be capable of being powered by either 120VAC, 24VAC, or 24VDC, and shall provide relay contacts rated for 8 Amps at 120VAC.
 - c. Float Switch: Three mechanical float switches shall be supplied for level control and be suspended at the desired height from its own cable. The float switch case shall be made of polypropylene and the cable sheathed with a special PVC compound. The float switch cables shall be supplied with 40' of cable. Flygt 14-403222 ISR relays required.
 - d. Level Transducer: The submersible transducer shall be MPE model LM with cable length and pressure range to suit installation. The submersible transducer shall be supplied with a transducer vent bellows (TVB1) to prevent moisture from entering the vent tube. Provide a two-stage surge suppressor circuit using both an MOV and TVS to provide high voltage transient protection for the transducer circuitry. A stainless steel diaphragm and silicone oil fill shall be provided.

- e. All equipment shall be guaranteed for a period of three (3) years from date of shipment. The guarantee is effective against all defects in workmanship and/or defective components. The warranty is limited to replacement or repair of defective equipment.
- f. The manufacturer shall be a UL listed shop for industrial control systems and shall serialize evidence of such on the control panel enclosure.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The pumping unit shall be leveled, plumbed, and aligned into to position to fit the piping by the Contractor. Installation procedures shall be as recommended by the pump manufacturer.
- B. The pump base shall be grouted after initial fitting and alignment but before final bolting of the connection piping. After final alignment and bolting, pump connection shall be tested for applied stress by loosening the flange bolts. If any movement or opening of the joints is observed, piping shall be adjusted to ensure that piping stresses are not transmitted to the pump flanges.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Refer to Section 01 79 01.
- B. The Manufacturer's field service technician shall check the installation of the equipment, assist in the start-up, and provide training on the maintenance of the equipment. A minimum of two (2) trips, and a total of two (2) days at site shall be provided, exclusive of travel time.

3.3 FIELD TESTS

- A. Refer to Section 01 79 00.
- B. Complete System Commissioning and Training. Refer to Sections 01 79 00 and 01 79 01.
- C. If the performance of any part of the system does not meet the requirements specified, corrective measures shall be taken, and equipment shall be removed and replaced with equipment that satisfies the conditions specified. All expenses associated with field testing, including any corrective action, shall be borne by the Contractor.

END OF SECTION

**SECTION 43 26 00
VERTICAL MULTI-STAGE WATER PUMPS**

PART 1 GENERAL

1.1 SCOPE

- A. The work to be done under this Section consists of furnishing all material and equipment and performing all labor necessary to install a skid mounted duplex non self-priming vertical multistage pump system as indicated on the Contract Drawings and/or as specified herein.
- B. This specification section covers the plant water booster pumps. Control panel for the pumps is included in this section.

1.2 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 01 78 23 Operating and Maintenance Data
- C. Section 26 00 00 Electrical
- D. Section 31 23 00 Excavation & Fill for Pipeline.
- E. Section 31 23 34 Excavation & Fill for Structures.
- F. Section 33 31 00 Sanitary Utility Sewerage Piping
- G. Section 33 35 00 Process Valves and Appurtenances
- H. Section 33 39 00 Sanitary Utility Sewerage Structures

1.3 APPROVED SUPPLIERS

- A. Pumps and controls to be supplied by Xylem (Gould's Water Technology) or approved equal.
- B. The basis of design for this project is Xylem.

1.4 SUBMITTALS

- A. The following information shall be submitted for review in accordance with Section 01 33 00:
- B. Submit pump manufacturer's catalog data, descriptive literature, and assembly drawings. Show dimensions and materials of construction by specification reference.

1.5 REQUIREMENTS

- A. VERTICAL MULTI-STAGE PUMPS

- B. Provide two (2) non self-priming constant speed vertical multi-stage pumps. Pumps and piping will be installed in a precast concrete vault supplied by the Contractor.
- C. The installed pumps shall be supplied with a Victaulic or threaded suction and discharge connection manifold, 304 SS. Pumps will be installed on a skid. Each pump will be connected to the suction and discharge manifold pre-piped with stainless steel suction ball valve, discharge stainless steel check valve, discharge stainless steel ball valve and suction and discharge pressure gauges. Pump supplier to provide a connection for suction pressure switch, isolation valve and the suction pressure switch, all which are located on the suction manifold.

a. Basis of Design	Gould
b. Maximum RPM	3500
c. Constant Speed	Required
d. Number of Stages	8, minimum
e. Outlet Size, inches	1.25-inches, minimum
f. Motor Horsepower, HP	3 HP, maximum
g. Motor Voltage, volts	460 V
h. Phase, Poles	3 Phase, 4
i. Number of Pumps	2
j. Fluid	Water (filtered & disinfected wastewater)

D. Duty Point Table for Single Pump Operation

Duty Point	GPM	TDH, feet	Pump Efficiency
Primary	30	220	70
Secondary	37	180	68

PART 2 PRODUCTS

2.1 PUMP CONSTRUCTION

- A. Major pump components shall be identified as below.

a. Pump Body	AISI 316L stainless steel
b. Impellers	AISI 316L stainless steel

c.	Diffuser	AISI 316L stainless steel
d.	Pump Casing	AISI 316L stainless steel
e.	Pump Shaft	AISI 316L stainless steel
f.	Base	Aluminum
g.	Mechanical Seal	Silicon/carbide/Viton
h.	Impeller Wear Ring	PPS
i.	Seal Gland	316 stainless steel
j.	Motor	TEFC

2.2 CONTROL PANEL

- A. Provide and install one common control panel for the pumps. Pump control panel will be located adjacent to the pump vault in which the pumps are located.
- B. Control panel enclosure:
 - a. Enclosure shall be a 14 gauge, NEMA 4X rated enclosure manufactured from 304 stainless steel. The enclosures shall be a free-standing type with a minimum depth of 12", sized to adequately house all the components. The door gasket shall be rubber composition with a retainer to assure a positive weatherproof seal. The door shall open a minimum of 180 degrees.
 - b. A polished, aluminum front shall be mounted on a continuous aircraft type hinge. It shall contain cutouts for mounted equipment, and provide protection for personnel from live, internal wiring. Breaker handles shall be provided to allow operation of breakers without entering the compartment. All control switches, indicator lights, duplex receptacle, and other operational devices shall be mounted on the external surface of the front panel. All devices shall be permanently identified.
 - c. The panel power distribution shall include necessary components and be completely wired stranded copper conductors rated at 90 degrees. All conductor terminations shall be as recommended by the device manufacturer.
 - d. Circuit breakers shall be heavy duty thermal magnetic or motor circuit protectors similar and equal to Square D Type FAL. Each motor breaker shall be adequately sized to meet the pump motor operating characteristics with minimum interrupting capacity of 35,000 A R.M.S. symmetrical at 480 volts. The control circuit shall be controlled by heavy duty breakers.
 - e. Circuit breakers shall be indicating type, providing "on-off-trip" positions of the

operating handle. When the breaker is tripped automatically, the handle shall assume a middle position indicating “trip.”

- f. Thermal magnetic breakers shall be quick-make and quick-break on manual and automatic operation and have inverse time characteristics secured through the use of bimetallic tripping elements supplemented by a magnetic trip.
- g. Breakers shall be designed so that an overload on one pole automatically trips and opens all legs. Field installed handle ties shall not be accepted.
- h. Motor starters shall be installed in the control panel.

C. Provide Pump Control features include:

- (1) Pump controller
- (2) Pump Duty Alternation
- (3) Hand-Off-Automatic selector for each pump
- (4) Start and Stop pushbutton (for Hand Mode only).
- (5) Pump RUN and Pump FAIL indicator lights.
- (6) Reset pushbutton for each pump.
- (7) LOW suction pressure alarm indicator light.
- (8) Ethernet/IP interface to transmit pump status and alarms to the plant SCADA.
- (9) There is no control of the pumps from the plant SCADA.
- a. The control system shall include, but not be limited to, the ancillary equipment listed below.
- b. Each complete suppression unit shall be UL listed as a secondary surge arrestor and bear CSA certification and meet ANSI/IEEE C62-11-1987; suitable for indoor and outdoor applications; suitable for use in service entrance location; meet requirements of NEC Article 280; rated at 650V phase-to-ground maximum.
- c. Control transformers shall be provided to produce the 120 VAC and/or 24 VAC for control circuits. Transformers shall be fused on the primary and secondary circuits. The secondary circuits shall be grounded.
- d. A line voltage rated, adjustable phase monitor shall be installed to sense low voltage, loss of power, reverse phase, and loss of phase. Control circuit shall de-energize upon sensing any of the faults and shall automatically restore service upon return to normal power.

D. A final, “As-built” drawing encapsulated in mylar shall be attached to the inside of the front door. A list of all legends shall be included.

- E. All component parts in the control panel shall be permanently marked and identified as they are indicated on the drawing. Marking shall be on the back plate adjacent to the component. All control conductors shall be identified with wire markers at each end, as close as practical to the end of the conductor.
- F. All panels shall be tested to the power requirements as shown on the plans to assure proper operation of all components. Each control function shall be activated to check for proper indication.

2.3 PUMP OPERATION

A. Pump Operation -HAND

- a. Place the desired pump H-O-A selector in HAND mode. To START the pump, press the associated START pushbutton. To STOP the pump, press the associated STOP pushbutton. The pump operation in HAND is typical for use during pump maintenance.

B. Pump Operation- AUTOMATIC

- a. Select the lead pump from the pump controller. Select the lag pump from the pump controller.
- b. Place both LEAD and LAG pump H-O-A selector in AUTO mode. To START the LEAD pump, a remotely located pressure switch indicating low hydro tank pressure signals the pump controller to START the pump. The LEAD pump continues to run until the remotely located pressure switch signals the pump controller to STOP the pump.
- c. Upon completion of the LEAD pump cycle, the pump controller will alternate operation to allow the LAG pump to operate the next cycle. When the LAG pump has completed its cycle, the pump controller will alternate operation to allow the LEAD pump to operate the next cycle and so forth.
- d. If during the operation of the LEAD or LAG pump, a pump failure occurs, the pump controller will automatically signal the remaining pump to START. The pump that is called to operate will complete the cycle.
- e. If pump FAILURE occurs to one of the pumps, the AUTOMATIC pump alternation will discontinue until such time as a RESET is depressed at the pump controller. When the FAILURE occurs, the pump called to complete the cycle will operate each time a pump is signaled to START from the pump controller.
- f. Suction pressure is continuously monitored on the suction manifold. The pump supplier will establish the suction pressure alarm value. If suction pressure drops below a pre-set value (adjustable), a light on the pump control panel will illuminate and an ALARM indication will be sent to the main plant SCADA system. This indication will be used by the operations staff to alert them of the

need to clean the suction strainer located downstream of the suction manifold. When suction pressure is restored to above ALARM indication, the alarm will automatically reset.

C. Pump Operation- OFF

- a. When a pump is placed in OFF, the AUTOMATIC pump alternation will discontinue until such time the pump is placed into AUTOMATIC. When the FAILURE occurs, the pump called to complete the cycle will operate each time a pump is signaled to START from the pump controller.

D. All equipment shall be guaranteed for a period of three (3) years from date of shipment. The guarantee is effective against all defects in workmanship and/or defective components. The warranty is limited to replacement or repair of defective equipment.

E. The manufacturer shall be a UL listed shop for industrial control systems and shall serialize evidence of such on the control panel enclosure.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The pumping skid unit shall be leveled, plumbed, and aligned into a position to fit the piping by the Contractor. Installation procedures shall be as recommended by the pump manufacturer. All suction and discharge piping shall be supported.
- B. Stainless steel piping and valves are required for all piping to install the pumps. Refer to the Contract Drawings for details.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Refer to Section 01 79 01.
- B. The Manufacturer's field service technician shall check the installation of the equipment, assist in the start-up, and provide training on the maintenance of the equipment. A minimum of one (1) trip, and a total of one (1) days on site shall be provided, exclusive of travel time.

3.3 FIELD TESTS

- A. Refer to Section 01 79 00.
- B. Complete System Commissioning and Training. Refer to Sections 01 79 00 and 01 79 01.
- C. If the performance of any part of the system does not meet the requirements specified, corrective measures shall be taken, and equipment shall be removed and replaced with equipment that satisfies the conditions specified. All expenses associated with field testing, including any corrective action, shall be borne by the Contractor.

END OF SECTION

**SECTION 46 21 12
VAC TRUCK RECEIVING STATION**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. This section describes the vacuum truck (vac truck) receiving station equipment and controls. The equipment shall effectively reduce, separate, wash and de-water vac truck waste that has been delivered to the system.
- B. The system shall be provided with controls. The equipment shall be installed as shown on the plans, as recommended by the supplier, and in compliance with all OSHA, local, state, and federal codes and regulations.
- C. Vac truck unloading provisions to include hose quick connect and the ability to pump waste into the receiving equipment from a remote location.

1.2 QUALITY ASSURANCE

A. QUALIFICATIONS

- 1. Qualified suppliers shall have a minimum 10 years of experience in designing and manufacturing septage receiving stations. Supplier shall provide a list of names and dates of installations for verification by the Engineer or Owner's Representative.

1.3 IDENTIFICATION

- A. Each piece of equipment shall be identified with a corrosion resistant nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, supplier's name, and location.

1.4 RELATED WORK

- A. Testing & Startup are included in Section 01 79 00.
- B. Manufacturer services and training included in Section 01 79 01.
- C. Operation and maintenance manuals included in Section 01 78 23.
- D. Delivery, Storage and Handling is included in Section 01 45 34.
- E. Miscellaneous metals are included in Section 05 10 00.
- F. Field painting is included in Section 09 91 00.
- G. Centrifugal Chopper Pump in Section 43 24 00.

1.5 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01 33 00, copies of all materials required to establish compliance with this Section. Submittals shall include the following:
 - 1. Drawings showing general arrangement of the system.
 - 2. Drawings showing details of the equipment, piping, electrical and instrumentation.
 - 3. Materials and manufacturing specifications.
 - 4. Flow rate versus Headloss curves.
 - 5. Installation, operation, and maintenance instructions.
 - 6. List of any exceptions taken to the plans and specifications including written justification.
 - 7. Literature that describes the equipment and shows all key details of construction and dimensions. Dimensions shall show overall size and space requirements including that for installation, leveling, dismantling and maintenance.
 - 8. Weight of the equipment and its distribution on the supports.
- B. Operation and maintenance manuals as specified in Section 01 78 23.
- C. Test Reports to be Submitted:
 - 1. Refer to Section 01 79 00 for details.
 - 2. Copies of all test results, as specified in Part 3 of this Section.
- D. Submit the Equipment Warranty and Certification Form as specified in Section 01 33 00.
- E. Submit manufacturers certificate of installation per Section 01 33 00.

1.6 WARRANTY

- A. The manufacturer shall warrant in writing all equipment against defects in materials and workmanship for a period of 12 months from the date of acceptance. Within this 12-month period, any defective or malfunctioning equipment, component, or accessory shall be repaired or replaced upon notice at no additional cost to the Owner.

1.7 QUALITY ASSURANCE

- A. The equipment shall be designed and constructed in accordance with the best practices and methods of the industry and shall be installed in accordance with the manufacturer's recommendations and the Drawings. Use only new materials.
- B. The Contractor is responsible for proper coordination and integration required for installation and all other associated work shown on the drawings and specified in the Contract Documents.

- C. Should equipment which differs from this Section be offered and determined to be the equal of that specified, such equipment will be acceptable only on the basis that any structures, piping, appurtenant equipment, electrical work, etc., required to accommodate such a substitution shall be made at no additional cost to the Owner and shall be as approved by the Engineer.

1.8 DELIVERY, HANDLING AND STORAGE

- A. Equipment and materials provided under this Section shall be delivered, stored, and handled in compliance with Section 01 45 34.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. The system shall be supplied by one of the following manufacturers:
 - 1. JWC Environmental®
 - 2. Approved equal.

2.2 PERFORMANCE REQUIREMENTS AND DESCRIPTIONS

- A. Performance Requirements
 - 1. Septage receiving station shall be rated for 400 GPM clean water flow.
 - 2. Septage receiving station shall be rated for 15 PSI maximum inlet pressure.
- B. Inlet Piping
 - 1. Description
 - a. Inlet piping shall provide connection between the metal trap, grinder, plug valve, and tank.
 - b. Inlet Piping shall be constructed of passivated AISI 304 stainless steel.
 - c. Pipe segments shall have 4-inch class 150 lb. weld neck flanges.
 - d. Gaskets shall be constructed of 1/8 neoprene rubber.
 - e. Fasteners shall be constructed of 18-8 stainless steel.
 - f. Provide connection for direct pumping into inlet piping as shown in the drawings.

2.3 GRINDER

- A. Components
 - 1. Grinder shall reduce inlet solids for protection of other components and enhance the

VAC TRUCK RECEIVING STATION

SECTION 46 21 12

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separation, washing, and de-watering process. Grinder shall be two shafted design consisting of individual cutters and spacers. Grinder shall have a single piece main body housing consisting of pipe flanges and inspection ports. Cutter cartridge shall be removable with the main body housing remaining in situ. Grinder shall have motor and speed reducer for cutter drive.

2. Cutters and Spacers

- a. Cutting stack height shall be a nominal height of 12-inches.
- b. Cutter shall be an individual disk constructed of AISI alloy steel surface ground to thickness of .438-inches $\pm .000/-0.001$.
- c. Cutters shall be heat treated to produce a hardness of 45-53 Rockwell C.
- d. Cutters shall have 7 cam shaped teeth. Tooth height shall not be greater than ½-inch (13 mm) above the root diameter of the cutter.
- e. Spacers shall be an individual disk constructed of AISI alloy steel surface ground to a thickness of .446-inches $\pm .001/-0.000$.
- f. Spacers shall have a hardness of 34-42 Rockwell C.
- g. Spacers shall have a smooth outside diameter with no tooth profiles.

3. Shafts

- a. Shafts shall be constructed from ASTM 4140 alloy steel with a minimum tensile strength of 149,000 PSI.
- b. Shafts shall measure a nominal 2-inches across flats of hex.
- c. Shafts shall be hardened to 32-38 Rockwell C.

4. Seal Cartridges

- a. Seal cartridges shall be rated to a maximum of 90 PSI.
- b. Seal cartridges shall not require flushing.
- c. Dynamic and rotating seal faces shall be tungsten carbide with 6% nickel binder.
- d. O-rings shall be Buna-N.
- e. Radial and axial loads shall be borne by sealed, oversized, deep-groove ball bearings.

5. Housings and Covers

Main body, gear, base, and end housings shall be ASTM A536-84 ductile iron.

- a. Top cover and inspection port covers shall be ASTM A536-84 ductile iron.
- b. Main body housing shall have inlet and outlet flanges with bolt pattern machined to class 150 4-inch pipe flange size.
- c. Main body housing shall have integral side wall deflectors to direct solids into cutters.
- d. Inspection port covers shall be on both inlet and outlet sides of main body housing.
- e. End housing shall have integral bushing deflector to guide solids away from seal cartridges.

6. Speed Reducer

- a. Reducer shall be manufactured by Sumitomo Machinery Corporation of America.
- b. Reducer shall be internal planetary mechanism with trochoidal curved tooth profile.
- c. Reducer shall be a vertically mounted single 29:1 reduction.
- d. Reducer shall be grease lubricated.

7. Motor

- a. Motor shall be manufactured by Baldor Electric Company.
- b. Motor shall be 5 hp, TEXP, 1725 rpm, 230/460 volt, 3 phase, 60 Hz .
- c. Motor shall have a minimum service factor of 1.15, 87.5% minimum efficiency factor at full load, minimum 75% power factor at full load.

B. Performance

1. Grinder shall have a maximum headloss of 11 inches of water column at 400 GPM of clean water.
2. Grinder shall provide a peak shaft torque of 4,246 lb.-in/hp.
3. Grinder shall provide a peak force at cutter tip of 1,831 lb_f/hp.

2.4 PLUG VALVE

- A. Provide an actuated plug valve to regulate the process flow as controlled by the ultrasonic level transmitter.

1. Valve Body
 - a. Valve body shall be manufactured by Milliken and cast of ASTM A-126 iron class B.
 - b. Valve shall have 4-inch class 125 inlet and outlet flanges.
 - c. Valve body shall have 316 SST sleeve type metal shaft bearings, sintered, oil impregnated permanently lubricated.
 - d. The valve plug shall have a cylindrical seating surface that is offset from the center of the plug shaft.
 - f. The valve plug shall be 100% encapsulated with Buna-N, 70 shore and shall withstand 75 lbs. pull under test procedure ASTM D-429-73 Method B.
2. Actuator
 - a. The actuator shall be manufactured by Rotork and be model IQT125 or equal.
 - b. The actuator enclosure shall be rated NEMA 4/4x/6 (IP68).
 - c. The actuator shall have a drive hand wheel for emergency manual operation.

2.5 TANK ASSEMBLY

A. Description

1. The tank shall house auger assembly and spray wash assemblies for the purpose of separating undesirable solids from the processed fluid. The tank shall include covers for access and removal of the inclined screw conveyor for maintenance. The tank shall include mounting tubes for the ultrasonic level sensor.
2. Two spray wash assemblies shall direct water onto to the captured solids and perforations of the incline screw screen trough for purposes of cleaning the captured solids. A third spray wash assembly shall direct water onto the tank walls for cleansing.
3. The spray wash assemblies shall all be controlled from a single control loop with 1-inch NPT inlet connection.

B. Components

1. Tank
 - a. Tank shall have a class 150, 4-inch inlet flange.
 - b. Tank shall have a 12-inch straight pipe discharge port.
 - c. Tank shall be constructed of passivated 10 gauge AISI 304 stainless steel.
 - d. Tank shall include lifting points for slings and separate lifting points for forklift.

- e. Tank shall include mounting points for spray wash assemblies.
- f. Tank shall have fully removable covers.

2. Spray Wash Assemblies

- a. Basket strainer shall be 304 stainless steel with 80 mesh screen.
- b. Y-strainer shall be bronze construction with a 20 mesh AISI 304 stainless steel screen.
- c. Solenoid valves shall be bronze body construction with a 120 volt AC Coil, explosion proof.
- d. Ball valves shall be manual and constructed of 304 stainless steel.
- e. Pipe and fitting shall be constructed of 316 stainless steel.
- f. Spray nozzles shall be constructed of 303 stainless steel, V-spray.
- g. Nozzles shall be AISI 303 stainless steel and rated 1.5 GPM @ 40 PSI.
- h. Tank spray rotating nozzle shall be AISI 304 stainless steel/ polypropylene and rated 10 GPM @ 40 PSI.

2.6 PIVOT SUPPORT

A. Description

- 1. Pivot Support shall provide a structure for positioning and lifting of the inclined screw in or out of the tank. Pivot Support shall allow 360⁰ rotation of the inclined screw once removed from the tank. Pivot Support shall include a maintenance support stand for supporting of the inclined screw above the tank.

B. Components

- 1. Support and stand shall be constructed of AISI 304 stainless steel.
- 2. Support shall include braces for positioning of the Pivot Support relative to the tank.
- 3. Support stand shall allow inclined screw to disengage from stand without disassembly.
- 4. Pivot Support shall support inclined screw at a 35⁰ inclination.

2.7 INCLINED SCREW CONVEYOR

A. Description

- 1. Inclined screw conveyor shall separate, transport, de-water, and discharge captured

solids. Inclined screw shall include a perforated screen trough, transport segment, de-watering segment, packing gland, drive, and rotor. The baffles of the screen trough shall create an overflow weir for protection of excess flow.

B. Components

1. Perforated Screen Trough

- a. Screen trough shall be constructed of AISI 304 stainless steel and electropolished to remove burrs.
- b. Perforations shall be ¼-inch diameter.
- c. Screen trough shall have baffles mounted on either side of the trough with replaceable ¼-inch neoprene seals attached to the baffles.

2. Transport Segment

- a. Transport segment shall be constructed of passivated AISI 304 stainless steel.
- b. Transport segment shall have 17-4PH wear bars.
- c. Transport segment shall be 19-11/16 inch flange to flange.

3. De-watering Segment

- a. De-watering segment shall be constructed of passivated AISI 304 stainless steel.
- b. De-watering segment shall have dual compartment design for shaft to enter in one compartment and captured solids into another compartment.

4. Packing Gland and Housing

- a. Packing shall be constructed of four (4) PTFE impregnated cords.
- b. Packing Gland housing shall be constructed of AISI 304 stainless steel.

5. Rotor

- a. Rotor shall be constructed of alloy steel.
- b. Lower section of rotor shall be 480mm diameter with ½-inch groove for mounting of brush.
- c. Brush shall mount into groove and be secured with set screws.
- d. Rotor shall have a transition section from 480 mm to 285mm.

- e. Rotor shall have a double helix 285 mm section prior to compaction zone.
- f. Brush shall be single piece design with stainless steel backing and nylon bristles.
- 6. Speed Reducer
 - a. Reducer shall be manufactured by Nord Gear Corporation
 - b. Reducer shall be helical parallel shaft mounted with a 160:1 reduction.
- 7. Motor
 - a. Motor shall be manufactured by Baldor Electric Company or Equal.
 - b. Motor shall be 2 hp, TEXP, 1725 rpm, 230/460 volt, 3 phase, 60 Hz.
 - c. Motor shall have a minimum service factor of 1.15, 84% minimum efficiency factor full load, minimum 81% power factor at full load.

2.8 CONTROLLER

A. Description

- 1. An enclosure controller shall provide control of the septage receiving station components. The enclosure shall have an Operator Interface Terminal, indicator lights, switches and other control devices.
- 2. Make provisions in the control panel to interlock operation of a remote chopper pump with the start/stop pushbuttons of the septage receiving station.

B. Components

- 1. Enclosures
 - a. Enclosure shall be AISI 304 stainless steel NEMA 4X and house the PLC.
 - b. Enclosure shall house control devices, motor starters, Emergency Stop, OIT, Start & Stop pushbuttons.
- 2. Operator Interface Terminal (Operator Enclosure)
 - a. OIT shall be manufactured by Red Lion or equal.
 - b. OIT shall be rated for outdoor use.
 - c. OIT shall display fail, service reminder and operational messages.

- d. OIT shall display Volume, Tank Level and Valve Position.
 - e. OIT shall allow for a programmable system cleaning cycle.
 - f. Recorder shall store operation data.
3. Start & Stop Pushbuttons
- a. Pushbuttons shall be rated NEMA 4X.
 - b. Start pushbutton shall initiate operation of the system.
 - c. Stop pushbutton shall initiate a stop of the system and immediately stop the grinder motor and close the plug valve. Tank spray wash solenoid shall energize and operate along with the auger motor and auger spray wash for the duration of the cleaning cycle.
4. Grinder ON/OFF/AUTO three-position keyed selector switch.
- a. In the ON position, the grinder shall run continuously.
 - b. In the AUTO position, the grinder shall operate as controlled by the START and STOP pushbuttons.
5. Auger ON/OFF/AUTO three-position keyed selector switch.
- a. In the ON position, the auger shall run continuously.
 - b. In the AUTO position, the auger shall operate as controlled by the START and STOP pushbuttons.
6. Plug Valve OPEN/CLOSE/AUTO three-position keyed selector switch.
- a. In the OPEN position, the plug valve will open.
 - b. In the CLOSE position, the plug valve will close.
 - c. In the AUTO position, the plug valve will open and close as controlled by the ultrasonic level sensor mounted on the tank.
7. RESET momentary two-position keyed selector switch.
- a. Switch shall be rated NEMA 4X.
 - b. Reset switch shall clear any fault condition and rest system for operation.
8. Pilot Lights
- a. Lights shall be LED type rated NEMA 4X.

- b. Lights shall indicate GRINDER RUN, AUGER RUN, PLUG VALVE OPEN and FAIL.
- 9. Emergency Stop Pushbutton
 - a. Emergency Stop Pushbutton shall be rated NEMA 4X.
 - b. When activated Emergency Stop shall close plug valve, stop all motors including the remote chopper pump and de-energize solenoid valves.
- 10. Motor Starter and Control Transformer
 - a. Starter shall be a full voltage reversing type with 120 volt operating coils.
 - b. Overload relays shall be adjustable and sized to full load amperes (FLA) of the motor.
- 11. Programmable Logic Controller
 - a. PLC shall be manufactured by Panasonic.
 - b. PLC shall have a minimum of 16K of memory.
- 12. Remote Pump Interlock Operation
 - a. To utilize the remote transfer pumping equipment (chopper pump) specified in Section 43 24 00 of these specifications to feed the septage receiving station, open the associated inlet valve and close the septage receiving equipment inline plug valve near the cam lock connection.
 - b. Place the grinder, auger in AUTO position. Place the transfer pump in AUTO at its local control panel. When the START pushbutton is depressed on the septage receiving control panel, a command signal will automatically START the transfer pump. During periods when the macerator is reversing, the pump will automatically STOP and then START again with the return of operation of the macerator. If the macerator is in FAIL condition, the pump shall automatically STOP.
 - c. When the STOP pushbutton on the septage receiving control panel is depressed, a command will be sent to automatically STOP the pump.
 - d. If the E-STOP pushbutton is depressed at the local septage receiving station control panel, the transfer pump will automatically STOP.
- C. Safety Features
 - 1. When a grinder jam condition occurs while the system is operating, the controller shall stop the grinder, then reverse the grinder rotation to clear the obstruction. If the jam is

cleared, the controller shall return the grinder to normal operation. If three reverses occur within a 30 second interval, the controller shall de-energize the grinder motor and activate the grinder FAIL indicator and relay. The auger shall continue to operate.

2. When an inclined screw jam condition occurs while the system is operating, the controller shall stop the screw, then reverse the screw rotation to clear the obstruction. If the jam is cleared, the controller shall return the screw to normal operation. If two reverses occur within a 30 second interval, the controller shall de-energize the grinder motor and activate the auger FAIL indicator and relay. The grinder shall continue to operate.
3. When a power failure occurs while the system is operating the system shall be required to be restarted using the START pushbutton.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Septage Receiving Station and controller shall be installed in accordance with the supplier's installation instructions, and in accordance with all OSHA, local, state, and federal codes and regulations.

3.2 TESTING

- A. Test the Septage Receiving Station to demonstrate correct alignment, smooth operation and freedom of excessive vibration and noise. Make corrections if system fails to operate correctly.

3.3 START-UP TESTING

- A. Refer to Section 01 79 00 for Facility Testing and Start-up.

3.4 MANUFACTURERS FIELD SERVICE

- A. Provide field services identified in Section 01 79 01. Include 2 days on site (1 day for training and 1 day for start-up), exclusive of travel time.

END OF SECTION

**SECTION 46 21 13
CHAIN &RAKE BAR SCREEN**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. This section describes the Chain & Rake Bar Screen System which shall consist of a screenings unit for particle capture and transport to the discharge point identified on the drawings.
- B. The Chain & Rake Bar Screen System shall be provided with a controller and ultrasonic differential level measurement system for operation and control of the bar screen. The equipment shall be installed as shown on the plans, and /or as recommended by the supplier, and in compliance with all OSHA, local, state, and federal codes and regulations.

1.2 QUALITY ASSURANCE

A. QUALIFICATIONS

- 1. Qualified suppliers shall have a minimum 10 years of experience in designing and manufacturing screens. Supplier shall provide a list of names and dates of installations for verification by the Engineer or Owner's Representative.

1.3 IDENTIFICATION

- A. Each unit of equipment shall be identified with a corrosion resistant nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, supplier's name, and location.

1.4 RELATED WORK

- A. Testing & Startup are included in Section 01 79 00.
- B. Manufacturer services and training included in Section 01 79 01.
- C. Operation and maintenance manuals included in Section 01 78 23.
- D. Delivery, Storage and Handling is included in Section 01 45 34.
- E. Miscellaneous metals are included in Section 05 10 00.
- F. Field painting is included in Section 09 91 00.

1.5 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01 33 00, copies of all materials required to establish compliance with this Section. Submittals shall include the following:

1. Drawings showing general arrangement of the screening system.
 2. Drawings showing details of the screen, piping, electrical and instrumentation.
 3. Materials and manufacturing specifications.
 4. Flow rate versus Headloss curves.
 5. Installation, operation, and maintenance instructions.
 6. List of any exceptions taken to the plans and specifications including written justification.
 7. Literature that describes the equipment and shows all key details of construction and dimensions. Dimensions shall show overall size and space requirements including that for installation, leveling, dismantling and maintenance.
 8. Weight of the equipment and its distribution on the supports.
- B. Operation and maintenance manuals as specified in Section 01 78 23.
- C. Test Reports to be Submitted:
1. Refer to Section 01 79 00 for details.
 2. Copies of all test results, as specified in Part 3 of this Section.
- D. Submit the Equipment Warranty and Certification Form as specified in Section 01 33 00.
- E. Submit manufacturers certificate of installation per Section 01 33 00.

1.6 WARRANTY

- A. The manufacturer shall warrant in writing all equipment against defects in materials and workmanship for a period of 12 months from the date of acceptance. Within this 12-month period, any defective or malfunctioning equipment, component, or accessory shall be repaired or replaced upon notice at no additional cost to the Owner.

1.7 QUALITY ASSURANCE

- A. The equipment shall be designed and constructed in accordance with the best practices and methods of the industry and shall be installed in accordance with the manufacturer's recommendations and the Drawings. Use only new materials.
- B. The Contractor is responsible for proper coordination and integration required for installation and all other associated work shown on the drawings and specified in the Contract Documents.
- C. Should equipment which differs from this Section be offered and determined to be the equal of that specified, such equipment will be acceptable only on the basis that any structures, piping, appurtenant equipment, electrical work, etc., required to accommodate such a substitution shall be made at no additional cost to the Owner and shall be as approved by the Engineer.

1.8 DELIVERY, HANDLING AND STORAGE

- A. Equipment and materials provided under this Section shall be delivered, stored, and handled in compliance with Section 01 45 34.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Chain & Rake Unit with motor controller shall be in compliance with these specifications and plans and shall be supplied by one of the following manufacturers:
1. JWC Environmental® Model CRM-2
 2. Vulcan- Model VMR-24 Multi-Rake Bar Screen
 3. Headworks MS series
 4. Approved equal.

2.2 CHAIN AND RAKE UNIT

A. GENERAL

1. The Chain & Rake System shall be a self-contained, screening system used to capture and transport wastewater debris to the discharge point. The controller shall provide independent control of the Chain & Rake System. Provide an interface for the ultrasonic transducers.
2. The Chain & Rake screen consists of vertically oriented rectangular or tapered bars, spaced to create a fabricated and stiffened grid which is carried on supports spanning the channel width.
3. The bar rack extends from the invert of the channel to a minimum of six inches above the maximum water level unless noted, where it shall connect to a debris plate on which the screenings shall be lifted to the discharge apex prior to them dropping across the apron plate into a receptacle.
4. The screenings are mechanically cleaned from the bar rack by rakes with tine plates mounted on carriers attached to the links of the roller chains on each side of the screen. The completed screen forms a strong and rigid integral structure which is secured to the support beams which span the width of the channel.
5. The chains run over stainless steel drive sprockets keyed to the main drive shaft mounted in bearings and driven by a shaft mounted motorized gear unit.

B. PERFORMANCE DATA

1	Peak hour flow per screen	4.00 MGD
2	Waste fluid type	Domestic Wastewater
3	Channel width	24.00 inches
4	Nominal screen width	24 inches

5	Channel depth	64.44 inches
6	Amount of vertical screen recessing	None (standard installation configured)
7	Downstream water level at peak flow	19.08 inches
8	% screen panel blinding	50%
9	Head drop at % blinding (Kirschmer's)	6.84 inches
10	Upstream water level at % blind	26 inches
11	Hydraulic flow regime	Subcritical flow (standard open channel flow)

C. DESIGN DATA

1	Number of Chain & Rake Screens	1
2	Inclination angle, from horizontal	75 or 85 degrees from horizontal
3	Bar rack bar size	5/16" x 1/4" x 1-1/2"
4	Bar rack bar profile	Tapered
5	Bar spacing (spacing width)	1/4 inches
6	Wiper blade material	UHMW Polyethylene
7	Screen Side frame plate thickness	0.250 inch (Minimum)
8	General construction material	304L SST
9	Top of channel to operating floor	5.37 feet
10	Discharge height (above operating floor)	52.00 inches (Minimum)
11	Rake speed, minimum	10 feet / minute
12	Roller chain pitch	6 inch
13	Roller chain side plate material	316 SST
14	Roller chain roller, pin, bushing material	17-4 SST
15	Roller chain ultimate strength (per chain)	16,000 lb _f
16	Screen drive reducer type	Helical Bevel
17	Screen drive reducer ratio	380:1
18	Screen motor power	2.0 hp, (Maximum)
19	Screen motor rating	TEFC
20	Screen motor / control panel voltage	460 volts
21	Screen motor / control panel phase	3 phase
22	Screen motor / control panel frequency	60 Hz
23	Main control panel enclosure rating	NEMA 4X
24	Local control station enclosure rating	NEMA 4X

2.3 COMPONENTS

A. CHAIN SPROCKET AND CHAIN

- The chains shall be roller type with stainless steel side plates. The rollers, pins and bushings shall be hardened stainless steel. Chain material and strength shall be as specified in the Design Data section above, items 12, 13, 14.

2. The stainless steel drive shaft shall be supported on each side by grease lubricated take-up bearing assemblies.
3. The chain shall track in a stainless steel guide system mounted in each side frame. The guide system shall incorporate UHMW wear strips.
4. Provide lower sprocket engagement system or static guide rail bearing tracking system for lower engagement (no sprocket).

B. SIDE FRAMES

1. The screen shall include side frames and bracing designed to support the chain, rakes, spray wash, discharge, and drive assemblies. The side frames shall be manufactured from material and thickness as specified in the Design Data section above, items 7, 8.
2. Each side frame shall be designed to house the replaceable stainless steel and UHMW polyethylene tracking system.

C. COVERS

1. The portion of the screen above the operating floor level shall have stainless steel covers.
2. The covers shall provide quick access to the equipment for maintenance. Material of construction shall be as specified in the Design Data section, item 8.

D. DRIVE ASSEMBLY

1. The screen drive assembly shall be a shaft-mounted reducer with an electric motor. The reducer type, ratio, motor rating, and characteristics shall be as specified in the Design Data section, items 16, 17, 18, 19, 20, 21, 22.
2. The rake speed shall be as specified in the Design Data section, item 11.

E. WIPER

1. The wiper shall be stainless steel, pivoting and be easily adjustable.
2. The wiper shall have a replaceable UHMW polyethylene blade.

F. BAR RACK

1. Bars shall be stainless steel and shaped as specified in the Design Data section, items 3, 4. The bar rack shall extend 6" above the max water level unless noted.
2. The bar spacing shall be as specified in the Design Data section, item 5. The bars shall be supported as required.
3. Bars shall not be welded in place. Provide removable bars or removal rack.

G. RAKES

1. The stainless steel rakes shall be constructed of two or more pieces and are bolted to the

stainless steel chain on each side.

2. The stainless steel rake frame is designed to fasten to, support, and align the rake teeth.
3. The stainless steel rake teeth shall be machined in sections and designed to fasten to the rake frame.

H. APRON AND DEAD PLATE

1. The apron and dead plate shall be stainless steel.
2. Provide heat trace system for dead plate is desired.

I. DISCHARGE CHUTE

1. The discharge chute shall receive screened debris that has been removed from the rakes by the wiper.
2. An enclosed stainless steel discharge chute shall transport the discharge to a sluiceway, and discharge into a container.
3. The height of the discharge chute from the operating floor level shall be as specified in the Design Data section, item 10.
4. Chute manufactured of 14-gauge 304 stainless steel and shall be provided with an access door to facilitate wiper replacement.

2.4 CONTROLS

A. COMPONENTS

1. PLC shall be an Allen Bradley model MicroLogix 1400
2. OIT shall be an QSI model X2 Extreme 7.
3. Circuit Breaker shall be Siemens.
4. Starters shall be Allen Bradley IEC
5. Relays shall be Allen Bradley and/or IDEC.
6. Pilot lights shall be Allen Bradley 22mm Type 4/4X/13.
7. Selector switches shall be Allen Bradley Type 4/4X/13.
8. Ultrasonic differential level system shall be Endress & Hauser or equal.

2.5 CONTROL PANEL

- A. The control panel shall be UL/cUL listed and wired as specified in the Design Data section, items 20, 21, 22.
- B. The main control panel shall be mounted remotely to the screen and contain the following switches and lights:
 1. Reset push button.
 2. Power on light
 3. Screen run light.
 4. Alarm light (overload).

- C. The local control station shall be mounted locally to the screen and contain the following:
 - 1. Hand/Off/Auto selector switch for the screen.
 - 2. Forward /Off/Reverse selector switch, spring returned in reverse.
 - 3. Emergency Stop push button.
- D. Ratings for the main control panel and local control station enclosures shall be as specified in the Design Data section, items 23, 24.
- E. Control logic shall be PLC based with timers and counters written in control logic. Timers and counters shall be adjustable via operator interface on the exterior of the control panel. Operator interface shall be a QSI model X2 Extreme 7 and the PLC shall be an Allen Bradley model MicroLogix 1400.

2.6 OPERATION

- A. When the screen is in the Hand mode and in the Forward position the screen shall run continuously. The Reverse position is spring loaded.
- B. In the Auto Mode the screen cycle shall start by a signal from one of the following:
 - 1. Differential level system
 - 2. Timer
 - 3. Input error from transducer (loss of echo)
 - 4. High level alarm
 - 5. High level start
- C. If the screen starts at a differential level the screen shall run until the differential drops below the set point and the off timer times out.
- D. If the screen starts on high level and it shall run until the high level drops below the set point and the off timer times out.
- E. If one of level transducers has an error the screen shall run continuously.
- F. The screen also has a timer that shall allow the screen to operate periodically. The timer is adjustable for both start frequency and duration of run.
- G. Control logic shall be included to provide overload protection in case of screen blockage that would stall the raking mechanism. If a blockage were encountered, the controls would stop the raking mechanism, reverse direction to dislodge the blockage with the preceding rake, and then reverse to the normal raking direction. Once the blockage is dislodged, the operating sequence continues as normal. If the blockage is not dislodged after three (3) reversals, the screen will stop operation and an alarm signal will be generated.

2.7 FACTORY TESTING

- A. The Chain & Rake System and controller shall be factory tested to ensure satisfactory operation.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Contractor shall install the equipment as indicated on the contract drawings and in strict accordance with the manufacturer's recommendations.
- B. The final installation must be certified by the manufacturer as complete and correct.

3.2 START-UP TESTING

- A. Refer to Section 01 79 00 for Facility Testing and Start-up.

3.3 MANUFACTURERS FIELD SERVICE

- A. Provide field services identified in Section 01 79 01. Include 2 days on site (1 day for training and 1 day for start-up), exclusive of travel time.

END OF SECTION

**SECTION 46 23 23
GRIT REMOVAL EQUIPMENT**

PART 1 GENERAL

1.1 SUMMARY

- A. This specification describes the equipment and scope of work to replace the existing grit concentrator, hopper and grit screw with a new equipment. The existing control panel will be used to control the new equipment.
- B. The new equipment shall be equivalent to the Smith and Loveless Pista Model 15 (Dewatering Screw Conveyor) with a grit concentrator rated for 250 gpm.

1.2 QUALITY ASSURANCE

- A. Qualifications
 - 1. Qualified suppliers shall have a minimum 10 years of experience in designing and manufacturing grit handling equipment.

1.3 IDENTIFICATION

- A. The equipment shall be identified with a corrosion resistant nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, supplier's name, and location.

1.4 RELATED WORK

- A. Allowances are included in Section 01 21 00.
- B. Testing & Startup are included in Section 01 79 00.
- C. Manufacturer services and training included in Section 01 79 01.
- D. Operation and maintenance manuals included in Section 01 78 23.
- E. Delivery, Storage and Handling is included in Section 01 45 34.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 00, Submittals, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following information:
 - 1. General arrangement drawings showing materials, details of construction, dimensions, and connections.
 - 2. Complete equipment performance data including where applicable:

3. Motor type and voltage.
4. List of recommended spare parts broken down into parts for the first year of operation.
5. Copies of all test results, as specified in Part 3 of this Section.
6. Submit the Equipment Warranty and Certification Form as specified in Section 01 33 00.
7. Field-testing procedures.
8. Submit manufacturers certificate of installation per Section 01 33 00.
9. Descriptive Brochures
10. Motor Data
11. Operation and maintenance manuals as specified in Section 01 78 23.

1.6 WARRANTY

- A. The Manufacturer of the equipment shall warrant for one (1) year from date of startup that all equipment he provides will be free from defects in material and workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Smith and Loveless
- B. Or approved equal.

2.2 GRIT CONCENTRATOR (CYCLONE)

- A. Provide one(1) Grit Concentrator rated for 250 gpm. The unit shall operate on the constant rate vortex principle. Design shall be such that a small volume of water and grit will discharge at the bottom for final dewatering and ultimate disposal of the grit.
- B. As a minimum, 93 to 94 percent of the water pumped to the 250 GPM rated concentrator and 95 to 96 percent of the residual organic material shall flow out the top and be returned to the plant for re-processing. The remainder will fall into a grit hopper located directly below. The unit shall be capable of intermittent operation with minimal variation in removal efficiency. There shall be less than 5% putrescible material in the recovered grit from the underflow.
- C. The grit concentrator shall be constructed of Ni-hard , with minimum of 1.2-inch and 1-1/4 inch in high wear areas. Refer to the drawings for inlet and outlet configuration and size.

2.3 GRIT HOPPER AND SCREW CONVEYOR CRITERIA

- A. The grit screw conveyor shall be constructed of 316 stainless steel with a 316 stainless steel hopper to receive the mixture of water and grit. The hopper shall be equipped with an energy dissipation zone to prevent turbulence in the remaining portion of the hopper.
- B. The hopper shall have parallel plates located in the settling zone to improve retention of the fine grit. An overflow weir trough shall be provided to return the water to the system. The conveyor shall be freestanding with support legs to hold the conveyor at an angle of approximately 22°. The discharge shall be 8" diameter, flanged. The drive assembly shall be located at the discharge end.
- C. The screw conveyor shall have an open, 3/16" stainless steel U trough. The screw diameter required is 9 inches and overall screw length as shown on the drawings. The hopper shall have a 4" full-length outlet weir trough to minimize the overflow rate and carryover of the fine grit. The total surface area shall be a minimum of 22 square feet.
- D. The maximum surface overflow rate (SOR) shall be 0.004 FPS, and the maximum weir overflow rate shall be 12,000 GPD/FT of weir length at steady/normal operating flow conditions. The screw shall run on anti-friction bearings at the outlet end, and a bronze bushing at the inlet end. The inlet end shaft bushing shall be capable of being greased. The inlet end shall have two 2" (50 mm) drains with isolation valve and insulation to prevent freezing. Clearance between the legs and the discharge outlet shall be per manufacturer recommendations.
- E. The drive to the dewatering screw shall be belt driven motor with shaft mounted helical gear reducer. The motor shall be 1 HP, 1200 RPM, (TEFC) 3-phase, 60 cycle, 460 volt with a 1.0 Service Factor. The screw speed shall be 10 RPM. The drive shall be mounted on a plate at the discharge end and the plate shall be bolted to the flanges on the trough. Electrical over-torque sensing with shutdown shall be provided to prevent damage to the unit.
- F. A solid stainless steel cover shall be provided over the hopper and trough openings. The inlet opening over the hopper shall mesh covered of stainless steel.
- G. Stainless steel, aluminum and other corrosion-resistant surfaces shall not be coated. Carbon steel surfaces not otherwise protected shall be coated with a suitable non-hardening rust preventative compound. Auxiliary components shall be furnished with the original manufacturer's coating.
- H. Finish coating shall be accomplished prior to shipment of the equipment from the factory and shall comply fully with the intent of these specifications. A touch-up kit shall be provided by the manufacturer for repair of any mars or scratches occurring during shipping and installation. This kit shall contain detailed instructions for use.

2.4 MANUFACTURING QUALITY

- A. The specified Manufacturer markets, designs, fabricates and manufactures the grit chamber equipment at its own U. S. facility. The Manufacturer shall have on staff registered engineers,

both in process and design. This would be for providing current capabilities in these areas as well as future capabilities after the equipment is installed and operating, for the best long term interest of the Owner.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with instructions provided by the Manufacturer.
- B. Contractor to insulate and heat tracing piping in accordance with schedule on the Drawings.

3.2 STARTUP

- A. The Manufacturer shall provide the services of a Factory-trained representative for a period of one (1) eight hour day on-site to assist with the initial startup, and to instruct the Owner's operating personnel in the operation and maintenance of the equipment.
- B. In the event a component fails to perform as specified or is proven defective in service during the warranty period, the Manufacturer shall repair or replace, at his discretion, such defective part. The cost of labor and all other expenses resulting from replacement or replacement of parts is the equipment vendor's responsibility.

END OF SECTION

**SECTION 46 51 21
COARSE BUBBLE DIFFUSED AERATION SYSTEM**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all materials, equipment, and services required for the coarse bubble diffused aeration system for the aerobic digesters as shown on the contract drawings and contained herein.
- B. System consists:
 - 1. Stainless steel dropleg, distribution headers and diffusers.
 - 2. Stainless steel manifold and supports.
 - 3. Stainless steel supports and anchor bolts.
 - 4. Stainless steel flanged and expansion joints.
 - 5. Bolts, nuts and gaskets for the aeration system flanges.
- C. The Contractor shall be responsible for furnishing all labor, materials, equipment, and incidentals required to install, test and commission.

1.2 RELATED WORK

- A. Testing & Startup are included in Section 01 79 00.
- B. Manufacturer services and training included in Section 01 79 01.
- C. Miscellaneous metals are included in Section 05 10 00.
- D. Field painting is included in Section 09 91 00.
- E. Operation and maintenance manuals included in Section 01 78 23.
- F. Delivery, Storage and Handling is included in Section 01 45 34.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01 33 00, copies of all materials required to establish compliance with this Section. Submittals shall include the following:
 - 1. Drawings showing general arrangement of the aeration system.
 - 2. Elevations and cross sections.
 - 3. Drawings showing details of the diffusers, diffuser connectors, piping, pipe supports, and pipe joints.
 - 4. Materials and manufacturing specifications and data sheets.
 - 5. Oxygen transfer and system headloss calculations.

COARSE BUBBLE DIFFUSED AERATION SYSTEM

SECTION 46 51 21

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6. Installation, operation, and maintenance instructions.
 7. List of any exceptions taken to the plans and specifications including written justification.
 8. Literature that describes the equipment and shows all key details of construction and dimensions. Dimensions shall show overall size and space requirements including that for installation, leveling, dismantling and maintenance.
- B. Operation and maintenance manuals as specified in Section 01 78 23.
- C. Test Reports to be Submitted:
1. Refer to Section 01 79 00 for details.
 2. Copies of all test results, as specified in Part 3 of this Section.
- D. Submit the Equipment Warranty and Certification Form as specified in Section 01 33 00.
- E. Submit manufacturers certificate of installation per Section 01 33 00.

1.4 WARRANTY

- A. The manufacturer shall warrant in writing all equipment against defects in materials and workmanship for a period of 12 months from the date of acceptance. Within this 12-month period, any defective or malfunctioning equipment, component, or accessory shall be repaired or replaced upon notice at no additional cost to the Owner.

1.5 QUALITY ASSURANCE

- A. The equipment shall be designed and constructed in accordance with the best practices and methods of the industry and shall be installed in accordance with the manufacturer's recommendations and the Drawings. Use only new materials.
- B. The Contractor is responsible for proper coordination and integration required for installation and all other associated work shown on the drawings and specified in the Contract Documents.
- C. Should equipment which differs from this Section be offered and determined to be the equal of that specified, such equipment will be acceptable only on the basis that any structures, piping, appurtenant equipment, electrical work, etc., required to accommodate such a substitution shall be made at no additional cost to the Owner and shall be as approved by the Engineer.

1.6 DELIVERY, HANDLING AND STORAGE

- A. Equipment and materials provided under this Section shall be delivered, stored, and handled in compliance with Section 01 45 34.

1.7 PERFORMANCE REQUIREMENTS

- A. Design the aerobic digester coarse bubble aeration system for installation in the following tanks.

Tank Dimensions (Each)	Aerobic Digesters 1 & 2
Length (ft.)	50'-0"
Width (ft.)	50'-0"
Max Water Depth (ft.)	14'-6"

- B. Design aeration system to transfer the following minimum amount of oxygen per day at standard conditions in clean water at the specified submergence, air rate and pressure.

SOR, lbs./day	2,478
Volumetric Air Rate (scfm/digester)	1,083
Pressure @ Top of Dropleg (psig)	6.20
Diffuser Submergence (ft.)	13.50
SOTE, %	9.1

- C. Minimum Header and Diffuser Criteria

Number of Headers/basin	2
Header Orientation	Width
Drop Leg Location and Size	End/ 8"
Number of diffusers per basin	72
Diffuser Style	Wide Band
Diffuser air flow, scfm	15.04
Diffuser orifice, inch	5/8

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The aeration system shall be supplied by Sanitaire, Aquarius Technologies, EDI (Nexom), or equal.

2.2 MATERIALS, MANUFACTURING & FINISHING

- A. Stainless Steel

1. Fabricate all welded parts and assemblies from sheets, plates, or bars of 304L stainless steel with a 2D finish conforming to ASTM A240, A554, A774 and A778.
2. Fabricate all non-welded parts and assemblies from sheets, plates, or bars of 304 stainless steel conforming to ASTM A240, or ASTM A276.
3. Furnish all nuts, bolts, washers, and anchors bolts from 18-8 series stainless steel.
4. Furnish 304L stainless steel diffusers with a 20-gauge stainless steel body and a cast 316L schedule 80 – ¾ inch NPT threaded nozzle.

5. Furnish diffuser connectors cast from 316L stainless steel.
6. Weld in the factory with ER 316L filler wire using MIG, TIG or plasma-arc inert gas welding processes. Provide a cross section equal to or greater than the parent metal.
7. Clean all welded stainless-steel surfaces and welds after fabrication to remove weld splatter and finish clean all interior and exterior welds by full immersion pickling and rinse with water to remove all carbon deposits and contaminants to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380 Section 6.2.11, Table A2.1 Annex A2 and Section 8.3.

2.3 EQUIPMENT COMPONENTS

- A. Drop Pipes – Provide a minimum 12-gauge stainless steel drop pipe from the air main connection to the manifold or air distribution header.

Provide a stainless-steel Van Stone flange with a 150-pound drilling at the top connection.

1. Provide a stainless-steel EPDM gasketed coupling for connection to the manifold or air distribution header.

- B. Manifolds and Air Distribution Headers – Provide a minimum 12-gauge stainless steel manifold and/or air distribution headers for connection to the drop pipe.

1. Fabricate manifolds and air distribution headers in sections up to 45 feet in length and join sections using flanged or expansion joints.
2. Design piping with eccentric reducers for changes in diameter to maintain constant invert elevation.
3. Provide piping with removable or welded end caps.
4. Design piping, pipe joints and supports to resist expansion/contraction thrust forces of the air distribution headers over a temperature range of 125° F.
5. Provide piping fabricated of stainless-steel material per section 2.2 A.

- C. Pipe Supports – Provide each section of manifold and/or air distribution header with a minimum of two supports.

1. Support spacing shall be limited to a maximum of 17.5 feet.
2. Design all supports to allow for thermal expansion and contraction forces over a temperature range of 125° F and to minimize stress build up in the piping system.
3. Design supports to be adjustable without removing the air distribution header from the support.
4. Design supports to include hold down guide straps, support structure and two anchor bolts.
5. Guide straps shall be fabricated from minimum 2-inch-wide, 12-gauge stainless steel to eliminate point load on piping and minimize binding.
6. Design support for a total of 1-inch lateral adjustment and 4-inch vertical adjustment for

leveling within +/-3/8 inch of a common plane.

7. Attach supports to tank floor with stainless steel anchor bolts designed for installation in 4,000 psi concrete.
 8. Provide system supports fabricated from stainless steel material per section 2.2A.
- D. Diffuser Assemblies – Furnish diffuser assemblies including diffuser, diffuser connector and air flow control orifice.
1. Air Diffuser
 - a. Provide diffuser fabricated of stainless-steel material per section 2. 2 A.
 - b. Design diffuser to include a ¾ inch NPT threaded nozzle, air reservoir, air exit ports and bottom deflector.
 - c. Locate exit ports discharging air into liquid on horizontal planes at two levels.
 - d. Provide deflector below each diffuser for its full length and width.
 - e. Design deflector to direct the liquid being aerated along the diffuser reservoir walls so that the air exits through the ports and is sheared into small bubbles and distributed into the liquid.
 - f. Diffuser design operating range of 8 to 40 SCFM.
 2. Diffuser Connectors
 - a. Provide diffuser connector fabricated of stainless-steel material per section 2.2.A.
 - b. Diffuser connector shall be designed to accommodate two diffusers.
 - c. Furnish PVC plugs for all unused diffuser connectors.
 - d. Factory weld connector to the invert centerline of the air distribution header with a full penetration butt weld.
 - e. Reinforce the connector header weld joint by providing and continuously welding gussets between the vertical side wall of the header and the connector ends to limit long term flexure failure. Minimum gusset thickness shall be 1/8 inch.
 - f. Design connector to resist a vertical dead load applied to the threaded end of the connector that results in a bending moment of 1,000 inch-lbs. without exceeding 24,000 psi design stress in any part of the air distribution header wall or connector.
- E. Anchor Bolts
1. Design a mechanical or adhesive anchor bolt system for embedment in 4,000 psi concrete with a pullout safety factor of 10.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Contractor shall install the equipment as indicated on the contract drawings and in strict accordance with the manufacturer's recommendations.

- B. The final installation must be certified by the manufacturer as complete and correct.

3.2 START-UP TESTING

- A. Refer to Section 01 79 00 for Facility Testing and Start-up.

3.3 MANUFACTURERS FIELD SERVICE

- A. Provide field services identified in Section 01 79 01. Include 2 days on site (1 day for training and 1 day for start-up), exclusive of travel time.

END OF SECTION

**SECTION 46 53 53
SEQUENTIAL BATCH REACTOR SYSTEM**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The Sequential Batch Reactor (SBR) System shall be supplied by Aqua Aerobics. At a minimum, the scope of supply includes the following: mixer(s), decanter(s), retrievable diffuser(s), actuated valves, and controls. Refer to Part 2 and Part 3 of this section for additional details.
- B. The basis of design for this project is Aqua Aerobics, no equal. Refer to Appendix A in this section for Aqua Aerobics Scope.
- C. Provide inspection, start-up training and 12 months of 24-hour customer service hotline with access to a certified plant operator.
- D. Under this Section furnish and deliver a Sequencing Batch Reactor (SBR) system capable of performing as specified herein. Equipment components shall conform to the specific requirements of this section insofar as they apply.
- E. It is the intent that the SBR supplier provide the process design , furnish equipment and controls and programming.
- F. The system is an expansion of the existing Aqua SBR with one new SBR basin (Basin 4 added) and existing digester 1,2 converted to an SBR (Basin 2A/2B). The four existing SBR basins will work in tandem as basins 1A/1B, 3A/3B.

1.2 RELATED WORK

- A. Testing & Startup are included in Section 01 79 00.
- B. Manufacturer services and training included in Section 01 79 01.
- C. Operation and maintenance manuals included in Section 01 78 23.
- D. Delivery, Storage and Handling is included in Section 01 45 34.
- E. SBR Rotary Positive Displacement Blowers are included herein.
- F. Rotary Positive Displacement Blowers is included in Section 43 11 33.
- G. SBR Submersible Wastewater Pumps are included herein.
- H. Ultraviolet Light Disinfection System in Section 46 66 56.
- I. Process Instrumentation and Supplier is included in Section 25 00 00.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 00, Submittals, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following information:
 - 1. General arrangement drawings showing materials, details of construction, dimensions, and connections.
- B. Complete equipment performance data including where applicable:
 - 1. RPM
 - 2. Capacity — SCFM and ICFM or GPM
 - 3. Discharge pressure
 - 4. Discharge temperature
 - 5. dB(A) noise pressure level
 - 6. Maximum gear tip speed and rotor tip speed (fpm)
 - 7. HP required at rated capacity and pressure.
 - 8. Rated maximum pressure rise of blowers.
 - 9. L10 bearing life calculations for each bearing.
 - 10. Weight.
 - 11. Motor type and voltage.
 - 12. List of recommended spare parts broken down into parts for the first year of operation.
- C. Copies of all test results, as specified in Part 3 of this Section.
- D. Submit the Equipment Warranty and Certification Form as specified in Section 01 33 00.
- E. Field-testing procedures.
- F. Submit manufacturers certificate of installation per Section 01 33 00.
- G. Descriptive Brochures
- H. Performance Curves
- I. Motor Data
 - 1. 1/2, 3/4, full load efficiencies and power factors.
 - 2. L10 bearing life calculations for each bearing.
- J. Silencers
 - 1. An attenuation performance curve for each type of silencer.

K. Valves and actuators

1. Complete operating and maintenance instructions professionally published, hard copy and electronic copy, shall be furnished for all equipment included under these specifications in accordance with the Contract requirements.

L. Operation and maintenance manuals as specified in Section 01 78 23.

M. Test Reports to be Submitted:

1. Refer to Section 01 79 00 for details.

1.4 QUALITY ASSURANCE

A. ELECTRICALLY ACTUATED VALVE

1. Actuated valves shall be tested to Aqua-Aerobic Systems test protocol prior to shipment. Testing shall consist of the following:
 - 1) Project and nameplate data verification per assembly documentation
 - 2) Limit switch and torque switch setup and cycle test
 - 3) Hydrostatic test (two pressurization cycles) for all plug and butterfly valves

1.5 FLOATING MIXER

- A.** The floating mixer(s) shall be shop inspected and tested prior to shipment. Testing shall consist of the following:
1. Project and nameplate data verification per assembly documentation
 2. Dynamic balancing
 3. Final inspection

1.6 MOTOR COMPLIANCE

- A.** Motors shall be in compliance with the Energy Independence and Security Act of 2007 (EISA 2007). All three phase motors and components shall be 460 volt, 60 hertz. All single phase components shall be 115 volt, 60 hertz.

1.7 ELECTRICAL CLASSIFICATION

- A.** The SBR area electrical classification shall be Non- classified. Motors within the basin shall be rated for a temperature code T2A (280 Deg. C).

1.8 SERVICE

- A.** The selected SBR manufacturer shall have a free troubleshooting help line available 24 hours a day, 365 days per year for the life of the plant. The line shall connect to a live service technician who shall have the capability of connecting to the control panel via internet, with the operator's permission.

1.9 WARRANTY

- A. The Manufacturer shall provide a written warranty against defects in materials and workmanship. Manufacturer shall warrant the goods provided by the Manufacturer to be free from defects in materials and workmanship under normal conditions and use for a period of one (1) year from the date the goods are put into service, or eighteen (18) months from shipment of equipment, whichever first shall occur. This warranty shall not apply to any goods or part which has been altered, applied, operated or installed contrary to the Manufacturer's instructions or subject to misuse, chemical attack/degradation, negligence or accident.

PART 2 PRODUCTS

2.1 SBR FUNCTIONAL REQUIRMENTS

- A. The manufacturer of the SBR system shall be completely responsible for the proper design of their system, including but not limited to; (diffused aeration equipment, transfer pump(s), mixer(s), aerator(s), decanter(s), and controls). All equipment shall perform as specified and the completed installation shall operate in accordance with the requirements of the plans and specifications.
- B. The aeration system is defined as the aeration device working in conjunction with a mixer. The aeration system shall be designed to provide oxygen distribution to the entire basin. It shall also ensure mixing to promote suspension of all biological solids in the basin without the introduction of air. No change in the basin geometry shall be allowed. The velocity and mixing in the basin shall be sufficient to ensure complete biological solids suspension and dispersion.
- C. The aeration system for the aeration basins shall be capable of providing mixing such that when operated under any combination of the specified design conditions it shall suspend all biological floc and mixed liquor suspended solids throughout the liquid mass in each basin. The aeration system shall further be capable of maintaining complete aerobic conditions and suspension of all biological floc and suspended solids throughout the liquid mass in each basin.

2.2 DESIGN CRITERIA

- A. The design criteria and job site information is provided below.
 - 1. Basin configuration: 4 TOTAL (3 EXISTING, AND 1 NEW)
 - 2. Four Basin Overall Design Hydraulic Criteria:
 - a. Average Flow: 1.60 MGD
 - b. Max Daily Flow: 2.71 MGD
 - c. Peak Hourly Flow: 4.00 MGD

Table 1- Influent and Effluent Constituent Design Criteria

Design Loadings	Influent (ADF)	Influent (Max Day)	Effluent (After Filtration)
BOD ₅	326 mg/l	268 mg/l	5 mg/l
TSS	343 mg/l	334 mg/l	5 mg/l
NH ₃ -N	50 mg/l	32 mg/l	0.9 mg/l
Phosphorus	8 mg/l	7 mg/l	1 mg/l

Table 2- Process Design Values

Design Value	Units
a. Wastewater Temperature (minimum)	54 °F
b. Wastewater Temperature (maximum)	77 °F
c. Ambient Temperature (minimum)	11 °F
d. Ambient Temperature (maximum)	100 °F
e. Jobsite Elevation as Feet, MSL	982
f. Alpha Factor	0.75
g. Beta Factor	0.95
h. MLSS at Low water Level (LWL)	4,500 mg/l
i. Maximum Cycles at Max Daily Flow per SBR Basin	5
j. Oxygen Requirements lbs. O ₂ /lb. BOD ₅ applied	1.25
k. Oxygen Requirements lbs. O ₂ /lb. NH ₃ N applied	4.60
l. Maximum Hourly AOR, lbs. O ₂ /hr.	10,524

Table 3- System Control Design Values

a. Minimum Aeration Time, hrs./cycle at max day flow	2.72
b. Minimum Mixing Time, hrs./cycle at maximum daily flow	3.05
c. Minimum Settling Time, hrs./cycle at maximum daily flow	0.75

- B. Control strategy to be time based with level override. Flow and/or level based only control systems are not acceptable.

2.3 SBR SYSTEM

- A. The SBR system shall be a field erected as shown on the contract drawings and summarized below in Table 4.

Table 4- SBR SYSTEM

a. Basin Quantity, (3 existing with two cells plus 1 new)	4
b. Basins 1,2,3 inside width per cell, feet	50
c. Basins 1,2,3 inside length per cell, feet	50

SEQUENTIAL BATCH REACTOR SYSTEM

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d. Basin 4 inside width, feet	50
e. Basin 4 inside length, feet	101.17
f. Basin minimum operating level, feet	9.4
g. Basin maximum operating level, feet	13.0
h. Overall basin height, feet	15.0
i. Decant centerline discharge above low water level, feet	4.0

2.4 INFLUENT PLUG VALVE

A. Furnish electrically operated flanged plug valve(s) to control the influent flow.

1. Valve Quantity: Two (2) total for basin (2A/2B)
2. Valve Size: 12 inch, flanged.
3. Valve Model: Milliken 601
4. Actuator: Auma
5. Actuator Power: Single phase
6. Actuator Type: Open/Close
7. Valve Quantity: One (1) Per New Basin 4
8. Valve Size: 16 inch. flanged
9. Valve Model: Milliken 601
10. Actuator: Auma
11. Actuator Power: Three phase
12. Actuator Type: Open/Close

B. Valves shall be a 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, coated non-lubricated ductile or cast iron plug with 80 % port opening, assembled and tested with an electric actuator. Valve actuator shall include motor winding protection, manual override, and limit switch feedback in the open and closed position. Actuator(s) to include local controls consisting of pushbutton(s), selector switch(es), and light(s). Field wiring and junction/box disconnect shall be provided by the installation contractor.

C. Provisions for valve access shall be provided by the installation contractor.

2.5 FLOATING MIXER

A. Furnish the AquaDDM® mechanical floating mixer(s) and related equipment accessories as described herein. Each mixer shall consist of a motor, direct-drive impeller driven at a constant speed, an integral flotation unit, and impeller volute. The Endura Series shall incorporate design enhancements that provide three (3) years without routine maintenance (greasing).

1. Basin 2 Quantity: Two (2) total (2A/2B)
2. Basin 4 Quantity: Two
3. Mixer Properties: Floating
4. Zone of Complete Mix: 60 ft
5. Direct Pumping Rate: 5,250 gpm
6. Recirculation Rate: 173,000 gpm
7. MLSS: 4,500 mg/l or less
8. Motor Size: 7.5 HP
9. Motor RPM: 1200 RPM
10. Motor Efficiency: Premium
11. Mounting Base: 304 stainless steel
12. Float Diameter: 71 inches
13. Float Shell: Fiber Reinforced Polyester Skin (FRP)
14. Impeller Volute: 304 stainless steel

B. PERFORMANCE

1. Each mixer shall meet the requirements summarized above. Complete mix shall be defined as maintaining biological suspension of all mixed liquor suspended solids with the specified MLSS concentration without the introduction of air.

C. MIXER DRIVE MOTOR

1. The motor shall be vertical P base design, totally enclosed fan cooled TEFC, and generally rated for severe duty. The motor shall in all cases equal or exceed standard NEMA specifications. A minimum service factor of 1.15 shall be provided.
2. The motor winding shall be non- hygroscopic, and insulation shall equal or exceed NEMA Class "F". A lip seal shall be provided below the bottom bearing to prevent moisture from penetrating around the motor shaft. A condensate drain shall be located at the lowest point in the lower-end bell housing. Unit shall have a one-piece motor shaft continuous from the top motor bearing, through the lower bearing and down to and through the propeller. The shaft shall be manufactured from 17-4 PH stainless steel.
3. Motor bearings shall be re-greaseable. Sealed bearings are not acceptable. The top bearing shall be shielded on the bottom side only. Bottom bearing shall be open. The top and bottom motor bearings shall be of combined radial and axial thrust type. The lower motor bearing inner brace shall be locked to the motor shaft via a special washer and locking nut arrangement. The shaft shall be threaded just below the lower bearing and shall have a keyway cut into the motor shaft. This key shall accept a tab from the inner diameter of the locking washer, and the locking nut shall have recesses to accept a tab from the outer diameter of the locking washer to prevent the nut from backing off. Snap ring type bearing retainers will not be acceptable.

4. Submerged motors, jet pumps, submerged gear motors or gearboxes shall not be acceptable.

D. MOTOR MOUNTING BASE

1. The motor shall be securely mounted onto a solid base which is integral with the motor base extension. All submersed wetted motor mounting base components shall be constructed of 304 stainless steel.
2. The upper portion of the motor mounting base, immediately below the lower motor bearing, shall include two independent acting air seals. The two seals shall be capable of sealing off the flow of air from the suction action of the pumped flow and prevent backflow of liquid during impeller reversal. The lower end of the motor base extension shall be provided with a rotating backflow seal that will prevent grit from being introduced into the anti-deflection insert reservoir but shall allow liquid to contact the shaft. The backflow seal shall not require scheduled lubrication or maintenance.

E. FLOATATION

1. Each unit shall be equipped with a modular float with a central float passage of a size to allow installation and removal of the pump impeller. The float shall be foamed full of polyurethane foam of the closed cell type and shall be totally sealed to prevent the foam from being in contact with the external environment.

F. IMPELLER

1. The impeller shall be designed to pump the liquid from near the surface and direct it down toward the vessel/basin bottom. The impeller shall be a two-blade marine type precision casting of 316 or 15/5 stainless steel and shall be specifically designed for the application intended. It shall be dynamically and hydraulically balanced. The propeller must be attached to the motor shaft with a hardened stainless steel pin and set screw. Impeller shall be capable of being reversed to cause back flow liquid movement without causing damage to the mixer chassis and without causing up flow liquid damage to the motor bearing and windings. No liquid spray or other liquid leakage upward onto the surface of the motor support surface or flotation chassis will be allowed.

G. INTAKE VOLUTE ASSEMBLY

1. The impeller shall operate in a volute made of stainless steel plate, minimum 3/16 inch thick.

H. VIBRATION

1. The entire rotating assembly including the motor rotor, shaft, shaft accessories, and impeller shall be dynamically balanced within 2.0 mils peak-to-peak horizontal displacement measured at the upper and lower motor bearing. Measurements shall be taken at a frequency equivalent to the motor RPM. Measurements shall be taken with the motor in a vertical, shaft down position with the entire power section mounted on resilient pads.

I. CABLE MOORING SYSTEM

1. Each unit shall be provided with a mooring system, as described below:
 - 1) Cable Material: 304 stainless steel
 - 2) Anchor Material: 304 stainless steel
 - 3) Anchor Type: Adhesive anchors
 - 4) Electrical Cable: #12-four conductor
2. Each unit shall be provided with a maintenance cable mooring system complete with mooring cable, clips, thimbles, quick disconnects, anchors (if necessary), and extension springs as shown in the drawings. Field attachment of mooring points to the tank(s) shall be the responsibility of the installing contractor.

J. ELECTRICAL POWER CABLE

1. Each unit shall include a power cable wired into the motor conduit box and terminating at the basin wall. Electrical cable shall be supplied with Kellam's grips at the motor and basin wall terminations. Electrical cable(s) shall be attached with cable ties provided by the equipment supplier. Attachment of cable and supply of junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

2.6 DECANTER ASSEMBLY

- A. Furnish floating decanter(s) and related equipment accessories as described herein for each basin. Each decanter shall consist of an integral flotation unit, a stainless steel movable weir assembly, and an electric motor-driven actuator to open and close the weir. Due to the risk of ragging, spring loaded valves are not an acceptable means to seal the decanter. Fixed decanters, or decant weirs lifted above the water surface are not acceptable.

- B. Decanter details for Basin 2A/2B:

1. Quantity: 2, one per (2A/2B)
2. Unit Size: 8 x 7 Aqua

Performance Requirements

1. Maximum Allowable Water Level (HWL): 13.0 ft
2. Minimum Allowable Water Level (LWL): 9.4 ft
3. Decant Pipe Centerline: 4 ft below LWL.
4. Decant Rate w/Orifice Plate (Maximum ($\pm 10\%$)): 1,129 gpm.
5. Weir Actuator Power: Single phase
6. Weir Actuator Closing Force: 1,500 lbs.
7. Power Section Material: Painted
8. Junction Box Rating: NEMA 4X

- | | |
|--------------------------------|--------------------------|
| 9. Power Cable(s): | #14-ten conductor |
| 10. Weir Shape: | Circular |
| 11. Weir Material: | 304 stainless steel |
| 12. Orifice Plate Material: | 304 stainless steel |
| 13. Float Reserve Buoyancy: | 875 pounds |
| 14. Float Shell Material: | FRP |
| 15. Discharge Type: | Pipe |
| 16. Discharge Size: | 10 inches |
| 17. Mooring Pylon Quantity: | 1 per unit |
| 18. Mooring Pylon Diameter: | 4 inch |
| 19. Dewatering Pylon Quantity: | 2 per unit |
| 20. Dewatering Pylon Diameter: | 4 inch |
| 21. Pylon Material: | Schedule 40, Galv. Steel |
| 22. Base Plate Material: | Galvanized steel |
| 23. Floor Connection: | Adhesive anchors |
| 24. Mooring Frame Material: | Galvanized steel |
| 25. Pipe and Elbow Material: | 304L stainless steel |
| 26. Flex Joint Material: | 304L stainless steel |
| 27. Decant Valve Size: | 10- inch, butterfly. |
| 28. Valve Model: | Milliken 511A |
| 29. Actuator: | Auma |
| 30. Actuator Power: | Single phase |
| 31. Actuator Type: | Open/Close |
| 32. Stem Extension: | Yes |

C. Decanter details for Basin 4

- | | |
|---------------|---------|
| 1. Quantity: | One (1) |
| 2. Unit Size: | 8x7 |

Performance Requirements

- | | |
|--|-----------------|
| 1. Maximum Allowable Water Level (HWL): | 13.0 ft |
| 2. Minimum Allowable Water Level (LWL): | 9.4 ft |
| 3. Decant Pipe Centerline: | 4 ft below LWL. |
| 4. Decant Rate w/Orifice Plate (Maximum ($\pm 10\%$)): | 2,258 gpm. |

- | | |
|---------------------------------|---------------------------|
| 5. Weir Actuator Power: | Single phase |
| 6. Weir Actuator Closing Force: | 1,500 lbs. |
| 7. Power Section Material: | Painted |
| 8. Junction Box Rating: | NEMA 4X |
| 9. Power Cable(s): | #14-ten conductor |
| 10. Weir Shape: | Circular |
| 11. Weir Material: | 304 stainless steel |
| 12. Orifice Plate Material: | 304 stainless steel |
| 13. Float Reserve Buoyancy: | 875 pounds |
| 14. Float Shell Material: | FRP |
| 15. Discharge Type: | Pipe |
| 16. Discharge Size: | 14 inches |
| 17. Mooring Pylon Quantity: | 1 per unit |
| 18. Mooring Pylon Diameter: | 4 inch |
| 19. Dewatering Pylon Quantity: | 2 per unit |
| 20. Dewatering Pylon Diameter: | 4 inch |
| 21. Pylon Material: | Schedule 40 , galv. steel |
| 22. Base Plate Material: | Galvanized steel |
| 23. Floor Connection: | Adhesive anchors |
| 24. Mooring Frame Material: | Galvanized steel |
| 25. Pipe and Elbow Material: | 304L stainless steel |
| 26. Flex Joint Material: | 304L stainless steel |
| 27. Decant Valve Size: | 14-inch Butterfly. |
| 28. Valve Model: | Milliken 511A |
| 29. Actuator: | Auma |
| 30. Actuator Power: | Single phase |
| 31. Actuator Type: | Open/Close |
| 32. Stem Extension: | Yes |

D. DECANTER PERFORMANCE

1. Each decanter shall be capable of withdrawing decant fluid from 4-6 inches beneath the liquid surface, regardless of liquid depth, down to the minimum allowable water level specified below. The decant liquid shall be drawn through an adjustable weir opening of 2-6 inches. The weir shall permit liquid to enter the decanter from the entire 360 degrees without obstruction.

2. The centerline of each decant pipe must be located at the elevation stated within this section by the installing contractor.

E. WEIR ACTUATOR

1. The weir actuator shall include a reversible electric motor operated linear actuator. The actuator shall be capable of operating with a closing force as required above and shall operate from a remote power source as required above. Adjustable limit switches shall be included to permit adjustment of the weir opening. A spring shall be included to provide for travel after the weir has closed and provide desired closure pressure. A corrosion resistant removable cover shall be included to provide protection to the actuator and motor during normal operation.
2. Power cable(s) as specified above shall be provided from the junction box of the unit to the basin wall. Supply of junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

F. WEIR

1. The weir shall include vortex control baffles permanently affixed to the weir. The weir shall be attached to the actuator through a removable single shaft or linkage which shall also function as the torque restraint.

G. FLOATATION

1. Each unit shall be equipped with a modular float filled with closed cell polyurethane foam having a minimum 2.0 lbs./ft³ density. Float shall be completely sealed to prevent the foam from being in contact with the external environment. Float shall have adequate reserve buoyancy as specified within this section to ensure stability and to provide support flotation required during decanter servicing. A urethane type seal shall be molded into the bottom of the float assembly to receive the decanter weir.

H. DECANTER DISCHARGE PIPE

1. Each decanter shall include a stainless steel elbow with schedule 10 stainless steel discharge pipe as specified above. Decanters with FRP or PVC discharge pipe are not acceptable. The installing contractor shall provide a ¾" valve with hose bib connection on the decant line between the decanter and the decant valve.
2. Each decanter shall include two stainless steel flex joints sized at the same diameter as the discharge pipe. Flex joints shall be constructed of stainless steel flanges and 321 stainless steel bellows. Flex joints shall utilize heavy duty stainless steel hinges with over-travel stops and full perimeter welds. Flex joints shall carry a rating per EJMA calculations, the Elastic Joint Manufacturer's Association. Flex joints shall be full port diameter, and not reduce flow area of the nominal pipe size. Flex joints shall be crated and provided with shipping bars that immobilize and protect the flex joint prior to final installation. Flex joints constructed of plastic or rubber material are not acceptable.
3. All piping, supports, gaskets, and hardware beyond the terminating flange of the decant pipe flexible joint shall be supplied by the installing contractor.

I. DECANter RESTRAINED MOORING SYSTEM

1. Furnished as part of the decanter assembly shall be a mooring frame, which shall permit the assembly to move up and down following the change in liquid level while restrained within the vertical pylons.
2. Each decanter shall be moored with a restrained mooring system consisting of vertical pylon(s) with base plate and/or supports as specified above. Each pylon/support with base plate shall be attached to the basin floor and filled with concrete by the installing contractor.
3. Mooring post supports, if specified within this section shall be provided for attachment to the basin wall by the installing contractor.

J. DECANt FLOW CONTROL VALVE

1. Furnish electrically operated butterfly valve(s) as specified above for each basin to control the decant flow rate.
2. Valve(s) shall be an AWWA C-504 Class 150B electrically operated butterfly valve(s) with ANSI Class 125# flanged end ASTM ductile or cast iron body and disk with a 316 stainless steel edge, EPDM seat, 304 stainless steel shaft assembled and tested with an electric actuator. Valve actuator shall include motor winding protection, manual override, and limit switch feedback in the open and closed position. Actuator(s) include local controls consisting of pushbutton(s), selector switch(es), and light(s). Field wiring and junction/box disconnect shall be provided by the installation contractor.
3. Provisions for valve access shall be provided by the installation contractor.

2.7 SLUDGE WASTING PUMP SBR (SBR's 1a,1b,2a,2b,3a,3b)

- A. Furnish seven (7) submersible non-clog pump(s) as specified herein. Each pump shall be equipped with a submersible electrical motor connected for three phase operation. Pump housing shall be painted cast iron. One pump will serve as an uninstalled spare.
- B. Each pump shall include an adequate length of multi-conductor chloroprene jacketed type SPC cable suitable for submersible pump applications. The power cable shall also be sized according to NEC and ICEA standards. The pump shall be supplied with a mating cast iron discharge elbow. Each unit shall be fitted with an adequate length of steel lifting chain of adequate strength to permit raising and lowering the pump.

C. Submersible Pump Details.

- | | |
|-------------------|---|
| 1. Quantity: | Seven (7) one pump in SBR 1a,1b,2a,2b,3a,3b |
| 2. Pump Function: | Sludge |
| 3. Pump Model: | Flygt NP3085, Impeller 462 |
| 4. Motor Size: | 3 HP |
| 5. Pump Flow rate | 195 GPM |

- | | | |
|-----|-----------------------------|-----------------------------------|
| 6. | Total dynamic head | 28 ft TDH |
| 7. | Discharge Valve | Plug |
| 8. | Valve Model: | Milliken 601 (by Aqua Aerobics) |
| 9. | Actuator: | Manual |
| 10. | Discharge Check Valve | Nibco F-918-B (by Aqua Aerobics) |
| 11. | Discharge Connection Elbow: | 3 inches |
| 12. | Discharge Pipe: | 4 inches, provided by contractor. |
| 13. | Valve(s): | 4 inches |
| 14. | Lifting Chain: | 304 stainless steel |
| 15. | Upper Guide Bar Bracket: | 304 stainless steel |
| 16. | Guide Rails: | Galvanized steel |
| 17. | SBR System Termination: | Pump discharge connection elbow |
| 18. | Basin Connection: | Adhesive anchors |

- D. The pump shall be capable of handling raw, unscreened sewage. The discharge connection elbow shall be permanently installed with the discharge piping. The pump shall be automatically connected to the discharge connection elbow when lowered into place and shall be easily removed for inspection or service. There shall be no need for personnel to enter the basin or pump well. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump.
- E. Guiderails and upper guide bar bracket shall be provided with each pump. The entire weight of the pumping unit shall follow guide bars into the operating position and pressed tightly against the discharge connection elbow with metal-to-metal contact. No sealing of the discharge interface by means of a diaphragm, O-ring, or other devices shall be acceptable. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 ft.
- F. The installing contractor shall supply all discharge piping, supports, gaskets, and hardware beyond the pump base elbow connection. Valves supplied by the SBR manufacturer shall be installed by the installation contractor.
- G. All valve(s) shall be provided loose for installation within the discharge piping by the installing contractor. Valve gaskets and hardware shall be supplied by the installation contractor.
- H. Field attachment of the pump to the basin shall be the responsibility of the installing contractor.

2.8 SLUDGE WASTING PUMP SBR (SBR 4)

- A. Contractor to relocate the existing digester 1 submersible pump and base elbow to SBR 4. The pump from existing digester 2 will serve as uninstalled stand-by.)

- B. Contractor to provide adequate length of new steel lifting chain of adequate strength to permit raising and lowering the pump and new guide rails and guiderail supports.
- C. Submersible Pump Details.
- | | |
|---------------------------------|---|
| 1. Quantity: | Two (relocate from existing digester 1,2) |
| 2. Pump Function: | Sludge |
| 3. Pump Model: | Flygt CP3085.980 |
| 4. Motor Size: | 3 HP |
| 5. Pump Flow rate | 195 GPM |
| 6. Total dynamic head | 20 ft TDH |
| 7. Discharge Valve | Plug |
| 8. Valve Model: | Milliken 601 (by Aqua Aerobics) |
| 9. Actuator: | Manual |
| 10. Discharge Check Valve | Nibco F-918-B (by Aqua Aerobics) |
| 11. Discharge Connection Elbow: | 3 inches |
| 12. Discharge Pipe: | 4 inch, provided by contractor. |
| 13. Valve(s): | 4 inches |
| 14. Lifting Chain: | 304 stainless steel |
| 15. Upper Guide Bar Bracket: | 304 stainless steel |
| 16. Guide Rails: | Galvanized steel |
| 17. SBR System Termination: | Pump discharge connection elbow |
| 18. Basin Connection: | Adhesive anchors |
- D. The installing contractor shall supply all discharge piping, supports, gaskets, and hardware beyond the pump base elbow connection. Valves supplied by the SBR manufacturer shall be installed by the installation contractor.
- E. All valve(s) shall be provided loose for installation within the discharge piping by the installing contractor. Valve gaskets and hardware shall be supplied by the installation contractor.
- F. Field attachment of the pump to the basin shall be the responsibility of the installing contractor.

2.9 RETRIEVABLE FINE BUBBLE AIR DIFFUSER ASSEMBLIES

- A. The aeration system shall be a fine bubble diffused air system and shall be a retrievable configuration as shown on the contract drawings. Systems with fixed diffuser configuration or jet aeration are not acceptable.

1. Airflow per basin 2a: 917 SCFM
2. Airflow per basin 2b: 917 SCFM
3. Airflow per basin 4: 1,834 SCFM
4. Assembly Quantity: Twelve (12) total:
 - Three (3) per basin 2a
 - Three (3) per basin 2b
 - Six (6) per basin 4
5. Diffuser Rack Size: 25 Duplex tubes
6. Materials of Construction
 - 1) Manifold: Galvanized steel
 - 2) Vertical Air Column: Galvanized steel
 - 3) Threaded Flange: Galvanized steel
 - 4) Quick Disconnect Adapter: 316 Stainless steel
 - 5) Track/beam Assembly: Galvanized steel
 - 6) Diffuser Hoist Assembly: Galvanized steel
 - 7) Valve Seat: EPDM
 - 8) Basin Connection: Adhesive anchors by System Manufacturer
- B. Furnish retrievable air diffuser assemblies for each basin. Each assembly shall consist of membrane diffusers, frame assembly, manifold weldment, vertical air column, track/beam, flexible airline, isolation valve, and lifting mechanism. Duplex diffuser tubes total that specified herein shall be provided for each diffuser rack. The 4" diffuser manifold weldment shall be constructed of stainless steel. The entire assembly shall be located such that each diffuser centerline is twelve (12) inches above the basin floor.
- C. Air diffuser assemblies shall be of the tubular, non-clog, fine bubble type with a flexible perforated air release membrane. Disc and panel diffuser designs are not acceptable. The diffuser membrane shall be constructed from EPDM rubber and be suitable for continuous or intermittent aeration. Each membrane shall be held in place by two 304 stainless steel band clamps. The membrane shall include UV inhibitor and compounds designed for resistance to chemical attack, weathering, fatigue, and aging. The diffuser assemblies shall have double backflow prevention to prevent liquid from passing into the aeration header. Backflow prevention shall consist of self-sealing slits and membrane clamping over the circumference of the diffuser support pipe. The membrane exterior surface shall be smooth as to inhibit biological film growth. The membrane shall inflate during aeration and deflate when the airflow is discontinued, further restricting biological film growth. The membrane shall be cleanable in place with water from a high pressure wash. Each diffuser membrane shall be supported over its' full length and circumference by a support tube. Tube diffuser shall be of non-buoyant design.
- D. Each assembly shall include a diffuser hoist assembly with base socket to receive a portable

electric winch. A total of one (1) portable electric winch shall be provided for the diffuser assemblies by the SBR system supplier. The winch mechanism shall be of sufficient design capacity to raise the diffuser rack assembly to the servicing position. The portable electric winch shall operate from a single phase, electrical supply rated for 12.6 full load amps. The winch shall be provided with a total of 8 feet of electrical cable. Supply of electrical power supply, wiring and junction box for winch shall be the responsibility of the installing contractor.

- E. The lifting mechanism shall consist of a hoist, polyolefin guide wheels, stainless steel sheave with bronze bushing, and 304 stainless steel lifting cable. The lifting mechanism shall be of sufficient design capacity to raise the diffuser rack assembly to the servicing position.
- F. The lifting mechanism shall be designed to allow the diffuser rack to be pivoted 360° when in the service position for ease of diffuser inspection and servicing.
- G. Each diffuser assembly shall include a 3" diameter wire reinforced EPDM flexible air line with quick disconnect end fittings, and a threaded flange, elbow and quick disconnect adapters. All air distribution installation gaskets, and hardware beyond the threaded flange shall be supplied by the installing contractor. The vertical track/beam shall support the lifting mechanism assembly during operation and servicing.
- H. Each diffuser assembly shall include a 3" diameter manually operated isolation butterfly valve for connection to the main air distribution piping by the installing contractor. Valve gaskets and hardware are to be provided by the installation contractor.
- I. Provide a butterfly valve with cast iron body, seat as specified herein, disk and one piece stainless steel shaft.
- J. Anchoring the diffuser assemblies to the basin shall be the responsibility of the installation contractor.
- K. Existing Diffusers basins in 2A and 2B to be removed by installing contractor prior to installation of new retrievable fine bubble diffuser racks.

2.10 SBR BLOWERS

- A. Furnish three phase rotary lobe type, positive displacement blowers as described below with premium efficient, T.E.F.C., Class F insulation, TECO, Siemens, or equal motor. The blowers shall be manifolded for individual and/or combined operation.
 - 1. Quantity: Three (3)
 - 2. Motor Size: 50 HP, variable speed
 - 3. Manufacturer: Aerzen
 - 4. Model Number: GM 035S
 - 5. Airflow Rate: 917 SCFM per blower
 - 6. Discharge Pressure: 7.2 PSIG

7. Enclosure: Powder Coated Galv. Steel Acoustic Hood w/ oil drip pan
- B. Each blower assembly shall be complete and mounted on a base weldment with four-corner anti-vibration mountings, designed for direct application on a concrete slab or other solid foundation. Each assembly shall be suitable for shipment as a complete unit, factory assembled (less discharge pipe fittings) as much as possible to facilitate shipping and handling.
- C. Equipment shall include a blower, electric motor, belts and sheaves, inlet package, discharge silencer, discharge check valve, rubber inlet sleeve and discharge connection, pressure relief valve, butterfly discharge isolation valve, and rubber expansion joint. A personnel protection guard shall be included over the belts and sheaves.
- D. DISCHARGE PRESSURE GAUGE
 1. Provide a discharge liquid filled pressure gauge to be Aerzen 32-0053-02 or approved equal for each blower.
 2. Range: 0 to 20 psig.
 3. Dial: 4"
 4. Case: Stainless steel
 5. Accuracy: $\pm 2\%$ of span
- E. Discharge Temperature Gauge / Switch
 1. Provide a discharge temperature gauge / switch to remove motor power in the event an unsafe blower discharge temperature is reached. The gauge / switch to be equivalent Jumo 8523-20-10 or approved equal.
 2. Range: 32°F to 572°F
 3. Dial: 4"
 4. Enclosure: NEMA 4
 5. Output: SA 28 SPDT microswitch
 6. Electrical Rating: 5A @ 250V
 7. Approvals: UL & CSA approved
- F. INLET VACUUM GAUGE
 1. Provide an inlet vacuum gauge to be Wika 611.10 or approved equal.
 2. Range: 0 to -60 mbar
 3. Dial: 2 1/2"
 4. Case: Steel, black
 5. Accuracy: $\pm 1.6\%$ of FSV

G. BLOWER ENCLOSURE

A sound enclosure shall be provided for each blower package to help reduce the resultant noise level. The sound enclosure shall encompass the entire blower package for maximum noise attenuation. The enclosure shall be constructed of durable powder coated carbon steel with a sound absorbing internal surface. The walls and ceilings shall be shop assembled with all corners and joints properly insulated to prevent noise leakage and maintain the attenuation levels of the room.

1. The blower package and sound enclosure shall ship as a unitized one piece assembly. Maintenance access doors shall be provided to facilitate servicing of the blower package. A baffled inlet shall be provided to allow supply and cooling air to enter the enclosure during the operation of the blower. An exhaust fan sized for proper enclosure ventilation will be supplied.

2.11 SBR BASIN PRESSURE TRANSDUCER

- A. Furnish submersible pressure transducer unit(s) constructed of stainless steel as specified herein. Transducer output shall be a 4-20 mA signal.
- B. Criteria
 1. Quantity: Two (2) Per Basin 2 (2A/2B) + One (1) Per New Basin 4
 2. Model: Keller Levelrat
 3. Support Pipe Mount: 304 stainless steel
 4. Supports: 304 stainless steel
 5. Anchors: 304 stainless steel
- C. Transducers shall be suspended on a removable mounting pipe assembly. Pipe, supports and anchors shall be provided by the SBR supplier. Field attachment of the pipe and supports to the basin shall be the responsibility of the installing contractor. A moisture excluding aneroid bellows shall be supplied loose for installation in the junction box/ disconnect. Attachment and supply of the junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.
- D. Field attachment of the pressure transducer mounting brackets to the tank shall be the responsibility of the installing contractor.

2.12 LEVEL SENSORS

- A. For each SBR basin 2A, 2B, and 4, furnish one (1) level sensor assembly consisting of an Anchor Scientific model GSI 40NONC float switch with a smooth, chemical resistant polypropylene casing, and 316 stainless steel mounting bracket for each basin. Each float switch shall be provided with a three conductor electrical cable. Electrical cable shall terminate at a junction box/disconnect located at the basin wall. Field wiring and junction box/disconnect shall be provided by the installation contractor.

- B. Field attachment of the level sensor assembly to the tank shall be the responsibility of the installing contractor.

2.13 DISSOLVED OXYGEN INSTRUMENT

- A. Provide dissolved oxygen instrumentation as described below. The SBR supplier is responsible for furnishing the equipment listed in this section.

- B. MANUFACTURER: Hach

Controller

- 1. Quantity: Three (3) – Two (2) Per (2A/2B) + One (1) Per New Basin 4
- 2. Model: SC 4500
- 3. Inputs: 2 per controller

Probes

- 1. DO Quantity: Three (3) – Two (2) Per (2A/2B) + One (1) Per New Basin 4
- 2. DO Model: LDO

Probe Mounting

- 1. Material: 304 stainless steel

- C. CONTROLLER

- 1. The controller will communicate with the main PLC via 4-20 mA signals. Provide controller with a NEMA 4X enclosure with corrosion-resistant finish and shall be AC powered from a 100-230VAC, power source.

- D. SENSORS

- 1. Furnish one sensor of each type specified above per basin. Sensors shall be suspended on a removable mounting pipe assembly. Stainless steel pipe, stainless supports and stainless steel anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of the installing contractor. Field wiring, conduit, and installation of cable shall be the responsibility of the installing contractor.

2.14 PROCESS CONTROL INSTRUMENTATION

- A. UV SYSTEM CONTROL

- 1. The SBR control panel will send a signal to the UV system to control the UV based on flow measured at the post equalization pump magnetic flow meter. UV system operation to be flow paced. Refer to Section 46 66 56 for additional details.

- B. AEROBIC DIGESTER BLOWER CONTROL

- 1. The SBR control panel will control the operation of the digester blowers. Refer to

Section 43 11 33 for control description and modifications required to the SBR panel and programming.

C. CONTROL PANEL WITHOUT MOTOR STARTERS

1. The control system shall be designed to optimize the AquaSBR® process while minimizing operator attention and to accommodate the continuous maximum daily flow without adjusting cycle structures. The control software program shall be factory tested prior to installation at the jobsite.
2. The control system shall be a timer based system with level overrides and shall provide control, sequence, monitoring, and alarm annunciation capabilities. The operator shall be able to access the timer values and set points through the operator interface panel to allow for adjustment of cycle times and system flexibility. The control system shall be designed to automatically accommodate the plant's full range of loads and flows.
3. A complete control system shall be provided as described in the following and as shown on the contract drawings. The control system shall include 115 volt control circuit breaker, microprocessor control, operator interface display, indicator lights, and HAND-OFF-AUTOMATIC selector switches.
4. The incoming service of the control system shall be 115 volt, 60 hertz, single-phase. Controls for the equipment listed below shall be provided within the SBR control panel. Elapsed time indication shall be provided through (the operator interface of) (hard-wired elapsed time meters located within) the SBR control panel for equipment indicated by an asterisk(*).
5. The existing control panel shall be utilized as the main control cabinet containing the PLC and the new control panel will be provided with RIO components to allow the entire system to communicate.

D. CONTROL PANEL WIRING AND ASSEMBLY

1. All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Short circuit rating of control enclosure shall be 5 kA RMS symmetrical @ 480VAC maximum.
2. All control panel single conductor wire shall be 16 AWG multi-strand machine tool wire (MTW) minimum, with PVC insulation.
3. Wire colors are as follows:
 - 1) 208 VAC or higher - Black
 - 2) 120 VAC control power - Red
 - 3) Neutral - White
 - 4) Ground - Green with Yellow Stripe
 - 5) Power from remote source - Orange
 - 6) Neutral from remote source - White with Orange Stripe
 - 7) 24 VDC (+) - Blue

- 8) 24 VDC (-) - White with Blue Stripe
 - 9) Intrinsically Safe - Light Blue
-
- 4. All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal transfer printable type. The material shall be self-laminating vinyl. Labels shall be Brady THT-9-427-10 or approved equal.
 - 5. Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122° F (50°C). Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door.
 - 6. Control components mounted internal and external to the enclosure shall be mounted with stainless steel hardware and clearly labeled with a plastic identification nametag. The tag shall be white with black lettering.

E. CONTROL PANEL QUALITY ASSURANCE

- 1. All Control panels shall be UL certified. Testing by manufacturer's electrical engineering prior to release for shipment shall be completed. Testing shall consist of the following:
- 2. Point to point testing of all wiring prior to application of power.
- 3. Intended supply voltage shall be applied to the enclosure.
- 4. All components shall be tested for proper operation and calibration.
- 5. The PLC and operator interface program shall be loaded and functionally checked.
- 6. All components shall be checked to confirm proper mounting specifications have been followed.
- 7. Enclosure shall be inspected for defects and repaired if necessary.
- 8. All labeling of wires and devices are correct, properly installed and clean.
- 9. The manufacturer shall finalize the factory checkout by completing a control panel checklist to document all testing completed above.
- 10. Upon the successful completion of the control testing of the enclosure assembly, all applicable documentation (i.e., finalized drawing set, signed control checklist cover page, device data sheets, etc.) shall be placed in the drawing pocket of the enclosure.

F. CONTROL ENCLOSURE

- 1. The automatic controls shall be provided in a UL listed, NEMA Type 12 mild steel (12 gauge) floor mount enclosure that provides a degree of protection for electrical controls and components from dust, dripping water and external condensation of non-corrosive liquids. The enclosure is intended for indoor installation. Enclosure shall include gasketed overlapping doors with a 3-point latch mechanism operated by an oil tight key-lock handle. The enclosure shall have white polyester powder paint inside with ANSI 61 gray polyester powder paint outside over phosphatized surfaces. The enclosure shall

include a painted white mild steel (10 gauge) sub-panel mounted with collar studs. Enclosure shall be manufactured by Hoffman or approved equal.

2. The control enclosure shall be mounted remotely.
3. Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure. The corrosion inhibitor shall be Hoffman AHCI5E or approved equal.

G. CIRCUIT BREAKER

1. All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed. Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or approved equal.

H. FUSE

1. Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuses shall be rated up to 250 VAC and be Littelfuse or approved equal. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or approved equal.

I. OPERATOR DEVICE

1. Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for all automatic controlled equipment. Transformer type push-to-test pilot lights and illuminated pushbuttons shall be provided for indication of an operation status. The lights shall be a 6 VAC incandescent type lamp. Color coding shall be applied as required and is as follows:

Amber – Alarm active, caution.

Green – Valve open, motor running.

Red – Valve closed.

White - Information

2. All operator devices shall be UL Listed, 30.5mm style, NEMA Type 4X rated, oil and watertight with finger safeguards located on the contact blocks to prevent accidental contact with wire connections. Operator device function shall be identified with an engraved white Gravoply nameplate with black letters. Operator devices shall be Square D 9001 or approved equal.

J. HIGH FREQUENCY NOISE FILTER

1. A UL listed active tracking filter shall be provided to protect the PLC and HMI power feeds from high-frequency noise and low-energy transients. It shall be designed for a single phase input voltage of 120VAC operating at 50/60 Hz. The unit shall provide surge capacity of 25,000 amps and provide transient protection in all modes (Line to neutral, line to ground and neutral to ground). The noise filter shall be a SolaHD STFV or approved equal.

K. GROUND FAULT DUPLEX RECEPTACLE

1. A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g., programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 120VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

L. 24 VOLT DC POWER SUPPLY

1. A UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such rated components. The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single-phase) incoming control power. The power supply shall have a green LED which shall be illuminated when output voltage is "OK". The power supply shall be an Allen Bradley 1606 or approved equal.

M. CONTROL RELAY

1. UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D, or approved equal.

N. TERMINAL BLOCK

1. Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating. Terminal blocks shall be Allen-Bradley 1492-J4 (35A max) and 1492-J16 (85A max) or approved equal.

O. REMOTE I/O

1. The existing CompactLogix Controller shall communicate to remotely located CompactLogix I/O via an EtherNet/IP network adapter module. Communication between devices shall occur over an Ethernet Category 5E cable.

P. PLC POWER SUPPLY

1. Input voltage range of 85-265 / 170-265 VAC, 47-63 Hz, maximum inrush current of 30 amps, backplane output current of 4 amps @ 5V or 2 amps @ 24V, internal fuse protection, ambient operating temperature of 32°F to 140°F, Class I, Division 2 hazardous location certified, UL Listed.

Q. DISCRETE INPUT MODULE

1. Operating voltage of 79 to 132 VAC at 47 to 63 Hz, backplane current draw at 5VDC = 115mA , off-state current 2.5mA maximum, maximum inrush current 250mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

R. DISCRETE OUTPUT MODULE

1. Operating voltage of 5 to 265 VAC at 47 to 63 Hz / 5 to 125 VDC, backplane current draw at 5 VDC = 205mA , at 24VDC = 180mA, off-state current leakage is 1.0mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed

S. ANALOG INPUT MODULE

1. Backplane current draw at 5 VDC = 120mA, at 24VDC = 70mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

T. ANALOG OUTPUT MODULE

1. Backplane current draw at 5 VDC = 120mA, at 24VDC = 170mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

U. ADAPTER MODULE

1. An EtherNet I/O adapter module shall be provided to enable communication between the SBR Control Panel mounted CompactLogix processor and remotely located I/O. The adapter module maximum backplane current draw shall be 500mA @ 5V and have an ambient operating temperature of 32°F to 140°F (0°C to 60°C). The adapter module shall be UL listed. The adapter module shall be Allen Bradley 1769-AENTR.

V. ETHERNET SWITCH

1. An unmanaged Ethernet switch shall be provided inside the control enclosure to provide connectivity between the PLC, operator interface and plant networking. The switch shall support both 10 and 100 Mbit/s operation. The switch shall have five (5) 10/100Base-T ports with RJ-45 sockets and shall support auto-crossing, auto-negotiation and auto-polarity. The maximum distance between the devices shall be 100m.
2. The unit shall be DIN rail mounted and require 24VDC power. Diagnostic LEDs for

power and connection status shall be included. The Ethernet switch shall be UL listed and manufactured by Allen-Bradley Stratix 2000 1783-US5T, or approved equal.

W. REMOTE ETHERNET ACCESS GATEWAY

1. A cULus marked, remote access VPN gateway shall be supplied to securely connect to a PLC via the Internet using an Ethernet port and a secure VPN tunnel. The gateway can be DIN rail or wall screw mounting and shall provide WAN/LAN 10/100 Mb Ethernet ports. The gateway shall be a Ewon Cosy + ETH.

2.15 EQUIPMENT CONTROLLED OR MONITORED BY SBR CONTROL PANEL

A. SBR EQUIPMENT DESCRIPTION (Total System)

1. 7.5 HP Mixers (qty.= 8)
2. 3 HP Sludge Pumps (qty.= 7)
3. 50 HP Blowers* (qty. = 9)
4. Influent Valves (qty 7)
5. Decanter Actuators (qty.= 7)
6. Decanter Valve(s) (qty. = 7)
7. 4-20 mA D.O. signal(s) (qty. = 7)
8. 4-20 mA Pressure Transducer(s) (qty. = 7)
9. Level Sensors (qty. =7)
10. Common Alarm

B. POST SBR EQUIPMENT DESCRIPTION

1. Post Equalization Basin Transfer Pump(s) (qty. = 3)
2. 4-20 mA Pressure Transducer(s) (qty. = 1)
3. Level Sensors (qty. =3)

C. FILTRATION DESCRIPTION (Monitored)

1. Turbidity Monitoring System (Existing)
2. 0.5 HP Drive Motor Assembly (qty.=4)
3. 2.9 HP Backwash/Waste Pump Assembly (qty. = 4)
4. Pressure Transducer Assembly (qty. = 4)
5. Float Switch (qty. = 4)

D. AEROBIC DIGESTER DESCRIPTION

1. 75 HP Blower (qty.=3)
2. Digester Level Sensors (qty.=4)

E. ANCILLARY EQUIPMENT DESCRIPTION (Monitor and Control)

1. UV Digital Outputs (qty. = 4)
2. Digester Digital Blower Outputs (qty.= 9)

**F. ANCILLARY EQUIPMENT DESCRIPTION BY OTHERS
(MONITORING ONLY)**

1. Chemical Feed Monitoring (qty. = 2 shared pumps with 4 solenoid valves)
2. Plant Drain Transfer Pump Monitoring (qty. = 2)
3. Effluent Flow Meter Monitoring (qty. = 1)
4. Sludge Flow Meter Monitoring (qty. = 1)
5. Post Equalization Magnetic Flow Meter (qty.=1)

2.16 SBR CONTROL MODES

- A. SBR control will be similar to current plant. Aqua Aerobics will be responsible for all programming modifications and presets.
- B. Provide the ability to operate in a 2,3 or 4 basin mode.
- C. The PLC controls shall allow the following control logic:
 1. Automatic operation program.
 2. Manual override (Hand/Off/Auto or Open/Closed/Auto Switch).
 3. Cycle reset in order to take a basin offline.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Contractor shall provide all labor and materials to install all equipment in accordance with the supplier's recommendation. The Contractor is responsible for obtaining detailed erection drawings.
- B. The contractor shall provide all anchor bolts, hardware, connectors, gaskets and support required that are not included in the Aqua Aerobics scope of supply (Appendix A).
- C. Contractor shall provide, at a minimum, the following:
 1. Unload and store all equipment on site.
 2. Provide and install all schedule 5 stainless steel air supply piping between blower isolation valves and SBR basins, air supply piping to top of each drop pipe.
 3. Provide inside and outside sludge piping at all pumps.
 4. Provide and install field wiring, conduits, wire ways, and cable trays.
 5. Provide and install all platforms, gratings, handrails, ladders and stairs.
 6. Provide start-up factory services for all equipment not included in Aqua field service

scope of supply. This includes all coordination required, factory service costs including travel and per diem.

7. Provide all start-up chemicals as required.
8. Provide all lubricants required for all other equipment associated with the SBR system (blowers, pumps, etc.) that is not included in Aqua's scope of supply.

3.2 INSTALLATION INSPECTION

- A. Contractor shall coordinate installation of all systems with Aqua and with other suppliers utilized by the Contractor.
- B. SBR system installation inspection shall include:
 1. Eight (8) man-hours per basin by Aqua,
 2. As required for all other equipment provided by the Contractor in accordance with the manufacturer's recommendations.
 3. Aqua shall provide 14 man-days of service, not including travel time, for installation, start-up and training. A maximum of 4 trips is allowed.
- C. In addition to Aqua Aerobics field services, provide the services of a factory-trained technical representative for all other equipment included in the SBR system including the blower and pumps for installation, start-up and training.
- D. Installation and Check-Out
 1. Provide the services of a factory-trained engineer who has at least three years' experience in SBR systems and is a certified operator to supervise and check out the installation.
 2. Provide the services of a factory-trained technical representative for the blowers, pumps and other equipment to check out the installation. Provide a minimum of 4 hours per piece of equipment at the job site by each manufacturer's field services representative.
 3. Submit report certifying that the equipment has been checked out and is ready for safe operation in the manner intended.
- E. Start-Up, Training and Continuing Operations Support
 1. Provide the services of a factory-trained engineer who has at least three years' experience in SBR systems to start up the system and provide training to the Owner's operators.
 2. Provide the services of a factory-trained engineer who has at least three years' experience for the specific equipment (blowers, pumps, etc.) to start the equipment and provide training to the Owner's operators. Provide a minimum of 4 hours per piece of equipment at the job site by each manufacturer's field services representative.
 3. Provide continuing operations support by a similarly qualified technical representative during the 12 months following start-up. Provide a minimum of four visits on an as-

needed and as-requested basis at the discretion of the Owner. Each visit shall consist of a minimum of 8 hours at the job site.

4. The above described visits are separate and in addition to any follow-up visits for warranty work.
5. The SBR manufacturer must maintain a 24-hour customer service hot-line with access to a certified plant operator for a 12 month period.

3.3 PAINTING

- A. The Contractor shall field paint equipment in accordance with Section 09 91 00 of these specifications.

3.4 FIELD TESTING

- A. Upon completion of installation and factory service visit, the Contractor shall fill one (1) (either SBR 2a/2b or SBR 4) basin with treated wastewater. Utilizing the SBR air supply, the system shall be tested for proper operation. Proper operation consists of no defects in the installation of the air piping system, no visible holes or blowouts in the air distribution system, and the proper amount of air being supplied to the basin. The Contractor shall, at his own expense adjust, repair, replace or re-install as necessary to provide satisfactory operation. All testing shall be performed in the presence of the Owner and the Engineer. Aqua Aerobics and the Contractor shall perform field oxygen testing to verify the performance of the aeration system.
- B. Upon successful completion, the Contractor shall transfer the contents from the completed basin into the adjacent Sequential Batch Reactor (either SBR 2a/2b or SBR 4) for field testing and repeat oxygen testing. This procedure shall be repeated until all SBR basins are field-tested. All cleaning and transferring costs associated with each basin installation shall be included in the bid price for the project.
- C. Upon completion, Aqua Aerobics shall submit certified test reports to the Engineer for review and approval. Failure to meet the performance criteria will require modifications to be made to the system at no additional cost to the Owner and no extension of the project completion date will be granted.

END OF SECTION

**SECTION 46 61 41
DISK FILTERS**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to install, test and commission disk filters. The scope of work includes installation, testing and commissioning. Modifications to the existing filter system is described in Part 3 of this specification section.
- B. These filters are pre-selected and will be provided by Aqua Aerobics. Refer to Appendix B for scope of supply and services provided by Aqua-Aerobics.
- C. The scope includes furnishing two (2) Model ADFC-54x4I-PC AquaDisk filter(s) as manufactured by Aqua-Aerobic Systems, Inc., of Loves Park, Illinois. These filters will work in tandem with the two (2) existing Model ADFC-54x4-PC tertiary filters.
- D. Filter Supplier to provide:
 - 1. Field services and training
 - 2. Operation and maintenance manuals.
 - 3. Start-up services.
- E. Each filter unit will include:
 - a. Basin Mounting Brackets and Hardware.
 - b. Turbidity Monitoring System (Existing).
 - c. Drive Assembly.
 - d. Centertube Assembly with Cloth Media Disks.
 - e. Backwash System.
 - f. Backwash/Waste Pump Assembly with access platform.
 - g. Valves.
 - h. Influent Weir.
 - i. Pressure Transducer Assembly.
 - j. Float Switch.
 - k. Electrical Controls with Internal Components.
 - l. All motors, pumps, and bearings shall be designed for continuous duty and long operating life in a high humidity atmosphere. All motors and pumps shall be 460 volt, 60 hertz, 3 phase.
- F. Through the wall spool piping and all external piping shall be provided by the installation Contractor.
- G. Effluent weir assembly shall be provided by the installation Contractor.

- H. Backwash platform for existing filters shall be provided by the installation Contractor and coordinated with Aqua- Aerobics. Submit details of the proposed platforms to be installed.

1.2 RELATED WORK

- A. Testing & Startup are included in Section 01 79 00.
- B. Manufacturer services and training included in Section 01 79 01.
- C. Miscellaneous metals are included in Section 05 10 00.
- D. Field painting is included in Section 09 91 00.
- E. Operation and maintenance manuals included in Section 01 78 23.
- F. Delivery, Storage and Handling is included in Section 01 45 34.

1.3 SYSTEM DESIGN AND PERFORMANCE CRITERIA

- A. The disk filters shall be capable of filtering effluent from a Secondary Activated Sludge process.
 - 1. Design proposed filters to meet the following:
 - a. Area per proposed disk filter: 215.2 sf. minimum effective area submerged.
 - b. Proposed number of filters: 2
 - c. ADF filter hydraulic loading rate: 3.25 gpm/sf.
 - d. PHF filter hydraulic loading rate: ≤ 6.5 gpm/sf.
 - 2. 10 mg/l average daily flow, as influent total suspended solids.
 - 3. 15 mg/l maximum daily flow, as influent total suspended solids.
 - 4. Filter effluent total suspended solids concentration shall not be greater than 5 mg/l based on a monthly average.
 - 5. Filter influent total phosphorus concentration shall be 2 mg/l daily average.
 - 6. Filter effluent turbidity shall not be greater than 3 NTU based on a daily average.
 - 7. Filter effluent total phosphorus shall not be greater than 1 mg/l based on a monthly average.
- B. Overall system performance (proposed plus existing units)
 - 1. Existing filters area: 430 sf

2. Proposed filter area: 430 sf
3. Total filter area: 860 sf with all units in service
4. Total filter area: 645 sf with one unit out of service
5. Average daily flow: 1.6 MGD
6. Maximum day flow: 2.71 MGD
7. Peak Hour flow: 4.08 MGD
8. Overall, Max day solids loading rate: 0.52 lbs. TSS/sf with 1 unit out of service.
9. The filtration system shall be able to treat 100% of the maximum design flow to meet the above design conditions with one unit offline.

1.4 WARRANTY

- A. The Manufacturer shall provide a written warranty against defects in materials and workmanship. Manufacturer shall warrant the goods provided by the Manufacturer to be free from defects in materials and workmanship under normal conditions and use for a period of one (1) year from the date the goods are put into service, or eighteen (18) months from shipment of equipment, whichever first shall occur. This warranty shall not apply to any goods or part which has been altered, applied, operated, or installed contrary to the Manufacturer's instructions or subject to misuse, chemical attack/degradation, negligence, or accident.

1.5 PROJECT CONDITIONS

- A. The drawings indicate the extent and general arrangement of the equipment, piping and electrical.
 1. Fit the equipment into the space allocated and allow adequate clearance for entry, installation, replacement, servicing, and maintenance.
 2. Verify actual and final arrangement, locations, grade, elevations.
 3. If adjustments and modifications are necessary, submit to the Engineer details of such adjustments and reasons for approval. Make no adjustments without Engineer's approval.

1.6 SUBMITALS

- A. Submit the following per Section 01 33 00:
 1. Drawings with dimensions, elevations and details.
 2. Cut sheets.

3. Media area calculations.
 - a. Calculations verifying the effective filtration surface area.
4. Hydraulic loading rate calculations.
5. Solids loading rate calculations.
6. Hydraulic profile through the filter showing the following:
 - a. Influent weir length
 - b. Influent weir elevation
 - c. Influent weir nappe at design and peak flow
 - d. Effluent weir length
 - e. Effluent weir elevation
 - f. Effluent weir nappe at design and peak flow
7. Elongation and breaking strength test report from ISO certified textile laboratory
8. Title 22 Conditional Approval letter
9. Control Panel shop drawings to include:
 - a. Outline
 - b. AC schematics, wiring diagrams.
 - c. Equipment interconnects drawings
 - d. Bill of materials
 - e. Clarifications and exceptions
 - f. Sequence of operations including list of functions monitored, controlled, and alarmed.
- B. Setting plans with tolerances for anchor bolts.
- C. Supplied tools and spares.
- D. Weights and lifting points of all equipment and subassemblies.
- E. Identify any special handling requirements.
- F. Field-testing procedures.

- G. Submit manufacturers certificate of installation per Section 01 33 00.
- H. Operation and maintenance manuals included in Section 01 78 23.

PART 2 PRODUCTS

2.1 FILTER BASIN

- A. Each filter shall be installed in a concrete basin. Each filter shall include one influent valve. Valve shall be 10” mechanical joint plug valve with square nut operator. Valve shall be Milliken or approved equal.

2.2 BASIN MOUNTING BRACKETS AND HARDWARE

- A. Each filter basin shall be fitted with 304 stainless steel mounting brackets to accommodate attachment of the filter components to inside of the basin. All mounting brackets shall be attached to the inside of basin wall with stainless steel anchors and hardware. Through the wall spool piping and all filter external piping shall be provided by the Installing Contractor.

2.3 FILTER DRIVE ASSEMBLY

- A. Each filter shall include an adjustable drive assembly with a gearbox, nylon drive sprocket, acetal drive chain with 304 stainless steel link pins, and a 304 stainless steel chain guard. The gearbox shall be parallel in-line helical type, with a 1/2 HP drive motor rated for 460 volt, 3 phase, 60 Hz. Gear reducer shall be Nord or approved equal. Drive motor shall be Nord, Weg, Baldor, or approved equal.
- B. To reduce energy demand, the drive assembly shall rotate the disks only during backwash. Systems requiring constantly rotating disks during filtration will not be acceptable. Belt drive systems or systems with multiple drive units per filter will not be acceptable.
- C. If motors and gearboxes require routine maintenance and are not accessible from the outside tank side walls, the equipment manufacturer shall provide an internal access platform between the tank side walls and motors and gearboxes.

2.4 CENTERTUBE ASSEMBLY

- A. Each centertube assembly shall include a minimum 1/4” thick 304 stainless steel centertube weldment, driven sprocket, wheel assemblies, 304 stainless steel disk segment rods, and frame and cloth assemblies. Each centertube assembly shall also include a Viton v-ring effluent port seal which provides superior chlorine resistance. Materials other than Viton are not acceptable for seal materials. Systems with swivel joints requiring routine lubrication are not acceptable. The driven sprocket shall be multi segment made of UHMW polyethylene. All fasteners shall be stainless steel.

2.5 CLOTH FRAME

- A. Each cloth disk assembly shall be comprised of six (6) individual segments, each consisting

of a cloth media sock supported by an injection molded glass filled polypropylene frame with corrosion resistant assembly hardware. Cloth/frame assemblies shall be constructed such that each segment is easily removable from the centertube, without special tools, to allow for removal and replacement of the cloth at the point of installation. Systems requiring special tools and/or the return of media segments to the factory for replacement will not be considered.

2.6 FILTER MEDIA

- A. Each cloth disk assembly shall have a minimum of 53.8 square feet of effective submerged filtration area. Each disk shall be divided into no more than six (6) segments and shall be easily removable for service.
- B. If the wet weight of the filter disk segment is greater than 50 pounds, a lifting mechanism shall be provided.
- C. Each basin shall include four cloth disk assemblies.
- D. Each filter unit shall have a total of 215.2 square feet of minimum effective submerged filtration area.
- E. Cloths shall be of fiber pile construction having a nominal filtration rating of 10 microns. Granular media and screens having structured identical openings shall not be allowed.
- F. Cloth filter media must have obtained conditional acceptance under California Title 22 regulations. The approval letter associated with this acceptance must be included with submittals.
- G. The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss.
- H. Individual pile fibers shall be held in place by a support backing integral to the media. To facilitate proper flow of backwash water through the cloth, the medium's back side shall be of open construction consisting of 10% open area at least 50 times larger than the nominal filtration media in any direction. Media that uses sewn in support structures, which have the potential to prevent free flow through the media, shall not be allowed.
- I. Cloth strength is critical to ensure long term performance of the media. Cloth media breaking strength and elongation shall be tested in accordance with ASTM Standard D5035 2R-E method by an ISO certified laboratory specializing in textile testing. Breaking strength shall be in excess of 200 lbf (890 N) in the warp and the weft direction. Elongation shall be less than 10% at 60 lbf (270 N) in the warp and the weft direction. Test reports shall be provided with submittals to demonstrate compliance with this requirement.
- J. To avoid excessive media movement, deformation and folding during backwash, the

maximum distance between cloth restraints must not exceed 36 inches.

2.7 FILTER HYDRAULICS

- A. During filtration, the filter unit shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the outside of the cloth media surface to allow for the direct contact of cleaning systems. Filtered effluent shall be used for backwashing. The filter flow path shall be from the outside of the cloth frame to the inside. Systems with flow paths from the inside to the outside of the cloth frame that collect filtered solids and plastic debris on the interior surfaces of the cloth frame will not be acceptable.
- B. Only media area below the effluent weir elevation will be considered in the filtration area calculation since this is the only area that is submerged and available for filtration 100% of the time.
- C. Submittal information shall include calculations that verify the effective filtration surface area. Media surface fused directly to support structure such that water cannot pass through the media shall not be included in these calculations.
- D. The operator shall be able to bring a drained filter online by simply opening the influent isolation device. If the filter design is such that it must be filled with water before the influent isolation device is opened to prevent damage to the filter media, an automated process that sequentially brings the filter back online with a single switch shall be provided to prevent accidental media damage. The automated process shall activate a minimum 6" diameter motorized valve to fill the filter with effluent or other clean water source in not more than five minutes, verify that the filter is full, and open the motorized influent isolation device.
- E. Because of the frequency of the backwash and misting associated with spray systems, designs that utilize high pressure spray or a moving vacuum head as the sole means of solids removal will not be acceptable.

2.8 BACKWASH SYSTEM

- A. The backwash function shall incorporate a pump that draws filter effluent through the cloth as the media rotates past the fixed backwash shoe, thereby removing accumulated solids from the cloth surface. Each disk shall be cleaned by a minimum of two backwash shoes, one on each side. The backwash shoes shall remain in a fixed position. Springs shall be used to maintain the proper tensioning of the backwash shoe against the media surface.
- B. The backwash shoe shall be in direct contact with the cloth to ensure effective media cleaning. Systems utilizing media cleaning mechanisms that do not contact the filter media will not be acceptable.
- C. Neither the cloth / support assemblies nor the backwash shoes shall include any gridwork overlays or other interferences that would prevent direct contact of the backwash shoes with the cloth fibers.
- D. The backwash system shall include 304 stainless steel backwash shoe supports with UHMW

backwash shoes, 316 stainless steel springs reinforced PVC flexible hose with stainless steel hose clamps, 304 stainless steel backwash manifolds, and PVC sludge collection manifold.

2.9 BACKWASH/WASTE PUMP ASSEMBLY

- A. Each backwash/waste pump assembly shall include backwash/waste pump(s) and valves.
- B. The equipment manufacturer shall provide an internal access platform and access ladder to allow in basin backwash pump maintenance and repairs.
- C. The backwash/waste pump(s) shall be shipped loose for field installation by the installing Contractor. Backwash piping between the filter basin and pump(s) as well as piping following the pump(s) shall be supplied by the installing Contractor. Installing Contractor shall supply unions or flanges for service, and interconnecting wiring.
- D. Each backwash/sludge discharge assembly shall include one sludge pump and three backwash/ solids pump(s). In the external piping shall be two 3" recirculation ball valves. The 3" ball valves shall be two-piece, full port, with brass body. Valves shall conform to MSS SP-110 and shall be Nibco or approved equal.
- E. The backwash/sludge pump(s) shall be a painted cast iron Hidrostral A2QS2 submersible centrifugal pump. Pump shall be provided with a 2.9 HP, 460 volt, 3 phase, 60 HZ motor. Pump shall be rated for 130 gpm at 37 ft TDH. Operator shall have the ability to specify backwash time interval elapses through the operator interface. Backwash shall also be enabled by tank water level, timer or manual initiation.
- F. Filtering shall not be interrupted during normal backwashing and sludge discharge.
- G. Each filter shall include a solids waste removal system consisting of perforated manifold, mounted on the floor of the filter basin. The manifold shall be designed to siphon settled solids for waste discharge through the backwash/waste pump. The operation of the solids waste removal system shall be automatic with user adjustable intervals and duration through the operator interface. Filters that are designed without a solids waste removal system will not be acceptable.

2.10 INFLUENT WEIR BOX

- A. Each filter shall include a 304 steel influent weir box. The weir box shall be mounted to the filter basin interior using 304 stainless steel wedge anchors and hardware. The basin wall must be smooth and plumb to facilitate a quality installation.

2.11 PRESSURE TRANSDUCER

- A. A submersible pressure transducer shall be supplied for each filter basin. The pressure transducer shall have stainless steel wetted parts and provide a 4-20 mA signal over a range of 0 psi to 5 psi. Units shall monitor the water level in the filter basin. Pressure transducer shall be provided with a mounting bracket and stainless steel anchors. A bellows providing vented gage atmospheric reference shall be supplied for Contractor installation in junction

box. The installation Contractor shall provide junction box, bellows mounting and interconnecting wiring. Transducers shall be Keller Levelgage series or approved equal.

2.12 FLOAT SWITCH

- A. A float switch shall be furnished to indicate emerging overflow level. The float switch shall be Anchor Scientific Model GSI 40NONC-STO or approved equal. The float shall contain a non-mercury switch, chemical resistant polypropylene casing and a PVC #18 AWG three conductor cable. Switch rating shall be minimum 4.5 amps non-inductive at 120 VAC.

2.13 CONTROL SYSTEM

- A. The automatic and manual controls for operation of the Aqua Disk® Filter system shall be furnished, fully assembled, wired and pre-programmed in a UL 508A Certified Industrial Control Panel. Controls shall be provided to control or monitor equipment as described in the contract drawings.
- B. One control panel shall be provided to operate the proposed filters.
- C. The control system shall include the following control components and practices:

1. CONTROL PANEL WIRING AND ASSEMBLY

- a. All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Short circuit rating of control enclosure shall be 5 kA RMS symmetrical @ 480VAC maximum.
- b. All control panel single conductor wire shall be 16 AWG multi-strand machine tool wire (MTW) minimum, with PVC insulation.
- c. Wire colors are as follows:

(1)	208 VAC or higher	-	Black
(2)	120 VAC control power	-	Red
(3)	Neutral	-	White
(4)	Ground	-	Green with Yellow Stripe
(5)	Power from remote source	-	Orange
(6)	Neutral from remote source	-	White with Orange Stripe
(7)	24 VDC (+)	-	Blue
(8)	24 VDC (-)	-	White with Blue Stripe
(9)	Intrinsically Safe	-	Light Blue
- d. All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal transfer printable

type. The material shall be self-laminating vinyl. Labels shall be Brady THT-9-427-10 or approved equal.

- e. Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122° F (50°C). Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door.
- f. Control components mounted internal and external to the enclosure shall be mounted with stainless steel hardware and clearly labeled with a plastic identification nametag. The tag shall be white with black lettering.

2. CONTROL PANEL QUALITY ASSURANCE

- a. All Control panels shall be UL certified. Testing by manufacturer's electrical engineering prior to release for shipment shall be completed. Testing shall consist of the following:
 - (1) Point to point testing of all wiring prior to application of power.
 - (2) Intended supply voltage shall be applied to the enclosure.
 - (3) All components shall be tested for proper operation and calibration.
 - (4) The PLC and operator interface program shall be loaded and functionally checked.
 - (5) All components shall be checked to confirm proper mounting specifications have been followed.
 - (6) Enclosure shall be inspected for defects and repaired if necessary.
 - (7) All labeling of wires and devices are correct, properly installed and clean.
- b. The manufacturer shall finalize the factory checkout by completing a control panel checklist to document all testing completed above.
- c. Upon the successful completion of the control testing of the enclosure assembly, all applicable documentation (i.e., finalized drawing set, signed control checklist cover page, device data sheets, etc.) shall be placed in the drawing pocket of the enclosure.

3. CONTROL ENCLOSURE

- a. The automatic controls shall be provided in a UL listed, NEMA Type 4X 304 stainless steel (12 gauge) floor mount enclosure that provides insulation and protection for electrical controls and components from highly corrosive environments indoors and outdoors. Enclosure shall include a seamless foam-in-place gasket to assure watertight and dust-tight seal. An internal 3-point latch and 316SS padlocking POWERGLIDE® handle shall be provided. Enclosures shall be unpainted, with a smooth #4 brushed finish. Enclosure shall include a

Painted white mild steel (12 gauge) sub-panel mounted with collar studs.
Enclosure shall be manufactured by Hoffman or approved equal.

- b. The control enclosure shall be mounted remotely.

4. CORROSION INHIBITOR

- a. Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.
- b. The corrosion inhibitor shall be Hoffman AHCI5E or approved equal.

5. AIR CONDITIONER

- a. A thermostat controlled air conditioner with noise suppression shall be supplied to protect control components mounted inside the enclosure from high temperatures, humidity and ambient air contaminants. The air conditioner shall be constructed of brushed finish stainless steel 304 material and provide NEMA 4X Type protection from outdoor and hose-down applications. The air conditioner unit shall use CFC-free or environmentally safe refrigerant that is universally accepted. The air conditioner shall be manufactured by Hoffman or approved equal.

6. ELECTRIC HEATER

- a. An electric heater shall be provided inside the control enclosure to protect sensitive mechanical and electrical components from the harmful effects of condensation, corrosion and low temperatures. The heater is a thermostatically controlled, fan-driven unit. The heater shall be manufactured by Hoffman or approved equal.

7. MAIN DISCONNECT CIRCUIT BREAKER

- a. A UL listed; automatic molded case 3-pole disconnect breaker shall be provided in the control enclosure(s). The primary function of the disconnect switch shall be to provide a means to manually open a circuit and automatically open a circuit under overload or short circuit conditions. The disconnect breaker shall have a door mounted operating mechanism with trip indication. Power distribution connectors shall be mounted integrally to the circuit breaker for multiple load connections. Integral connectors shall be provided. The disconnect circuit breaker shall be a Square D/HDL, JDL, LDL, MDL, PDL or approved equal.

8. MOTOR STARTER

- a. A full voltage non-reversing Integrated Motor Starter-Controller shall be provided for motor applications up to 15 kW. Each starter shall provide control,

protection and monitoring functions for the motor. The starter shall be IEC rated and shall have certifications according to UL and CSA standards and shall bear the CE marking. The starter shall have a maximum rated operational voltage of 690V and provide a 42kA @ 480 VAC rated breaking capacity on short circuit. The starter shall have a mechanical durability of 15 million operations. The starter shall provide short circuit trip, thermal overload trip with selectable tripping class, under current trip and phase imbalance trip.

- b. A full voltage non-reversing IEC Style motor starter shall be provided for motor applications over 15 kW. Each starter shall consist of a circuit breaker, contactor and overload relay. The starter shall be IEC rated and shall have certifications according to UL and CSA standards and shall bear the CE marking. The starter shall have a maximum rated operational voltage of 690V and provide a minimum 18 kA @ 480VAC and 25 kA @ 240 VAC interrupt rating on short circuit when used in combination with a PowerPact circuit breaker. The starter shall have a mechanical durability of 15 million operations. The solid state overload relay shall have class 10 tripping characteristics with trip current adjustment, phase loss and unbalance protection.

9. TRANSFORMER

- a. A step-down multi-tap transformer shall be supplied when there is a necessity to reduce incoming 3-phase power to 120 VAC single-phase. The transformer power wire connections (incoming and outgoing) shall be protected with a finger-safe cover to protect against accidental contact. Primary and secondary fuse protection shall be provided. Transformer shall be UL listed and of continuous wound construction with vacuum impregnated with non-hygroscopic thermosetting varnish. Transformer shall be Square D 9070T or approved equal.

10. TRANSFORMER PRIMARY AND SECONDARY FUSE

- a. Properly rated fuses and fuse blocks shall be provided for primary and secondary protection of the transformer. Each fuse shall be equipped with a thermoplastic cover to protect against accidental contact. Clip style fuse block shall be rated up to 600 VAC and 100 amps, dual element, time delay fuses shall be rated up to 600 VAC. Fuse blocks and fuses shall be UL listed. Fuses shall be Littelfuse Class CC or approved equal. Fuse blocks and fuse covers shall be manufactured by Marathon or approved equal.

11. CIRCUIT BREAKER

- a. All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed. Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or approved equal.

12. FUSE

- a. Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuses shall be rated up to 250 VAC and be Littelfuse or approved equal. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or approved equal.

13. OPERATOR DEVICE

- a. Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for all automatic controlled equipment. Transformer type push-to-test pilot lights and illuminated pushbuttons shall be provided for indication of an operation status. Lights shall be a 6 VAC incandescent type lamp. Color coding shall be applied as required and is as follows:
 - (1) Amber – Alarm active, caution.
 - (2) Green – Valve open, motor running.
 - (3) Red – Valve closed.
 - (4) White – Information.
- b. All operator devices shall be UL Listed, 30.5mm style, NEMA Type 4X rated, oil and watertight with finger safeguards located on the contact blocks to prevent accidental contact with wire connections. Operator device function shall be identified with an engraved white Gravoply nameplate with black letters. Operator devices shall be Square D 9001 or approved equal.

14. HIGH FREQUENCY NOISE FILTER

- a. A UL listed active tracking filter shall be provided to protect the PLC and HMI power feeds from high-frequency noise and low-energy transients. It shall be designed for a single phase input voltage of 120VAC operating at 50/60 Hz. The unit shall provide surge capacity of 25,000 amps and provide transient protection in all modes (Line to neutral, line to ground and neutral to ground). The noise filter shall be a SolaHD STFV or approved equal.

15. GROUND FAULT DUPLEX RECEPTACLE

- a. A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g., programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 120VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

16. 24 VOLT DC POWER SUPPLY

- a. A UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such rated components. The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single-phase) incoming control power. The power supply shall have a green LED which shall be illuminated when output voltage is “OK”. The power supply shall be an Allen Bradley 1606 or approved equal.

17. CONTROL RELAY

- a. UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D, or approved equal.

18. TERMINAL BLOCK

- a. Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating. Terminal blocks shall be Allen-Bradley 1492-J4 (35A max) and 1492-J16 (85A max) or approved equal.

19. PROGRAMMABLE LOGIC CONTROLLER

- a. Automatic operation of the filters shall be controlled through a programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a power supply, CPU, discrete input and output modules and analog input and output modules. The processor unit shall include built-in USB and two (2) Ethernet IP communication ports. All input and output points supplied (including unused) shall be wired to terminal blocks. Processor design characteristics shall include: 1.0MB user memory size, real-time clock and calendar, battery backed RAM and an operating temperature range between 32 °F and 140°F. The PLC processor shall be an Allen-Bradley CompactLogix 1769-L30ER or approved equal.
- b. Modular equipment shall be provided to complete the PLC system. These Allen-Bradley components include: 1769-PA4 – Power Supply, 1769-IA16 – Discrete input (16 point) modules, 1769-OW16 – Discrete output (16 point) modules and 1769-IF8 – Analog input (8 point) modules, 1769-OF4CI – Analog output (4 point) modules.

20. PLC POWER SUPPLY

- a. Input voltage range of 85-265 / 170-265 VAC, 47-63 Hz, maximum inrush

current of 30 amps, backplane output current of 4 amps @ 5V or 2 amps @ 24V, internal fuse protection, ambient operating temperature of 32°F to 140°F, Class I, Division 2 hazardous location certified, UL Listed.

21. DISCRETE INPUT MODULE

- a. Operating voltage of 79 to 132 VAC at 47 to 63 Hz, backplane current draw at 5VDC = 115mA , off-state current 2.5mA maximum, maximum inrush current 250mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

22. DISCRETE OUTPUT MODULE

- a. Operating voltage of 5 to 265 VAC at 47 to 63 Hz / 5 to 125 VDC, backplane current draw at 5 VDC = 205mA , at 24VDC = 180mA, off-state current leakage is 1.0mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

23. ANALOG INPUT MODULE

- a. Backplane current draw at 5 VDC = 120mA, at 24VDC = 70mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

24. ETHERNET SWITCH

- a. An unmanaged Ethernet switch shall be provided inside the control enclosure to provide connectivity between the PLC, operator interface and plant networking. The switch shall support both 10 and 100 Mbit/s operation. The switch shall have five (5) 10/100Base-T ports with RJ-45 sockets and shall support auto-crossing, auto-negotiation and auto-polarity. Maximum distance between devices shall be 100m.
- b. The unit shall be DIN rail mounted and require 24VDC power. Diagnostic LEDs for power and connection status shall be included. The Ethernet switch shall be UL listed and manufactured by Allen-Bradley Stratix 2000 1783-US5T or approved equal.

25. HUMAN MACHINE INTERFACE OVERVIEW

- a. The control system shall be equipped with a UL listed operator interface that provides control display screens. These screens shall be used by the operator to monitor and control filter status, setpoint and alarm information.
- b. The Interface shall allow the Operator access to adjust the following operating parameters:
 - (1) Backwash interval,

- (2) Backwash duration,
 - (3) Sludge waste interval,
 - (4) Sludge waste duration,
 - (5) Number of backwashes between sludge wasting.
- c. The operator interface shall provide information to assist the Operator in assessing the status of the filter system. The interface screen shall display, at minimum, the following parameters:
 - (1) Water level in the filter,
 - (2) Time since last Backwash,
 - (3) Time since last Sludge withdrawal,
 - (4) Elapsed time on the Drive Motor,
 - (5) Elapsed time on the Backwash Pump(s),
 - (6) Total backwash time and cycles,
 - (7) Total sludge withdrawal time and cycles.
- d. The interface shall display the alarm history. The alarm history shall include the time and date of the most recent 25 alarms along with the description of the alarm.
- e. The interface shall also display current alarms, including the date, time and a description of the alarm.
- f. As a diagnostic aid to the Operator, the interface shall display the time between backwashes for the most recent 40 backwashes.

26. HUMAN MACHINE INTERFACE

- a. The operator interface shall be a NEMA Type 12, 13, 4X rated, 6.5” diagonal, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 640 x 480 pixel resolution. The rated operating temperature shall be 32° to 131° F (0° to 55° C). The operator interface shall be an Allen Bradley PanelView Plus 7 Performance 7”.

27. HUMAN MACHINE INTERFACE SUN SHIELD

- a. A sun shield constructed of 304 stainless steel shall be mounted over the operator interface to provide protection and visibility of operator screens in outdoor applications.

PART 3 EXECUTION

3.1 PREPARATION

- A. The installing Contractor shall conduct a field inspection to verify the preparations are complete and that the site is ready for installation of the proposed equipment.
- B. All equipment shall be properly crated to protect any and all components from damage during shipment.
- C. The Contractor shall ensure that all parts are properly protected so that no damage or deterioration will occur during a prolonged delay from the time of delivery until installation is complete and the units and equipment are ready.

3.2 INSTALLATION

- A. Installation shall be in accordance with the recommendation of the equipment manufacturer to ensure that systems are professionally installed.
- B. All field wiring will be performed by the General Contractor.
- C. The existing filter system must remain in service during the construction of the proposed filter system. Modifications to the existing system are presented below in 3.4 of this section.

3.3 FIELD TESTS /START-UP SERVICES

- A. Furnish the services of a factory representative, having complete knowledge of the operational and maintenance requirements of the system to instruct the Owner's personnel in the proper operation of the equipment. Provide (6) hours of training. Training may be scheduled concurrent with trip to site required for purposes of start-up.
- B. After the equipment in this Section has been completely installed, under the direction of the manufacturer's factory representative, conduct in the presence of the Engineer preliminary and pre-final testing in accordance with 01 79 00 to ensure that all equipment conforms to this Section.
- C. If any part of the system does not meet the requirements specified, corrective measures shall be taken, and/or equipment shall be removed and replaced with equipment that satisfies the conditions specified. All expenses associated with field testing, including any corrective action, shall be borne by the Contractor.

3.4 MODIFICATIONS TO THE EXISTING FILTER SYSTEM

- A. The General Contractor to modify the existing filter system as follows:
 - 1. Interconnection of existing and the proposed filter effluent channels.
 - 2. Removal with replacement of existing filter effluent pipe to the existing UV system.

3. Addition of a maintenance platform inside each existing filter box to allow access to filter backwash pumps for repairs and maintenance. Maintenance platform and design by filter supplier. Submit shop drawings for review.
- B. All of this work must be coordinated with the Owner. At all times a minimum of 2 filters must be in service. Contractor to provide temporary pumping, piping, controls as required to complete construction. Refer to the drawings for additional details.

END OF SECTION

**SECTION 46 66 56
ULTRAVIOLET DISINFECTION EQUIPMENT**

PART 1 GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, equipment and appurtenances required to provide an open channel, gravity flow, low pressure high intensity ultraviolet lamp (UV) treatment system complete with an automatic mechanical/chemical cleaning system and variable output electronic ballasts. The UV system to be complete and operational with all control equipment and accessories as shown and specified herein. This system will be capable of inactivating effluent to meet the water quality standards listed in this section.
- B. The ultraviolet system will be purchased by the Contractor. The system to be installed by the Contractor and tested and commissioned by UV Disinfection Equipment supplier, as specified in this section.

1.2 APPROVED EQUIPMENT MANUFACTURER

- A. The UV system shall be manufactured by Trojan.

1.3 RELATED WORK

- A. Testing & Startup are included in Section 01 79 00.
- B. Manufacturer Services and Training in Section 01 79 01.
- C. Operation and Maintenance Manuals are included in Section 01 78 23.

1.4 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01 33 00, copies of all materials required to establish compliance with this Section. Submittals shall include the following:
 - 1. Complete description in sufficient detail to permit an item comparison with the specification. Manufacturer's literature, illustrations, specifications, engineering data, connection details, and performance data.
 - 2. Dimensions and installation requirements. limits of equipment supplier
 - 3. Electrical schematics and layouts.
 - 4. Hydraulic calculations demonstrating compliance with the required hydraulic characteristics.
 - 5. Independent bioassay validation and dosage calculations demonstrating compliance with the specified dose requirements.

6. Disinfection performance guarantee.
- B. Operation and maintenance manuals as specified in Section 01 78 23.
- C. Test Reports to be Submitted:
 1. Refer to Section 01 79 00 for details.
 2. Copies of all test results, as specified in Part 3 of this Section.
- D. Submit the Equipment Warranty and Certification Form as specified in Section 01 33 00.
- E. Field-testing procedures.
- F. Submit manufacturers certificate of installation per Section 01 33 00.

1.5 QUALITY ASSURANCE

- A. Any alternate UV manufacturer that is not named or listed as approved equal must submit the following 15 days prior to bid to be considered for approval:
 1. To be considered, the manufacturer will be regularly engaged in the manufacture of UV systems with a proven track record of at least twenty (20) operating installations.
 2. The manufacturer will provide documentation of previous experience with municipal UV disinfection systems in wastewater applications with variable output electronic ballasts.
 3. Documentation of UV manufacturer's service capabilities including location and experience.
 4. Sample disinfection performance guarantee including scope and duration.

1.6 PERFORMANCE AND DESIGN CRITERIA

- A. Provide equipment that will disinfect effluent with the following characteristics:
 1. a) Current Peak Flow: 2.71 MGD
 2. b) Total Suspended Solids: 5 mg/l (Maximum, grab sample)
 3. c) Effluent Temperature Range: 33 to 85 °F (1 to 30 °C)
 4. d) Ultraviolet Transmittance @ 253.7 nm : 65 %, minimum
 5. e) Maximum Mean Particle Size : 30 microns
 6. f) Effluent standards to be achieved: 23 FC/100 ml ⁽¹⁾

7. g) Future standards to be achieved: 123 E. Coli/100 ml.⁽¹⁾

⁽¹⁾ Based on a 30 -day Geometric Mean of daily samples for the effluent standard as specified in a) through e). Effluent standards will be guaranteed regardless of influent count to UV system.

- B. The UV system is to be installed in existing open channel(s) having the following dimensions:

- a. Length: 25'-0"
- b. Width: 18 inch (clear opening)
- c. Overall Depth: 42 inch

- C. The effluent depth in the channel will be as per layout drawing.

- D. System configuration:

1. The UV system must fit within the UV channel(s) as stated without modification.

2. The UV system configuration will be as follows:

- a. Number of Channels: 1 serpentine shape
- b. Number of Banks per Channel: 3
- c. Number of UV Modules per Bank: 4
- d. Number of Lamps per UV Module: 6
- e. Total Number of Lamps in the UV System: 72
- f. Number of System Controllers: 1 pedestal mounted.
- g. Number of UV Detection Systems: 3
- h. Number of Power Distribution Centers: 3
- i. Number of Level Controllers: 1
- j. Number of Hydraulic System Centers: 1
- k. Number of Level Control Panels: 1

- E. Performance Requirements:

1. The ultraviolet treatment system will produce an effluent conforming to the following discharge permit: 23 Fecal Coliform/100 ml, based on a 30 day Geometric Mean. The same treatment system shall be able to meet future discharge permit of 123 E. Coli/100

ml based on 30 day Geometric Mean without modifications. Grab samples will be taken in accordance with the Microbiology Sampling Techniques found in *Standard Methods for the Examination of Water and Wastewater, 19th Edition*.

2. Provide a UV system complete with UV Banks, System Control Center, Power Distribution Center(s), Support Racks(s) and Level Controller(s) as shown on the contract drawings and as herein specified.
3. The UV system will be designed to deliver a minimum UV dose of 35mJ/cm² MS2 at peak flow, in effluent with a UV Transmission of 65 % at end of lamp life (EOLL) after reductions for quartz sleeve fouling. The basis for evaluating the UV dose delivered by the UV system will be the independent third-party bioassay, without exception. Bioassay validation methodology to follow protocols described in NWRI *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse*.
4. The UV Dose will be adjusted using an end of lamp life factor of 0.5 to compensate for lamp output reduction over the time corresponding to the manufacturer's lamp warranty. The use of a higher lamp aging factor will be considered only upon review and approval of independent third party verified data that has been collected and analysed in accordance with protocols described in NWRI *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse*.
5. The UV Dose will be adjusted using a quartz sleeve fouling factor of 0.8 when sizing the UV system to compensate for attenuation of the minimum dose due to sleeve fouling during operation. The use of a higher quartz sleeve fouling factor will be considered only upon review and approval of independently verified data that has been collected and analysed in accordance with protocols described in NWRI *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse*.
6. Independent Validation for use of higher factors (lamp aging and sleeve fouling) must be submitted to the Engineer a minimum of fifteen (15) days prior to bid.
7. The system will be able to continue providing UV treatment while replacing UV lamps, quartz sleeves, ballasts and while cleaning the UV lamp sleeves.
8. The system will be designed for complete outdoor installation.

1.7 GUARANTEE

- A. Equipment: The Contractor shall guarantee the system as required under the General Conditions, and as specified herein. If, during the guarantee period, the system fails or does not meet any of the specified requirements or test criteria herein, the Contractor shall correct such deficiencies as may be necessary to meet these requirements and criteria, and at no additional cost to the Owner. Any proposed remedial measures must first be reviewed by the Engineer before any work is done. The equipment furnished under this section will be free of defects in material and workmanship, including damage that may be incurred during shipping for a period of 12 months from date of acceptance by the Owner.

- B. UV Lamps: The UV lamps to be warranted for a minimum of 12,000 hours when operated in automatic mode, prorated after 9,000 hours. On/off cycles are limited to four (4) per day.
- C. Ballasts: Ballast to be warranted for 5 years, prorated after 1 year.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. The physical layout of the system shown on the contract drawings and the equipment specified herein are based upon the UV3000Plus™ System, as manufactured by Trojan Technologies, London, Ontario, Canada.

2.2 DESIGN, CONSTRUCTION AND MATERIALS

- A. General
 - 1. All module welded metal components in contact with wastewater will be Type 316 stainless steel.
 - 2. All metal components above the wastewater will be Type 304 stainless steel except for the ballast enclosure, which is constructed of anodized aluminum.
 - 3. All wiring exposed to UV light will be Teflon coated.
 - 4. All wires connecting the lamps to the ballasts will be enclosed inside the frame of the UV Module and not exposed to the effluent.
- B. Lamp Array Configuration
 - 1. The lamp array configuration will be the uniform array with all lamps parallel to each other and to the flow.
 - 2. The system will be designed for complete immersion of the UV lamps including both electrodes and the full length of the lamp tube in the effluent.
- C. UV Module
 - 1. Each UV module will consist of UV lamps with an electronic ballast enclosure mounted on a Type 316 stainless steel frame. Ballasts housed in a separate enclosure located external to the channel will be equipped with a suitable air conditioning system, supplied by the UV manufacturer.
 - 2. Each lamp will be enclosed in its individual quartz sleeve, one end of which will be closed, and the other end sealed by a lamp end seal.
 - 3. The closed end of the quartz sleeve will be held in place by means of a retaining O-ring.
 - 4. The ends of the lamp sleeve will not protrude beyond the stainless-steel frame of the

UV Module.

5. Lamp wires will terminate in the electronic ballast enclosure located at the top of the UV Module.
6. All lamp to ballast connections will be made by and tested by the UV Manufacturer.
7. The electronic ballast enclosure will contain the electronic ballasts and addressable lamp status monitoring systems.
8. Each UV Module will be connected to a receptacle on the Power Distribution Center.
9. At the point of exit from the UV Module frame the multi conductor cable will pass through a waterproof strain relief.
10. Each UV module will have a rating of Type 6P.

D. UV Lamps

1. Lamps will be high intensity low pressure amalgam design. The lamp will be preheated to promote longevity. Lamps that are not amalgam or that are based on driving a low-pressure lamp at amperages greater than 500 milliamps will not be allowed.
2. The filament will be of a clamped design, significantly rugged to withstand shock and vibration.
3. Electrical connections will be at one end of the lamp and have four pins, dielectrically tested.
4. Lamps will be operated by electronic ballasts with variable output settings.

E. Lamp End Seal and Lamp Holder

1. The open end of the lamp sleeve will be sealed by means of a sleeve nut which threads onto a sleeve cup and compresses the sleeve O-ring.
2. The sleeve nut will have a knurled surface to allow a handgrip for tightening. The sleeve nut will not require any tools for removal.
3. The lamp will be held in place by means of a molded lamp holder that will incorporate two seals. The lamp holder will incorporate a double seal against the inside of the quartz sleeve to act in series with the external O-ring seal.
4. The second seal on the lamp holder will isolate and seal the lamp from the module frame and all other lamps in the module.
5. In the event of a quartz sleeve fracture the two seals of the lamp holder will prevent moisture from entering the lamp module frame and the electrical connections to the other lamps in the module.

6. The lamp holder will also incorporate a UV resistant PVC molded stop that will prevent the lamp sleeve from touching the steel sleeve cup.
- F. UV Lamp Quartz Sleeves
1. Type 214 clear fused quartz circular tubing as manufactured by General Electric or equal.
 2. The nominal wall thickness will be 1.5 mm.
- G. UV Module Support Rack
1. The UV module support rack will be minimum Type 304 stainless steel and be mounted above the effluent in the channel allowing adjustment to the precise height of the channel.
- H. Level Controller
1. Level Controller
 - a. Utilize existing weir located at the discharge end of the UV channel.
- I. Low Water Level Sensor
1. One low water level sensor will be provided by the UV Manufacturer for each UV channel.
 2. During manual, automatic, and remote modes of system operation, the water level sensor will ensure that lamps extinguish automatically if the water level in the channel drops below an acceptable level.
 3. The low water level sensor will be powered by the Power Distribution Center.
- J. Electrical
1. Each UV module within a bank will be powered from the bank's dedicated Power Distribution Center.
 2. UV manufacturer to supply all cabling and conduit between lamps and ballasts.
 3. UV manufacturer to perform all terminations between lamps and ballasts.
 4. Each electronic ballast within a UV module will operate two lamps.
 5. Power factor will not be less than 98% leading or lagging.
 6. Electrical supply to each Power Distribution Center will be 480/277V 60Hz.
 7. Electrical supply to the Hydraulic System Center will be 480V 60Hz.

8. Electrical supply for the water level sensor will be provided by the PDC and be 12 Volt DC.
9. Electrical supply to the System Control Center will be 120V 60Hz.
10. The installation contractor to provide disconnects on the electrical supply feeding the UV system electrical panels.

K. Power Distribution Center

1. Power distribution will be through environmentally sealed receptacles on the PDC(s) to allow for local connection of UV modules.
2. Data concentration will be through integrated circuit boards located inside the Power Distribution Center.
3. PDC enclosure material will be Type 304 Stainless Steel - Type 4X (IP66).
4. All internal components will be sealed from the environment.
5. All Power Distribution Center to be UL listed with a rating of Type 4X.
6. One separate sealed Power Distribution Center will be provided per bank of lamps.
7. Systems that have ballasts mounted in cabinets, the UV manufacturer will provide one complete cabinet for each bank of lamps, to ensure that each bank is electrically isolated for safety.

L. Control and Instrumentation

1. System Control Center (SCC):
 - a. The operation of the UV3000Plus™ is managed at the SCC by a PLC based controller which continuously monitors and controls the system functions. PLC will be “Compact Logix” as manufactured by Allen Bradley. Pedestal mount the SSC. Pedestal and control panel provided by UV supplier.
 - b. The operator interface display screen will be menu driven with automatic fault message windows appearing upon alarm conditions. Operator Interface will be Beijer -Type 4X (7") Outdoor Rated
 - c. Alarms will be provided to indicate to plant operators that maintenance attention is required or to indicate an extreme alarm condition in which the disinfection performance may be jeopardized. The alarms will include but not be limited to:
 - (1) Lamp Failure
 - (2) Multiple Lamp Failure
 - (3) Low UV Intensity

(4) Module Communication Alarm

- d. The 100 most recent alarms will be recorded in an alarm history register and displayed when prompted.
- e. Bank status will be capable of being placed either in Manual, Off or Auto mode.
- f. Elapsed time of each bank will be recorded and displayed on the display screen when prompted.
- g. Optional: Digital I/O modules will be provided to remotely indicate status and alarms such as:

(1) Alarm conditions (major, critical)

(2) Bank Status (one for each UV bank supplied)

M. UV Detection System

- 1. A submersible UV sensor will continuously monitor the UV intensity produced in each bank of UV lamps.
- 2. The sensor will measure only the germicidal portion of the light emitted by the UV lamps. The detection system will be factory calibrated. Detection systems that can be field calibrated will not be permitted.

N. Dose-Pacing

- 1. A dose-pacing system will be supplied to modulate the lamp UV output in relationship to a 4-20 mA DC signal from an effluent flow meter (by Others).
- 2. The system to be dose-paced such that as the flow and effluent quality change, the design UV dose is delivered while conserving power.
- 3. The dose-pacing system will allow the operator to vary the design dose setting. Logic and time delays will be provided to regulate UV bank ON/OFF cycling.

O. Hydraulic System Center (HSC)

- 1. One (1) HSC will be supplied to house all components required to operate the automatic cleaning system.
- 2. Enclosure material for construction will be Type 304 Stainless Steel - Type 4X (IP66).
- 3. The HSC will contain a hydraulic pump complete with integral 4-way valve and fluid.

P. Cleaning System

- 1. An automatic cleaning system will be provided to clean the quartz sleeves using both mechanical and chemical methods. Wiping sequence will be automatically initiated

with capability for manual override.

2. The cleaning system will be fully operational while UV lamps and modules are submerged in the effluent channel and energized.
3. Cleaning cycle intervals to be field adjustable.
4. Provide Remote Manual and Remote Auto cleaning control options.
5. Provide the cleaning system with the required solutions necessary for initial equipment testing and for equipment start-up.
6. Systems that use only mechanical wiping must have the ability to periodically be cleaned out of channel using a chemical bath. Out of channel cleaning will include lifting slings, removable banks, cleaning tanks, agitation system and air compressors, as required. The UV manufacturer will be responsible for supplying all equipment including any equipment not specifically listed required to perform out of channel chemical cleaning. Contactor will be responsible for installation.

Q. Module Lifting Device

1. One Davit crane, base and lifting sling will be supplied to assist in removing individual modules from the effluent channel.
2. Lifting device will be a crane with hand winch and will include an adjustable boom to ensure adequate reach and height.
3. Lifting device to include a swivel handle for rotation and positioning.
4. UV manufacturer to supply crane for installation by the Contractor.
5. Crane material to be painted mild steel.

R. Spare Parts

Supply the following spare parts and safety equipment.

1. 6 UV Lamps
2. 6 Quartz Sleeves
3. 3 Lamp Drivers
4. 1 Operator's kit including face shield, gloves, and cleaning solution.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The contractor shall install the equipment, control panel, hydraulic conduits and anchor bolts in accordance with contract drawings, manufacturers' shop drawings, instructions, and installation checklist.
- B. All labor, materials, and test apparatus necessary for completing the installation shall be furnished by the Contractor at no additional cost to the Manufacturer or Owner.

3.2 TESTING

- A. Refer to Section 01 79 00.
- B. Performance testing- Four (4) grab samples will be taken (once per day, for four days by the plant operations staff, at the time selected by the operators) and in accordance with the Microbiology Sampling Techniques found in Standard Methods for the Examination of Water and Wastewater, 19th Edition. An independent lab will analyze the samples and the results will be issued to the Engineer for review. Cost of laboratory testing will be borne by the installation Contactor. All samples must achieve the performance requirement to be considered passing the performance test. Failure to meet the performance requirement will result in re-testing and modifications at no cost to the Owner.

3.3 MANUFACTURER'S SERVICES

- A. Manufacturer's field service technician shall check the installation of the equipment, assist in the start-up, and provide training on the maintenance of the equipment. A minimum of two (2) trips for a total of four (4) days at site (exclusive of travel time) shall be provided.
- B. Operator Training: As outlined in the project scope document.
- C. Warranty Service: As outlined in the warranty agreement.

END OF SECTION

**SECTION 46 73 19
FLOATING SUPERNATE DECANTERS**

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. Two (2) floating supernatant decanter(s) for installation as shown on the project plans. Equipment furnished under this Section shall include floating decanters, decanter support rests, and necessary components to provide a completely functional system.
- B. The floating decanter shall be the DynaCanter™ floating supernatant decanter as manufactured by Parkson Corporation.
- C. The Contractor shall be responsible for furnishing all labor, materials, equipment, and incidentals required to install, test and commission.

1.2 RELATED WORK

- A. Testing & Startup are included in Section 01 79 00.
- B. Manufacturer services and training included in Section 01 79 01.
- C. Miscellaneous metals are included in Section 05 10 00.
- D. Operation and maintenance manuals included in Section 01 78 23.
- E. Delivery, Storage and Handling is included in Section 01 45 34.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01 33 00, copies of all materials required to establish compliance with this Section. Submittals shall include the following:
 - 1. Drawings showing general arrangement of the decanting system.
 - 2. Elevations and cross sections.
 - 3. Drawings showing details of the decanter, connectors, piping, pipe supports, and pipe joints.
 - 4. Materials and manufacturing specifications and data sheets.
 - 5. Installation, operation, and maintenance instructions.
 - 6. List of any exceptions taken to the plans and specifications including written justification.
 - 7. Literature that describes the equipment and shows all key details of construction and dimensions. Dimensions shall show overall size and space requirements including that

for installation, leveling, dismantling and maintenance.

- B. Operation and maintenance manuals as specified in Section 01 78 23.
- C. Test Reports to be Submitted:
 - 1. Refer to Section 01 79 00 for details.
 - 2. Copies of all test results, as specified in Part 3 of this Section.
- D. Submit the Equipment Warranty and Certification Form as specified in Section 01 33 00.
- E. Submit manufacturers certificate of installation per Section 01 33 00.

1.4 WARRANTY

- A. The manufacturer shall warrant in writing all equipment against defects in materials and workmanship for a period of 12 months from the date of acceptance. Within this 12-month period, any defective or malfunctioning equipment, component, or accessory shall be repaired or replaced upon notice at no additional cost to the Owner.

1.5 QUALITY ASSURANCE

- A. The equipment shall be designed and constructed in accordance with the best practices and methods of the industry and shall be installed in accordance with the manufacturer's recommendations and the Drawings. Use only new materials.
- B. The Contractor is responsible for proper coordination and integration required for installation and all other associated work shown on the drawings and specified in the Contract Documents.
- C. Should equipment which differs from this Section be offered and determined to be the equal of that specified, such equipment will be acceptable only on the basis that any structures, piping, appurtenant equipment, electrical work, etc., required to accommodate such a substitution shall be made at no additional cost to the Owner and shall be as approved by the Engineer.

1.6 DELIVERY, HANDLING AND STORAGE

- A. Equipment and materials provided under this Section shall be delivered, stored, and handled in compliance with Section 01 45 34.

PART 2 EQUIPMENT

2.1 GENERAL

- A. One (1) floating decanter shall be provided in each aerobic digester basin to remove supernatant. Each decanter shall be designed to accommodate the full range of travel between top water level (TWL) and decanter rest elevation. Decanter design , main components and materials of construction shall be as outlined in the table below.
- B. Contractor responsible for providing wall pipe and basin mounted plug valve with extension stem and floor stand for each decanter.

2.2 DECANTER DESIGN AND MATERIALS

DECANTER DESIGN AND MATERIALS TABLE

Minimum draw and drain tube diameters	4-inch
Top water level	14.5 feet
Decanter rest	6.5 feet
Decanter throttling and isolation	Interior mounted plug valve, 4 inch
Average decant rate	300 gpm
Float	ASTM D2996 FRP filled with closed cell foam
Draw tube	ASTM D2996 FRP
Drain tube	ASTM D2996 FRP
Flex connector	Natural Rubber / Neoprene (wire re-enforced)
Knee joint assembly	304 stainless steel
Lower mitered elbow	304 stainless steel
Decanter rests	304 stainless steel

- C. The draw tube and float assembly are located in parallel and permanently connected using laminated FRP supports. The drain tube is located in the center of the draw tube and provides the flow path for supernatant to exit the basin through the flex hose and lower mitered elbow. Miter joint connecting the draw tube and drain tube must be re-enforced with FRP hoop wraps to provide added strength. Drain tube, flex connector, and lower mitered elbow shall be connected by flanged connections with hardware and gaskets provided by the manufacturer.
- D. A knee brace assembly shall be provided to allow vertical articulation of the decanter as water levels move up and down in the reactor. The knee brace assembly shall support the flex connector and prevent lateral movement of the decanter unit. Flex connector shall be suitable for abrasive materials and shall be rated at 30 inches mercury vacuum and 15 PSI working pressure. Fixed or retractable decanters will not be accepted.
- E. The draw tube shall contain an adequate number of machined orifices to accommodate the average design flow rate based on site hydraulic conditions. Machined orifices shall be located on the upper side of the draw tube.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Contractor shall install the equipment as indicated on the contract drawings and in strict accordance with the manufacturer's recommendations.
- B. The final installation must be certified by the manufacturer as complete and correct.

3.2 START-UP TESTING

- A. Refer to Section 01 79 00 for Facility Testing and Start-up.

3.3 MANUFACTURERS FIELD SERVICE

- A. Provide field services identified in Section 01 79 01. Include one day on site (1 day for training and for start-up), exclusive of travel time.

END OF SECTION

APPENDIX A

AQUA AEROBICS PROPOSAL



AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Proposal#: 169972

TO: All Bidding Contractors

PROJECT: SPOUT SPRINGS WRF EXP GA

BID DATE: August 22, 2024

PROPOSAL DATE: July 1, 2024

CC: Templeton & Associates / ph#: 770/614-8550 / fx#: 770/614-5992
Jon Baker

Aqua-Aerobic Systems, Inc.
Paul Nelson / PNelson@aqua-aerobic.com

The following Notes apply to Aqua-Aerobic Systems' proposal:

- We are pleased to quote, for acceptance within 120 days of the bid date, prices and terms on equipment listed below.
- Equipment will be furnished by Aqua-Aerobic Systems, Inc. with unloading of goods, civil work, and installation by the Buyer.
- Reference: Specification Section 25 00 20 - Process Instrumentation and Control Supplier
- Reference: Specification Section 46 53 53 - Sequential Batch Reactor System
- Reference: Specification Section 46 61 41 - Disk Filters

AquaSBR

Influent Valves

2 Influent Valve(s) for SBR #2A/2B will be provided as follows:

- 12 inch diameter Milliken 601 electrically operated eccentric plug valve(s) with 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with an Auma, 115 VAC, 60 hertz, single phase open/close service electric actuator. Valve actuator includes compartment heater.

1 Influent Valve(s) for SBR #4 will be provided as follows:

- 16 inch diameter Milliken 601 electrically operated eccentric plug valve(s) with 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with an Auma, three phase, open/close service electric actuator. Valve actuator includes compartment heater.

Mixers

4 AquaDDM Direct Drive Mixer(s) will be provided as follows:

- 7.5 HP Model FSS Endura® Series AquaDDM® Mixer. Motor base and intake volute assemblies will be of 304 stainless steel. Float is fiber reinforced polyester skin (FRP), filled with closed cell polyurethane foam. Propeller is cast stainless steel. Motor will be premium efficient, TEFC, 460 volt, 3 phase, 60 hertz, 1200 RPM with 1.15 service factor and Class F nonhygroscopic insulation. Motor shaft is one-piece 17-4 PH stainless steel.

Mixer Mooring

**4 Mixer Cable Mooring System(s) consisting of:**

- #12 AWG-four conductor electrical service cable(s).
- Aerial support tie(s).
- Electrical cable strain relief grip(s), 2 eye, wire mesh.
- 304 stainless steel mooring cable(s).
- Maintenance mooring cable loop(s).
- Stainless steel mooring spring(s).
- 1/2" stainless steel eyebolt assembly(s).
- 1/4" 316 stainless steel wire rope thimble(s).
- 3/8" diameter 316 stainless steel quick disconnect snaphook(s).

Decaners**2 Decanter assembly(ies) for SBR #2A/2B consisting of:**

- 8x7 Aqua-Aerobics decanter(s) with fiberglass float, 304 stainless steel weir, galvanized restrained mooring frame, and painted steel power section with #14-10 conductor power cable wired into a NEMA 4X stainless steel junction box with terminal strips for the single phase, 60 hertz actuator and limit switches.
- Aluminum band clamp heater integral to the decanter power section(s).
- Decant pipe(s) with integral elbow, 304L stainless steel.
- 10 inch gasket kit(s).
- 10 inch diameter stainless steel flanged flexible joints.
- Stainless steel anchors.
- 4" schedule 40 galvanized restrained mooring post(s) with base plate.
- Galvanized steel dewatering support posts.
- 10 inch Milliken Fig. 511A AWWA C-504 Class 150B electrically operated butterfly valve(s) with ANSI Class 125# flanged end ASTM A-536 ductile iron body, ductile iron disk with a 316 stainless steel edge, fully lined EPDM seat vulcanized in the body, 304 stainless steel shaft assembled and tested with an Auma, 115 VAC, 60 hertz, single phase open/close service electric actuator. Valve actuator includes compartment heater.

6 10" Decanter Orifice Plate(s) to restrict the decant flow rate to plus or minus 10%:

- 304 stainless steel orifice plate.

1 Decanter assembly(ies) for SBR #4 consisting of:

- 8x7 Aqua-Aerobics decanter(s) with fiberglass float, 304 stainless steel weir, galvanized restrained mooring frame, and painted steel power section with #14-10 conductor power cable wired into a NEMA 4X stainless steel junction box with terminal strips for the single phase, 60 hertz actuator and limit switches.
- Aluminum band clamp heater integral to the decanter power section(s).
- Decant pipe(s) with integral elbow, 304L stainless steel.
- 14 inch gasket kit(s).
- 14 inch diameter stainless steel flanged flexible joints.
- Stainless steel anchors.
- 4" schedule 40 galvanized restrained mooring post(s) with base plate.
- Galvanized steel dewatering support posts.
- 14 inch Milliken Fig. 511A AWWA C-504 Class 150B electrically operated butterfly valve(s) with ANSI Class 125# flanged end ASTM A-536 ductile iron body, ductile iron disk with a 316 stainless steel edge, fully lined EPDM seat vulcanized in the body, 304 stainless steel shaft assembled and tested with an Auma, 115 VAC, 60 hertz, single phase open/close service electric actuator. Valve actuator includes compartment heater.

1 14" Decanter Orifice Plate to restrict the decant flow rate to plus or minus 10%:

- 304 stainless steel orifice plate.

Transfer Pumps/Valves**1 Submersible pump assembly(ies) consisting of the following items:**



- Flygt Model NP-3085, 3 HP, 3 phase, 60 cycle submersible pump(s) with painted cast iron pump housing, discharge elbow and multi-conductor electrical cable.
- 3 inch diameter Milliken 601 manual millcentric plug valve(s) with cast iron body, epoxy seat, flanged end style, EPDM coated ductile iron plug, stainless steel bearings, and manual operator.
- 3 inch diameter Nibco F-918-B check valve(s) with cast iron body with bronze disk.
- Galvanized guide bar(s).
- Stainless steel lifting chain(s).
- Stainless steel upper guide bar bracket(s).

Retrievable Fine Bubble Diffusers

12 Retrievable Fine Bubble Diffuser Assembly(ies) consisting of:

- 25 diffuser tubes consisting of two flexible EPDM porous membrane sheaths mounted on a rigid support pipe with 304 stainless steel band clamps.
- 304 stainless steel manifold weldment.
- 304 stainless steel leveling angles.
- 304 stainless steel leveling studs.
- Galvanized vertical support beam.
- Galvanized vertical air column assembly.
- Galvanized upper vertical beam and pulley assembly.
- Galvanized top support bracket.
- 3" EPDM flexible air line with stainless steel quick disconnect end fittings.
- Galvanized threaded flange.
- 3" manual isolation butterfly valve with cast iron body, EPDM seat, aluminum bronze disk and one-piece stainless steel shaft.
- Ny-glass quick disconnect cam lock adapter.
- 304 stainless steel adhesive anchors.
- Galvanized steel brace angles.

Positive Displacement Blowers

3 Positive displacement Blower Package(s), with each package consisting of:

- Aerzen Rotary Positive Displacement Blower(s) with 50HP, 460 volt, three phase, 60 hertz motor will be provided by Aqua. Each blower will include base frame with integrated type silencer, V-belt drive, and guard. Blower accessories provided by Aqua will include intake filter-silencer with maintenance indicator, pressure relief valve, check valve, pressure gauge, and rubber expansion joint. Electrical wiring, junction box/disconnect, air manifolds, gaskets, and hardware to be supplied by the installing contractor.
- Acoustic hood made of galvanized steel with oil drip pan and powder coated finish.
- 6" wafer style butterfly valve(s) with lever operator as manufacturer by Nibco or equal.
- Stainless steel anchors.

Level Sensor Assemblies

3 Pressure Transducer Assembly(ies) each consisting of:

- Pressure transducer(s).
- 304 stainless steel mounting bracket weldment(s).
- 304 stainless steel transducer mounting pipe weldment(s).
- Stainless steel anchors.

3 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- 316 stainless steel float switch mounting bracket(s).
- Stainless steel anchors.

3 Junction Box(es) for Level Controls consisting of:

- NEMA 4X 304 stainless steel junction box(es).

Instrumentation

3 Dissolved Oxygen Assembly(ies) consisting of:

- Hach LDO dissolved oxygen sensing probe. Sensor constructed of stainless steel. Probe includes electric cable.
- 304 stainless steel mounting bracket weldment(s).
- 304 stainless steel transducer mounting pipe weldment(s).
- Stainless steel anchors.

3 Process Controller(s) consisting of:

- Hach SC4500 controller and display module(s).
- Sun shield(s).

1 P.C. Based Control and Monitoring System will be provided as follows:

- Dell OptiPlex Tower 7090, Intel Core i7-10700 (8C, 10MB), 32GB 2400MHz DDR4 RDIMM ECC memory, 512GB Hard Drives, 1TB SATA Backup Hard Drive, Integrated Graphics Card, Integrated NIC, USB Laser mouse, USB Keyboard, 63 month ProSupport 7x24, 24" Dell Monitor.
- Microsoft Windows 10 Operating System
- Malware/Antivirus software
- Wonderware SCADA PC Software consisting of: Development/Runtime software, AquaSBR System Monitor, Communication driver, proprietary control graphic screens consisting of System graphic monitor, Event Log/Alarm, and Timer display and adjustment screens.
- Two (2) cable ends will be provided for installation by the purchaser onto the PC's serial communication cable provided by the purchaser.
- RS Logix 5000 Lite Edition software.

Misc/Spare Parts

1 Set(s), Spare Parts will be provided as follows:

- (1) Decanter linear actuator.
- (1) Decanter linear actuator capacitor.
- Limit switch(es).
- (1) Limit switch arm.
- Input card(s)
- Output card(s).
- Analog input card(s).
- Analog output card(s).
- Corrosion inhibitor(s).
- Uninterrupted power supply.
- Power supply(s).
- Power supply(s).
- Control relay(s).
- ATC time delay relay(s).
- Selector switch(es).
- Pilot light(s).
- Pushbutton(s).
- Variable input NEMA 4X process meter, Precision Digital #PD690-3-17



AquaSBR: Post-Equalization

Transfer Pumps/Valves

3 Submersible pump assembly(ies) consisting of the following items:

- Flygt Model NP-3127, 10 HP, 3 phase, 60 cycle submersible pump(s) with painted cast iron pump housing, discharge elbow and multi-conductor electrical cable.
- 6 inch diameter Milliken 601 manual eccentric plug valve(s) with cast iron body, welded nickel seat, flanged end style, EPDM coated ductile iron plug, stainless steel bearings, and manual operator.
- 6 inch diameter Nibco F-918-B check valve(s) with cast iron body with bronze disk.
- Galvanized guide bar(s).
- Stainless steel anchors.
- Stainless steel lifting chain(s).
- Stainless steel upper guide bar bracket(s).

Level Sensor Assemblies

1 Sensor installation(s) consisting of:

- Pressure transducer(s).
- Stainless steel sensor guide rail weldment(s).
- PVC sensor mounting pipe(s).
- 1 1/2" Flexible hose.
- Top support(s).
- Stainless steel anchor kit(s).

1 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- 316 stainless steel float switch mounting bracket(s).
- Stainless steel anchors.

1 Junction Box(es) for Level Controls consisting of:

- NEMA 4X 304 stainless steel junction box(es).

Controls

Controls wo/Starters

1 Controls Package(s) will be provided as follows:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Pushbutton(s).
- Variable input NEMA 4X process meter, Precision Digital #PD690-3-17
- Uninterrupted power supply.
- Surge arrester(s).
- Fuse(s) and fuse block(s).
- CompactLogix PLC.
- Input card(s)
- Output card(s).
- Analog input card(s).
- Analog output card(s).
- Power supply(s).
- A/B PanelView Plus HMI



- Fiber optic patch panel(s).
- Control relay(s).
- Ethernet / Fiber Optic switch(es).
- Power supply(s).
- 115 V power line filter(s).
- Selector switch(es).
- Pilot light(s).
- GFI convenience outlet(s).
- Remote access Ethernet modem(s).
- Panel will be UL listed and labeled.

2 Remote I/O Panel(s) consisting of:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Uninterrupted power supply.
- Surge arrester(s).
- Isolation circuit breaker(s).
- CompactLogix remote I/O module(s).
- End cap(s).
- Power supply(s).
- Input card(s).
- Output card(s).
- Analog input card(s).
- Analog output card(s).
- Ethernet / Fiber Optic switch(es).
- 115 V power line filter(s).
- Selector switch(es).
- Pilot light(s).
- Control relay(s).
- GFI convenience outlet(s).
- Panel will be UL listed and labeled.

1 Remote I/O Panel(s) consisting of:

- NEMA 4X 304 stainless steel enclosure.
- Uninterrupted power supply.
- Surge arrester(s).
- Air conditioner(s).
- Isolation circuit breaker(s).
- CompactLogix remote I/O module(s).
- End cap(s).
- Power supply(s).
- Input card(s).
- Output card(s).
- Analog input card(s).
- Analog output card(s).
- Ethernet switch(es).
- 115 V power line filter(s).
- Selector switch(es).
- Pilot light(s).
- Control relay(s).
- GFI convenience outlet(s).
- Panel will be UL listed and labeled.



Engineering: AquaSBR

Engineering

1 Set(s) Documentation will be provided as described:

- Operation & Maintenance Manuals (English language) in electronic format.

1 Set(s) Documentation will be provided as described:

- Engineer's Approval Data (English language) in electronic format.

Supervision/Freight

Supervision/Freight Domestic

1 Supervision Services and Freight Package(s) will be provided as follows:

- 4 Day(s) On Site for INSTALLATION SUPERVISION
- 1 Trip(s) for INSTALLATION SUPERVISION
- 4 Day(s) On Site for MECHANICAL SUPERVISION
- 1 Trip(s) for MECHANICAL SUPERVISION
- 4 Day(s) On Site for ELECTRICAL SUPERVISION
- 1 Trip(s) for ELECTRICAL SUPERVISION
- 2 Day(s) On Site for PROCESS SUPERVISION
- 1 Trip(s) for PROCESS SUPERVISION
- FREIGHT TO JOBSITE

Cloth Media Filters

AquaDisk Tanks/Basins

4 Maintenance Platform

- Internal filter platform consisting of; stainless steel frame with fiberglass grating.

2 AquaDisk model # ADFC-54x4I-PC concrete filter basin accessories consisting of:

- Concrete basin (by others).
- Overall footprint will be dependent on influent, effluent, and overflow chamber configurations.
- 304 stainless steel centertube support beam wall brackets.
- 304 stainless steel backwash manifold wall brackets.
- 304 stainless steel effluent seal plate weldment(s).
- 304 stainless steel anchors.
- 6 inch diameter Milliken manual eccentric plug valve(s) with cast iron body, mechanical joint end style, neoprene resilient plug facing, and stainless steel extension with square nut.

2 Influent Flow Assembly(ies) consisting of:

- 304 stainless steel level weir / flow separation baffle(s).
- 304 stainless steel weir and separation baffle stiffening angle(s).
- 304 stainless steel anchors.

AquaDisk Centertube Assemblies

2 Centertube Assembly(ies) consisting of:

- 304 stainless steel centertube weldment(s).



- U.H.M.W. polyethylene multi-segment driven sprocket(s).
- Dual wheel carrier assembly(ies).
- Single wheel rider assembly(ies).
- Centertube end support bearing kit(s).
- Viton V-ring effluent port\centertube seal(s).
- Disk segment 304 stainless steel support rods.
- Media sealing gaskets.
- Pile cloth media and non-corrosive support frame assemblies.

2 Cloth set(s) will have the following feature:

- Cloth will be OptiFiber PES-14.

AquaDisk Drive Assemblies**2 Drive System Assembly(ies) consisting of:**

- Gearbox(es) with three phase 1/2 HP drive motor(s).
- Acetal drive chain(s) with 304 stainless steel link pins.
- Chain guard weldment(s).
- Warning label(s).
- Adjustable drive bracket weldment(s).
- Stationary drive bracket weldment(s).
- Nylon drive sprocket(s).

AquaDisk Backwash/Sludge Assemblies**2 Backwash/Sludge Pump Assemblies consisting of:**

- Hidrostal model # A2QS2, 2.9 HP, three phase submersible pumps.
- Nibco bronze swing check valve(s).
- 304 stainless steel combination nipple(s).
- 304 stainless steel quick coupling(s).

2 Backwash Discharge System Assembly(ies) consisting of:

- 304 SS backwash and sludge discharge manifold(s).
- Backwash discharge hose assemblies.
- Anti-siphon vacuum breaker(s).
- 3" threaded brass ball valve(s).

2 Backwash System Suction Assembly(ies) consisting of:

- 304 stainless steel backwash nozzles.
- Backwash suction hose assemblies.
- 304 stainless steel quick couplings.
- 304 stainless steel threaded flanges.
- Stainless steel backwash nozzle springs.
- PVC sludge collection manifold assembly(ies).
- Nylon combination nipple(s).
- Stainless steel hose clamps.
- 304 stainless steel backwash collection manifold(s).

2 Backwash Support Assembly(ies) consisting of:

- 304 stainless steel backwash support weldment(s).

AquaDisk Instrumentation**2 Pressure Transducer Assembly(ies) consisting of:**

- Pressure transducer(s).
- 304 stainless steel probe mounting bracket(s).



- Float switch(es).

AquaDisk Valves

2 Influent Valve(s) consisting of:

- 10 inch Milliken 511A-AG AWWA C-504 Class 150B manual butterfly valve(s) with ANSI Class 125# flanged end ASTM A-536 ductile iron body, ductile iron disk with a 316 stainless steel edge, fully lined EPDM seat vulcanized in the body, and 304 stainless steel shaft with gear operator.

AquaDisk Controls w/Starters

1 Control Panel(s) consisting of:

- NEMA 4X 304 stainless steel enclosure.
- Air conditioner(s).
- Operator interface sun shield(s).
- Uninterrupted power supply.
- Surge arrester(s).
- Corrosion inhibitor(s).
- Circuit breaker with handle.
- 2 KVA Transformer(s).
- Fuses and fuse blocks.
- Single phase circuit breaker(s).
- Line filter(s).
- GFI convenience outlet(s).
- Control relay(s).
- Selector switch(es).
- Indicating pilot light(s).
- Compactlogix Processor.
- Power supply(s).
- Input card(s)
- Output card(s).
- Analog input card(s).
- Ethernet switch(es).
- Power supply(ies).
- PanelView Plus 7 7" color touch screen display(s).
- Operator interface sun shield(s).
- Motor starter(s).
- Terminal blocks.
- UL label(s).

AquaDisk Engineering

1 Set(s) Documentation for the AquaDisk will be provided as described:

- Engineer's Approval Data (English language) in electronic format.

1 Set(s) Documentation for the AquaDisk will be provided as described:

- Operation & Maintenance Manuals (English language) in electronic format.

AquaDisk Supervision/Freight Domestic

1 Supervision Services and Freight Package(s) for the AquaDisk will be provided as follows:

- 4 Day(s) On Site for INSTALLATION SUPERVISION
- 1 Trip(s) for INSTALLATION SUPERVISION
- 3 Day(s) On Site for MECHANICAL SUPERVISION
- 1 Trip(s) for MECHANICAL SUPERVISION

- FREIGHT TO JOBSITE

The Following General Notes apply to Aqua-Aerobic Systems' Proposal:

- **SCHEDULE:** We expect submittals to be completed and in transit to you within 8-10* weeks after receipt of order with acceptable terms and conditions and guarantee of payment. We expect receipt of approved engineer's submittal with release for manufacture within 4-8 weeks of our transmittal of submittal data. We expect shipment of equipment (transit time excluded) to be approximately 16-22* weeks (or control panel lead times, whichever is more) from our receipt of approved engineer's submittal data and release for manufacture. Schedules may be adjusted at time of order placement, depending upon existing order backlog. *Weeks quoted are actual working weeks.
- We expect shipment of control panels (transit time excluded) to be approximately 24-30 weeks* from our receipt of approved engineer's submittal data and release for manufacture. The extended delivery on control panels is based on unprecedented supply chain delays associated with the COVID-19 pandemic. Schedules will be updated as new information becomes available.
- Schedule changes due to supply chain disruption may impact the above quoted times. Aqua-Aerobic Systems will advise if/when any such disruption applies.
- Aqua-Aerobic Systems will be closed for the Christmas Holidays beginning approximately December 24, through approximately January 2nd.
- **PRICE ESCALATION INDEX:** Aqua-Aerobic Systems, Inc. reserves the right to re-evaluate the pricing quoted prior to order acceptance if; 1) a purchase order is received after the validity date stated in this proposal or, 2) the lead times stated in this proposal are exceeded. Any pricing adjustments required shall be based on a published materials cost index specific to the materials proposed.
- **CONTROLS NON-DISCLOSURE / CONFIDENTIALITY AGREEMENT:** If applicable, Aqua-Aerobic Systems will provide information relating to software documentation to control the treatment system supplied using Aqua-Aerobic Systems' proprietary and/or trade secret information subject to execution of an Aqua-Aerobic "Controls Non-Disclosure / Confidentiality Agreement".
- Additional supervision services can be provided for an additional charge of \$1750/day plus travel and living expenses.

The Following Mechanical and/or Electrical Notes apply to Aqua-Aerobic Systems' Proposal:

- Individual blowers are sized with a free air intake. Blowers attached to a common intake manifold or provided with inlet extensions must be evaluated for possible additional pressure and horsepower requirements. Blowers positioned inside a building must be provided with adequate louvered free air intake to prevent negative pressures which may cause poor performance and overheating.
- Blower discharge manifold and piping losses are assumed at 0.3 PSI for coarse bubble and 0.5 PSI for fine bubble from the blower termination flange to the diffuser assembly termination flange. Engineer to verify actual piping losses do not exceed the above. Inlet losses are assumed at 0.25 PSI for inlet silencer and a clean filter. No inlet losses have been assumed for inlet filter piping, and it is assumed that the filter is located on each blower package.
- Valve and line sizes are to be verified by the engineer based on actual line losses.
- Electrical cables provided by Aqua-Aerobic Systems, as stated in our proposal, will terminate at the basin wall at the termination point as shown on the drawings or (if undefined) at the point nearest the powered equipment.
- Three phase motors will be 460 volt.
- Single phase motors will be 115 volt.
- Pumps and valves ship loose, unless otherwise specified.
- Filter flow hydraulics and plant's capability to handle the intermittent backwash flow is to be confirmed by the purchaser/purchaser's consulting engineer.

The Following Scope Exclusion Notes apply to Aqua-Aerobic Systems' Proposal:

- Materials and Services not specifically described/itemized in this proposal are not included in the quoted total price, and are to be supplied by the installing contractor/purchaser.

- Freeze protection may be required for outdoor installation in cold weather climates. All such protection, including but not limited to, heat tracing and insulation of pumps and piping, as well as protection against internal tank freezing, shall be provided and installed by the installing contractor.
- If steel tanks are utilized, field welding/attachment of equipment and/or components to the steel tank is the responsibility of the installing contractor/purchaser. Tank bosses, if applicable, are to be provided by the installing contractor/purchaser.
- If basins with sloped floors are utilized, supply of minimum 4000 psi type grout pads beneath the proposed equipment (such as base plates, brackets, mooring posts, diffuser supports/racks, etc.) are required to provide for a level installation elevation for the equipment. Grout pads are not included in Aqua-Aerobics' scope of supply or price, and are to be provided by the installing contractor/purchaser.
- Equipment vault(s) must be supplied with drain and/or sump.

SCOPE BY PURCHASER/CONTRACTOR:

*Note this is not intended as a complete listing and is provided as a courtesy.

- Unloading and storage.
- Provisions for equipment access.
- Concrete, handrail and all civil works.
- All air and process piping, spool pieces, supports, gaskets and hardware beyond Aqua-Aerobic's equipment terminations.
- Interconnecting piping, wiring and installation.
- All flanges and/or unions in the piping to service the equipment.
- Motor starters and MCC (Motor Control Center).
- Electrical conduit, hardware, supports, attachment of cables, wiring and j-boxes (if any) between motors, electrical valves, instruments and the control panel.
- Installation/field wiring of the control panel(s) that ship loose.
- Electrical wiring and supply power.
- Concrete, volumes as required, to fill mooring posts.

The Following Commercial Notes apply to Aqua-Aerobic Systems' Proposal:

- The following Exceptions/Clarifications are an integral part of this proposal:

- Peak hourly flow in Section 46 53 53 is discrepant from Section 46 61 41. Please clarify if the PHF is 4.08 MGD or 4.00 MGD. Note that either works without issue, but the intent is to show the same peak flow on future shop drawings.
- A specification section have been referenced, but not provided for review. It is assumed that this section does not affect the Aqua-Aerobic Systems scope of supply: 46 66 56.
- Per the direction of David Gaulker from CEC, LCP-D and LCP-E do not exist in the scope of this project and therefore are not included in the Aqua-Aerobic Systems scope of supply.
- Per David Gualker, the existing Main SBR control panel will be removed and replaced entirely by a new main SBR control panel. Aqua Aerobic Systems' scope of supply for this panel matches the intent as described in the contract drawings and not the description in SBR spec section 46 53 53. This control panel is assumed to be inside a climate controlled building.
- Aqua-Aerobic Systems' scope of supply for the main SBR control panel meets the general requirements given in Section 25 00 20 with the intent of matching the LCP panels A and B for indoor use.

- F.O.B. JOBSITE; TITLE AND RISK OF LOSS: All prices and all shipments of goods are F.O.B. Jobsite City Location. It is the responsibility of the Buyer to unload shipments and utilizing the packing list and bill of lading provided with the shipment notate shortages/damages upon receipt of the shipments and notify Aqua-Aerobic Systems in writing within 7 days of the shortages/damages to facilitate filing of a freight claim. Delivery of the goods sold hereunder by the carrier shall be deemed delivered to Buyer, and upon such delivery, title to such goods and risk of loss or damage shall be upon Buyer.

- TAXES: State and/or local taxes are not included in the price but will be charged unless we receive a valid sales exemption certificate, direct pay permit, or other documentation required specifically by the taxing entity

prior to shipment.

- **PAYMENT TERMS:** Subject to credit approval and guarantee of payment, we request the following progress payments due Net 45 days from invoice issued for the designated event:

25% of total purchase price at order execution.

25% of total purchase price at our receipt of approved engineer's submittal data or Net 45 from transmittal of submittals.

40% of total purchase price at shipment of goods.

10 % of total purchase price at Owner Acceptance following Start-up or 6 months from shipment whichever occurs first.

- **SCOPE OF SUPPLY NOTE:** Aqua-Aerobic Systems' scope of supply (and pricing) is as described in this proposal, including the listed Integral Documents and the terms and conditions of sale. Please refer to the proposal notes and notated drawings for equipment terminations and items not included in the proposal which are to be provided by the Buyer. Engineer's submittal data will be prepared using these proposed goods and services, and the submittal approved by the Consulting Engineer will become an integral part of the scope of supply under the contract resulting from this offer. Any additions or deletions to the scope of supply will be presented as change orders.

- **TRADEMARKS:** Aqua-Jet® Surface Mechanical Aerator, Aqua-Jet II® Contained Flow Aerator, AquaDDM® Direct-drive Mixer, TurboStar® Directional Mixer, ThermoFlo® Surface Spray Cooler, Endura® Series Limited Maintenance Product, OxyMix® Pure Oxygen Mixer, OxyStar® Aspirating Aerator, TurboSta® Directional Mixer, Fold-a-Float® Self-deploying Segmented Float, SAF-T Float® Safe Accessible Float Technology, Aqua MixAir® Aeration System, AquaCAM-D® Combination Aerator/Mixer/Decanter, AquaSBR® Sequencing Batch Reactor, Aqua MSBR® Modified Sequencing Batch Reactor, AquaPASS® Phased Activated Sludge System, Aqua BioMax® Dual Treatment System, AquaEnsure® Ballast Decanter, Aqua EnduraTube® Fine-bubble Tube Diffuser, Aqua EnduraDisc® Fine-bubble Disk Diffuser, Aqua CB-24® Coarse-bubble Diffuser, AquaDisk® Cloth Media Filter, AquaDiamond® Cloth Media Filter, AquaDrum® Cloth Media Filter, Aqua MiniDisk® Cloth Media Filter, Aqua MegaDisk® Cloth Media Filter, AquaPrime® Cloth Media Filter, AquaStorm® Cloth Media Filter, OptiComb® Backwash System, OptiFiber® Cloth Filtration Media, OptiFiber PES-13® Cloth Filtration Media, OptiFiber PA2-13® Cloth Filtration Media, OptiFiber PES-14® Cloth Filtration Media, OptiFiber PF-14® Cloth Filtration Media, OptiFiber UFS-9® Cloth Filtration Media, Trust the Tag® OptiFiber® Service Mark, AquaABF® Automatic Backwash Filter, AquaMB® Multiple Barrier Membrane System, Aqua-Aerobic® MBR Membrane Bioreactor System, Aqua MultiBore® Membranes, Aqua Multibore® C-Series Ceramic Membranes, Aqua Multibore® P-Series Polymeric Membranes, Aqua ElectrOzone® Ozone Generation System, IntelliPro® Monitoring and Control System, AquaPRS™ PFAS Removal System, AquaPR-206™ PFAS Removal System, Aqua-Aerobic®, and the Aqua-Aerobic Corporate logo artwork are registered trademarks or pending trademarks of Aqua-Aerobic Systems, Inc. Nereda®, AquaNereda® Aerobic Granular Sludge Technology, and the AquaNereda Product logo artwork are a registered trademark of Royal HaskoningDHV. All other products and services mentioned are trademarks of their respective owners.

GOODS QUOTED ABOVE WILL BE SOLD SUBJECT ONLY TO THE TERMS AND CONDITIONS OF SALE SET FORTH HEREIN. ANY DIFFERENT OR ADDITIONAL TERMS ARE HEREBY OBJECTED TO.

Total Price: \$2,231,190.00

**TERMS AND CONDITIONS OF AQUA-AEROBIC SYSTEMS, INC. (A Metawater Company)****Page 1 of 2**

This offer and all of the goods and sales of Aqua-Aerobic Systems, Inc. are subject only to the following terms and conditions. The acceptance of any order resulting from this proposal is based on the express condition that the Buyer agrees to all the terms and conditions herein contained. Any terms and conditions in any order, which are in addition to or inconsistent with the following, shall not be binding upon Aqua-Aerobic Systems, Inc. This proposal and any contract resulting therefrom, shall be governed by and construed in accordance with the laws of the State of Illinois, without regard to conflicts of laws principles. Resale of any products purchased from - Aqua-Aerobic Systems, Inc. is not permitted without prior written agreement with Aqua-Aerobic Systems, Inc. expressly consenting to such resale. Any party who sells a product purchased from Aqua-Aerobic Systems, Inc. is subject to the terms and conditions included herein.

DURATION OF QUOTATION

This proposal of Aqua-Aerobic Systems, Inc. shall in no event be effective more than 30 days from date thereof, unless specifically stated otherwise, and is subject to change at any time prior to acceptance.

PROPRIETARY INFORMATION

This proposal, including all descriptive data, drawings, material, information and know-how disclosed by Aqua-Aerobic Systems, Inc. to Buyer in relation hereto is confidential information intended solely for the confidential use of Buyer, shall remain the property of Aqua-Aerobic Systems, Inc. and shall not be disclosed or otherwise used to the disadvantage or detriment of Aqua-Aerobic Systems, Inc. in any manner.

PAYMENT TERMS; ORDERS;

Unless specifically stated otherwise, quoted terms are Net 30 Days from invoice date. Past-due charges are 1.5% per month and will apply only on any past-due balance. Aqua-Aerobic Systems, Inc. does not allow retainage of any invoice amount, unless authorized in writing by an authorized representative of our Loves Park, Illinois office. Terms of payment are within Aqua-Aerobic Systems, Inc.'s sole discretion, and unless otherwise agreed to by Aqua-Aerobic Systems, Inc. payment terms must be accepted by Aqua-Aerobic Systems, Inc. prior to Aqua-Aerobic Systems' acceptance of an order. Payment for the products must be made by approved credit card, check, wire transfer, or some other prearranged payment method unless credit terms have been agreed to by Aqua-Aerobic Systems, Inc. Invoices are due and payable within the time period noted on the invoice, measured from the date of the invoice. Orders are not binding until accepted by Aqua-Aerobic Systems, Inc.

SECURITY

If at any time the financial responsibility of the Buyer becomes unsatisfactory to Aqua-Aerobic Systems, Inc., or Aqua-Aerobic Systems, Inc. otherwise deems itself insecure as to receipt of full payment of the purchase price from Buyer hereunder, Aqua-Aerobic Systems, Inc. reserves the right to require payment in advance or security or guarantee satisfactory to Aqua-Aerobic Systems, Inc. of payment in full of the purchase price.

SHIPMENT

Shipping dates are not a guarantee of a particular day of shipment and are approximate, being based upon present production information, and are subject to change per the production schedules existing at time of receipt of purchase order. Aqua-Aerobic Systems, Inc. shall not be responsible for any delay in shipment for causes beyond its control including, but not limited to, war, riots, strikes, labor trouble causing interruption of work, fires, other casualties, transportation delays, modification of order, any act of governmental authorities or acts of God. Quoted shipment dates in this proposal are approximate dates goods will be shipped and, unless agreed to in writing by Aqua-Aerobic Systems, Inc., Buyer may not postpone or delay the dates of shipment of goods from our plant or from our supplier's plants beyond the dates set forth in this proposal. Buyer is required to notify Aqua-Aerobic Systems, Inc. within 7-days of any discrepancies with shipment.

SHIPPING CHARGES; TAXES and OTHER RELATED FEES. Separate fees for shipping and handling will be charged on all purchases unless specifically stated otherwise. Prices quoted do not include any taxes, customs duties, or import fees. The Buyer is responsible for sales use and all other taxes and fees associated with the purchase. If Aqua-Aerobic Systems, Inc. is required by any taxing authority to collect or to pay any such tax, duty or fee, the Buyer shall be separately billed at such time for the amounts Aqua-Aerobic Systems, Inc. is required to pay

TITLE AND RISK OF LOSS

F.O.B. Destination - Delivery of goods to the destination shall be deemed delivery to the Buyer, and upon such delivery, title to such goods and risk of loss or damage shall be upon Buyer.

F.O.B. Aqua-Aerobic Systems, Inc's plant at Loves Park, Illinois - Delivery of the goods sold hereunder to the carrier shall be deemed delivery to the Buyer, and upon such delivery, title to such goods and risk of loss or damage shall be upon Buyer.

INSURANCE

Unless the goods are sold on a CIF basis, the Buyer shall provide marine insurance for all risks, including war and general coverage. Aqua-Aerobic Systems, Inc. will provide evidence of coverage upon request. At no time will Aqua-Aerobic Systems, Inc. issue a certificate of insurance listing Buyer as additional insured unless under fully executed contract and Aqua-Aerobic Systems, Inc. is providing start-up services.

LIMITATION OF ACTION

No action shall be brought against Aqua-Aerobic Systems, Inc. for any breach of its contract of sale more than two years after the accrual of the cause of action thereof, and, in no event, unless the Buyer shall first have given written notice to Aqua-Aerobic Systems, Inc., of any claim of breach of contract within 30 days after the discovery thereof.

CANCELLATION CLAUSE

No acceptance of this proposal, by purchase order or otherwise, may be modified except by written consent of Aqua-Aerobic Systems, Inc. nor may it be canceled except by prior payment to Aqua-Aerobic Systems, Inc. the following sums as liquidated damages therefore: 1) If cancellation is prior to commencement of production and prior to the assumption of any obligations by Aqua-Aerobic Systems, Inc. for any materials or component parts, a sum equal to 15% of the total purchase price; 2) If cancellation is after the commencement of production or after the assumption of any obligations by Aqua-Aerobic Systems, Inc. for any materials or component parts, a sum equal to the total of the direct, out-of-pocket expenses incurred to the date of cancellation for labor, machine time, materials and any charges made to us by suppliers for cancellation, plus 30% of the total purchase price. All charges and expenses shall be as determined by Aqua-Aerobic Systems, Inc. In the event any items are used by Aqua-Aerobic Systems, Inc. to fill a subsequent order, then upon receipt of payment for such order, Aqua-Aerobic Systems, Inc. shall pay the Buyer a sum equal to the direct out-of-pocket expenses previously charged and received from Buyer.



TERMS AND CONDITIONS OF AQUA-AEROBIC SYSTEMS, INC. (A Metawater Company)

Page 2 of 2

QUALIFIED ACCEPTANCE AND INDEMNITY

In the event the acceptance of this proposal by Buyer either is contingent upon or subject to the approval by any third party such as, but not limited to, a consulting engineer, with respect to goods, parts, materials, descriptive data, drawings, calculations, or any other matter, then upon such approval by any third party, Aqua-Aerobic Systems, Inc. shall have no liability to Buyer or to any third party so long as the goods sold and delivered by Aqua-Aerobic Systems, Inc. conform to this proposal. In the event any such third party requires modifications in the proposal prior to the approval thereof, Aqua-Aerobic Systems, Inc. may at its sole option and without liability to any party elect to cancel this proposal or return the purchase order to Buyer. In the event Aqua-Aerobic Systems, Inc. elects to modify this proposal to conform to the requirements for approval by any third party, Aqua-Aerobic Systems, Inc. in such event shall have no liability to Buyer or to any third party so long as the goods sold and delivered by Aqua-Aerobic Systems, Inc. conform to this proposal as modified.

Buyer agrees to indemnify and save harmless Aqua-Aerobic Systems, Inc. from and against all costs and expenses and liability of any kind whatsoever arising out of or in connection with claims by third parties so long as the goods sold hereunder conform to the requirements of this proposal as approved by any third party.

WARRANTY; LIMITATION OF LIABILITY; AND DISCLAIMER

In return for purchase and full payment for Aqua-Aerobic Systems, Inc. goods, we warrant new goods provided by us to be free from defects in materials and workmanship under normal conditions and use for a period of one year from the date the goods are put into service, or eighteen months from date of shipment (whichever first occurs). If the goods include an "Endura Series" motor, the complete Endura Series unit shall be warranted by Aqua-Aerobic Systems, Inc. to be free from defects in materials and workmanship under normal conditions and use for three years from the date the product is put into service or 42 months from the date of shipment (whichever occurs first).

OUR OBLIGATION UNDER THIS WARRANTY IS EXPRESSLY AND EXCLUSIVELY LIMITED to replacing or repairing (at our factory at Loves Park, Illinois) any part or parts returned to our factory with transportation charges prepaid, and which our examination shall show to have been defective. Prior to return of any goods or its parts to our factory, Buyer shall notify Aqua-Aerobic Systems, Inc. of claimed defect, and Aqua-Aerobic Systems, Inc. shall have the privilege of examining the goods at Buyer's place of business or where the goods have otherwise been placed in service. In the event this examination discloses no defect, Buyer shall have no authority to return the goods or parts to our factory for the further examination or repair. All goods or parts shall be returned to Buyer, F.O.B. Loves Park, Illinois. This warranty shall not apply to any goods or part which has been repaired or altered outside our factory, or applied, operated or installed contrary to our instruction, or subjected to misuse, chemical attack/degradation, negligence or accident. This warranty and any warranty and guaranty of process or performance shall no longer be applicable or valid if any product, including any software program, supplied by Aqua-Aerobic Systems, Inc., is modified or altered without the written approval of Aqua-Aerobic Systems, Inc. Our warranty on accessories and component parts not manufactured by us is expressly limited to that of the manufacturer thereof.

THE FOREGOING WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND OF ALL OTHER LIABILITIES AND OBLIGATIONS ON OUR PART, INCLUDING ANY LIABILITY FOR NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE; AND ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE IS EXPRESSLY DISCLAIMED; AND WE EXPRESSLY DENY THE RIGHT OF ANY OTHER PERSON TO INCUR OR ASSUME FOR US ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF ANY GOODS PROVIDED BY US. THERE ARE NO WARRANTIES OR GUARANTEES OF PERFORMANCE UNLESS SPECIFICALLY STATED OTHERWISE.

UNDER NO CIRCUMSTANCES, INCLUDING ANY CLAIM OF NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE, SHALL AQUA-AEROBIC SYSTEMS, INC. BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, COSTS OF CONNECTING, DISCONNECTING, OR ANY LOSS OR DAMAGE RESULTING FROM A DEFECT IN THE GOODS. LIMIT OF LIABILITY: AQUA-AEROBIC SYSTEMS, INC.'S TOTAL LIABILITY UNDER THE ABOVE WARRANTY IS LIMITED TO THE REPAIR OR REPLACEMENT OF ANY DEFECTIVE PART. THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE, AND OUR LIABILITY WITH RESPECT TO ANY CONTRACT OR SALE, OR ANYTHING DONE IN CONNECTION THEREWITH, WHETHER IN CONTRACT, IN TORT, UNDER ANY WARRANTY, OR OTHERWISE, SHALL NOT, IN ANY CASE, EXCEED THE PRICE OF THE GOODS UPON WHICH SUCH LIABILITY IS BASED.

Final acceptance of this proposal must be given to Aqua-Aerobic Systems, Inc. at their office in Loves Park, Illinois. Please acknowledge acceptance by signing the proposal and returning it to Aqua-Aerobic Systems, Inc.

Accepted by:

Company: _____

By: _____ Date: _____

Offer Respectfully Submitted,

Harry DeBruler, Project Application Engineer
Aqua-Aerobic Systems, Inc.

APPENDIX B

Trojan UV Proposal



SCOPE OF SUPPLY FOR HALLS COUNTY - SPOUT SPRINGS WATER RECLAMATION FACILITY

ULTRAVIOLET DISINFECTION EQUIPMENT – TROJAN SYSTEM UV3000Plus™

Prepared for: All bidding General Contractors

Project Name: Halls County - Spout Springs WRF Expansion to 1.6 MGD

Consulting Engineer: Civil Engineering Consultants, Inc.

Specification Section: 46 66 56

Trojan Quote: 239085 (June 25, 2024)

<u>Design Criteria:</u>	Current Peak Design Flow:	2.71 MGD
	UV Transmission:	65% minimum
	Total Suspended Solids:	5 mg/L (Maximum, grab sample)
	Minimum Dose:	35 mJ/cm ² MS2 RED
	Discharge Limit:	23 Fecal Coliform / 100 mL (30 Day Geometric Mean)
	Redundancy:	One (1) Redundant and two (2) Duty UV banks

We are pleased to submit the following scope of equipment based on the above criteria.

The purchaser is responsible for reading all information contained in this Supply Contract. Trojan will not be held accountable for the supply of equipment not specifically detailed in this document. Supplemental Terms and Conditions are attached to this document. Detailed installation instructions are provided with the shop drawings and are available earlier upon request. Changes to this Scope of Supply that affect selling price will be handled through a change order.

Please refer all inquiries to Trojan Manufacturer's Representative:

	Jon Baker
	Templeton & Associates
Phone:	770-614-8550

This proposal has been respectfully submitted by,
Trojan Technologies

Michael Shortt
Regional Manager
Trojan Technologies

GENERAL CONFIGURATION

The UV system equipment described in this Scope of Supply consists of two (2) duty and one (1) redundant UV banks for one (1) UV channel.

Unless otherwise indicated in this proposal all anchor bolts, conduit, conductors, cable trays, local disconnects and transformers (if required) are the responsibility of the CONTRACTOR and are not included in this Scope of Supply. Specific cable types listed below are for reference only. Selecting cables that are appropriate for the installation environmental conditions and in compliance with local code is the responsibility of the Installation Contractor.

ULTRAVIOLET MODULES

Trojan's Responsibility:

Each module supplied shall be completely assembled containing lamps, quartz sleeves and be electrically wired to each electronic ballast. Modules are shipped in a support rack and crated.

Model and Make:	Standard System TrojanUV3000Plus™
Quantity:	Twelve (12) UV modules each containing six (6) UV Lamps
Material of Construction:	316 stainless steel frame
Approximate Weight:	98 lbs per UV module

SYSTEM CONTROL CENTER

Trojan's Responsibility:

One (1) System Control Center (SCC) shall be supplied to monitor and control the UV System. Trojan will provide a PLC I/O and soft address map to aid the Contractor with integration of the UV PLC and WWTP SCADA system.

Note: if Trojan is required to provide a managed switch in the SCC, the Plant's IT department or System Integrator will be responsible for configuring the switch to meet the Plant's security and traffic routing requirements.

Quantity Supplied:	One (1) SCC
Location:	Pedestal Mounted
Enclosure Material/Rating:	304 Stainless Steel - Type 4X (IP66)
Controller Type:	Allen-Bradley CompactLogix 5069-L320 ER
Operator Interface:	12" Beijer HMI (Type 4X)
SCADA Protocol:	EtherNet/IP
Panel UPS:	30 Min on 24VDC
Surge Protection:	Trojan standard TVSS
Approximate Weight:	200 lbs

Installation Contractor's Responsibility:

The Installation Contractor is responsible for mounting the SCC as indicated on the drawings. The Installation Contractor is also responsible for the supply, installation and connection of the following at the SCC:

1. One (1) 120V, 60 Hz, 1 Ph, 2 Wire + GND, 1.5 kVA maximum power feed
2. One (1) 4 – 20 mA DC analog signal from plant flow meter/Ultrasonic analyzer (provided by Others)
3. One (1) Ground Link, 14 gauge (2.5mm²) minimum type TWH stranded, daisy chained to the HSC and PDCs
4. One (1) serial communication link consisting of one (1) shielded twisted pair, 18 gauge (1mm²) maximum from the HSC and PDCs (daisy chained)
5. Serial communication link to SCADA

POWER DISTRIBUTION CENTERS

Trojan's Responsibility:

The Power Distribution Center (PDC) distributes power to the UV Modules and shall consist of the following:

Quantity Supplied:	Three (3) PDCs
Enclosure Material/Rating:	304 Stainless Steel - Type 4X (IP66)
Approximate Weight:	220 lbs per PDC

Installation Contractor's Responsibility:

The Installation Contractor is responsible for setting in place and bolting the Power Distribution Centers to the top of channel. The Installation Contractor is also responsible for the supply, installation and connection of the following at each Power Distribution Center:

1. One (1) 480/277V, 60Hz, 3 phase, 4 wire + GND, 6.20 kVA power feed with local disconnect
2. One (1) Ground Link, 14 gauge (2.5mm²) minimum, TWH stranded single wire from the HSC
3. One (1) communication link consisting of one (1) shielded twisted pair from the SCC and daisy chained to other two PDCs
4. One (1) pair 24VDC, 18 gauge minimum power feed to the Level Control Panel from 2 PDCs in the channel
5. One (1) pair of 24VDC, 18 gauge (1mm²) minimum discrete signal from the water Level Control Panel to each PDC
6. Connection of communication, power cables and hydraulic lines from the UV Modules

HYDRAULIC SYSTEM CENTER

Trojan's Responsibility:

The Hydraulic System Center (HSC) houses the ancillary equipment required to operate the quartz sleeve cleaning system.

Quantity Supplied:	One (1) HSC
Enclosure Material/Rating:	304 Stainless Steel - Type 4X (IP66)
Approximate Weight:	310 lbs

Installation Contractor's Responsibility:

The Installation Contractor is responsible for setting in place and bolting the HSC and manifold as shown on the contract drawings. The HSC should be located within 50 feet from the farthest PDC. The Installation Contractor shall be responsible for the supply, connection and installation of the following at the HSC:

1. One (1) 480V, 3 phase, 3 wire + GND, 60Hz, 5 Amp power feed with local disconnect
2. One (1) ground link of, 14 gauge (2.5mm²) minimum, TWH stranded from the PDCs
3. Connection of the hydraulic hoses from PDCs (Hoses and connections will be supplied by Trojan)
4. One (1) serial communication link of one (1) twisted, shielded pairs, 18 gauge (1mm²) maximum cable from the SCC and daisy chained to the PDCs.

STREAM™ CONNECTION

Trojan's Responsibility:

Stream™ Connection is a digital support tool that provides our Technical Assistance Center with instant access to the UV system to quickly diagnose and resolve UV issues. The Stream connection is a free service throughout the warranty period to streamline technical support requests. Stream provides secure and encrypted connection external to the SCADA network and configured in the UV System Control Center.

SUPPORT RACKS

Trojan's Responsibility:

Support racks are provided to support UV modules in the effluent channel.

Quantity Supplied:	Three (3) Module Support Racks
Material of Construction:	304 Stainless Steel
Approximate Weight:	< 100 lbs each

Installation Contractor's Responsibility:

The Installation Contractor is responsible for setting in place and bolting the support racks to the channel walls. The Contractor will be required to supply eight (8) 1/2" Diameter x 5 1/2" Long expansion anchor bolts per rack. Install approved (engineered) anchor points for personnel to use as part of their fall restraint system around the open channels. The anchor points must be positioned so that the preferred retractable lifeline of 8 feet is of sufficient length to access the work at the channel. Refer to local safety regulation.

LEVEL CONTROLLER (EXISTING)

Regardless of the flow rate, a level control device for the UV channel is required to maintain and control the effluent level. Existing fixed weir will be used for this project and no additional items/replacement parts/pieces will be supplied by Trojan as part of this Scope of Supply.

WATER LEVEL SENSOR KIT

Trojan's Responsibility:

The water level sensor is located downstream of the UV System and provides a digital signal to shut down & protect the UV System if the water level is too low.

Quantity Supplied:	One (1) Water Level Sensor Kit including an electrode type water level sensor and one (1) water Level Control Panel (LCP)
Enclosure Rating:	Type 4X
Approximate Weight:	25 lbs (LCP), 10 lbs (Probe)

Installation Contractor's Responsibility:

Installation Contractor is responsible for setting in place and bolting the water level probes assembly to the effluent channel wall and mounting the Level Control Panel as indicated on the drawings. The Installation Contractor is also responsible for the supply of mounting hardware, watertight conduit and supply and connection of the following:

1. One (1) pair of 24VDC, 18 gauge (1mm²) minimum discrete signal to the LCP to two of the PDCs
2. One (1) pair of 24VDC and 18 gauge (1mm²) minimum power feed to the LCP from two PDCs in the channel
3. One (1) pair of 12VDC, 18 gauge (1mm²) minimum discrete signal to the low water level probes from the LCP

UV CHANNEL REDUCTION BAFFLES

Trojan's Responsibility:

Trojan will supply baffles to reduce the channel in the area of the UV Banks.

Quantity:	Three (3) Baffles, each 2" wide
Materials of Construction:	316 Stainless Steel

Installation Contractor's Responsibility:

Contractor shall install and seal watertight the baffles by anchoring the perimeter of the baffle to the channel floor and walls with approximately 20 anchors.

DAVIT CRANE

Trojan's Responsibility

In order to facilitate easy removal of the UV Modules from the Channel lifting devices will be supplied.

Quantity Supplied:	One (1) Davit Crane with two (2) bases
Description:	Thern Model # 5122M1-S19
Material of Construction:	Painted Mild Steel
Approximate Weight:	110 lbs

Installation Contractor's Responsibility:

The Installation Contractor to be responsible for the installation and integrity of the crane base.

INDIVIDUAL UV MODULE LIFTING SLING WITH FRAME

Trojan's Responsibility:

In order to remove individual modules, by mechanical means, a 2 rope sling with frame shall be supplied to interface with the existing overhead crane.

Quantity:	One (1) Sling Kit
Materials of Construction:	304 Stainless Steel
Approximate Weight:	5 lbs

SPARE PARTS AND SAFETY EQUIPMENT

Trojan's Responsibility:

The following spare parts and safety equipment will be supplied with the UV system:

Description	Quantity
Lamp/Sleeve Assembly	Eight (8)
Lamp Driver	Three (3)
Operators Kit	One (1)
Anchor Bolts	One (1) set

MICROBIOLOGICAL PERFORMANCE TESTING

Trojan's Responsibility:

Trojan will supply performance testing protocols to the Installation Contractor to be forwarded to the Engineer for approval. Trojan will produce the final test report (based on data supplied by the independent lab) and will forward the final report to the Installation Contractor.

Installation Contractor's Responsibility:

The Installation Contractor is responsible for covering all associated onsite costs for performance testing, i.e. retaining an independent lab for sample analysis and services, bottles, shipment, etc. The Installation Contractor is also responsible for completing the performance testing as per the testing protocol supplied by Trojan and approved by the Engineer.

NOTES AND CLARIFICATIONS TO SPECIFICATION

- **Section 46 66 56, article 2.2 N.3** – Varying of UV Dose setpoint by operator is not recommended since target UV dose setpoint is pre-set to the design dose based on project specifications and plant permit limits. Changing this setpoint can impact disinfection process and potentially performance guarantee of the system. Trojan Technical Assistance Center can be contacted for further assistance.

DOCUMENTATION (SHOP DRAWINGS AND O & M MANUALS)

Trojan's Responsibility:

The following documentation will be supplied to the contractor by Trojan per the following schedule:

- One (1) electronic copy of Trojan Shop Drawing Submittals within a minimum **5 – 6** weeks after receipt of written purchase order. ***Note that Submittals will not be issued externally until PO is fully executed.***
- One (1) electronic copy of Trojan Standard O&M manuals at time of equipment delivery.

DELIVERY, START-UP AND TRAINING

Equipment shipment to be within **18 – 20** weeks after approval of Shop Drawings.

Trojan's Responsibility:

The following start-up services will be provided by Trojan-certified technicians:

- Installation assistance as required by phone or fax. Technical Assistance Center 1-866-388-0488 or tac@trojantechnologies.com
- Start-up and testing of the installed UV equipment.
 - If the Trojan's Certified Service Technician determines the Contractor work is not complete and the start-up cannot be completed in the allotted time a return visit will be scheduled at the Contractors expense.
- Classroom and/or jobsite training for operations staff
 - If trainees are not available a return visit will be scheduled at the Contractors expense.

Installation Contractor's Responsibility:

The Contractor is responsible for:

- Unloading of the components supplied by Trojan, storage of all components, if required in a clean dry environment
- Installing the equipment outlined in the scope of Supply in accordance with contract drawings, Trojan's shop drawings, instructions and installation checklist.
- Supplying all conduits and conductors and components per the sites state regulations and components indicated as supplied by others,
- Completing the Checklist and returned at least two (2) weeks prior to date requested for commissioning.

WARRANTY

Trojan's Responsibility:

Trojan Technologies will warrant the equipment and parts for 12 months after UV equipment start-up or 18 months after shipment, whichever comes first. Warranty does not cover labor, consumables and/or wear components. Refer to attached Terms and Conditions for additional details.

- UV lamps shall be warranted for 12,000 hours prorated after 9,000 hours.
- Lamp drivers shall be warranted for 5 years, prorated after 1 year.

SELLING PRICE

\$ 324,950 USD (Price valid 30 days from August 22, 2024)

- Selling price does not include any duties or taxes that may be applicable.
- Freight included if destination is within North America.
- Incoterms 2020

PAYMENT TERMS AND INVOICING MILESTONE BREAKDOWN

Net 30 Days

- 10% upon Award of PO
- 40% upon Completion of Submittal package by Seller
- 45% upon Shipment or 30 days after notice to ship (whichever comes first)
- 5% upon Equipment Acceptance or 180 days after Shipment (whichever occurs first)

If UV System start-up is required within 30 days of shipment, Trojan requires 95% payment unless agreed upon in writing before authorizing system Start-up.

TERMS AND CONDITIONS

Trojan appreciates the opportunity to submit this proposal. Our proposal is submitted subject to and based on Trojan's standard terms and conditions, which we have attached as part of our proposal. We believe these terms and conditions are customary in the trade and respectfully reserve the opportunity to negotiate, fair and reasonable contract terms acceptable to both parties, if Trojan is selected for this project.



Terms and Conditions of Sale

This document sets forth the Terms & Conditions of Sale for goods manufactured and/or supplied, and services provided, by the seller entity identified on the purchase order ("SELLER") and sold to the original purchaser thereof ("BUYER"). The term "SELLER" includes only SELLER, and none of its affiliates. Unless otherwise specifically stated in a previously-executed written purchase agreement signed by authorized representatives of SELLER and BUYER, these Terms & Conditions of Sale establish the rights, obligations and remedies of SELLER and BUYER which apply to this offer and any resulting order or contract for the sale of SELLER's goods and/or services ("Products").

1. APPLICABLE TERMS & CONDITIONS: These Terms & Conditions of Sale are contained directly and/or by reference in SELLER's proposal, offer, order acknowledgment, packing slip, and/or invoice documents. The first of the following acts constitutes an acceptance of SELLER's offer and not a counteroffer and creates a contract of sale ("Contract") in accordance with these Terms & Conditions of Sale: (i) BUYER's issuance of a purchase order document against SELLER's offer; (ii) acknowledgement of BUYER's order by SELLER; or (iii) commencement of any performance by SELLER pursuant to BUYER's order. Provisions contained in BUYER's purchase documents (including electronic commerce interfaces) that materially alter, add to, or subtract from the provisions of these Terms & Conditions of Sale are not a part of the Contract.

2. CANCELLATION AND RETURN: The whole or any part of this order may be cancelled only with the prior written consent of SELLER. If SELLER does consent to a cancellation, such consent will be given only upon payment of reasonable cancellation charges in an amount determined by SELLER. In addition, with respect to any Products returned on cancellation, BUYER will pay SELLER's cost of placing the returned Products in a saleable condition, sales expenses incurred by SELLER in connection with such returned Products, a reasonable restocking charge and freight costs incurred in connection with the original shipment and in connection with returning such Products to SELLER, all in such amounts as are advised to the BUYER by SELLER.

3. DELIVERY: Delivery will be accomplished EXW or CIP at the point of shipment (Incoterms 2020), unless otherwise expressly agreed between the parties. Legal title and risk of loss or damage pass to BUYER upon transfer to the first carrier, regardless of final destination and mode of transit. SELLER will use commercially reasonable efforts to deliver the Products ordered herein within SELLER's normal lead-time necessary for SELLER to deliver the Products sold hereunder. Products will be boxed or crated as determined appropriate by SELLER for protection against normal handling and there will be an extra charge to the BUYER for additional packaging required by the BUYER with respect to waterproofing or other added protection. BUYER has sole responsibility for off-loading, storage and handling of the Products at the site. Where Buyer is responsible for any delay in the delivery date or installation date, the earlier of the date of delivery or the date on which the Products are ready for shipment by SELLER may be treated as the delivery date for purposes of determining the time of payment of the purchase price. Moreover, BUYER will be responsible for reasonable storage and insurance expenses with respect to such Products. Should BUYER fail to effect pick-up of Product as previously agreed in a timely manner, SELLER may, at its discretion, assess reasonable storage charges to the account of BUYER.

4. INSPECTION: BUYER will promptly inspect and accept any Products delivered pursuant to this Contract after receipt of such Products. In the event the Products do not conform to any applicable specifications, BUYER will promptly notify SELLER of such nonconformance in writing. SELLER will have a reasonable opportunity to repair or replace the nonconforming Product at its option. BUYER will be deemed to have accepted any Products delivered hereunder and to have waived any such nonconformance for such Products unless a written notification pursuant to this paragraph is received by SELLER within thirty (30) days of delivery to BUYER destination on order.

5. PRICES & ORDER SIZES: Prices do not include any charges for services such as insurance; brokerage fees; sales, use, inventory, or excise taxes; import or export duties; special financing fees; value added tax, income, or royalty taxes imposed outside the U.S. or Canada; consular fees; special permits or licenses; or other charges imposed upon the production, sale, distribution, or delivery of Products. BUYER will either pay any and all such charges or provide SELLER with acceptable exemption certificates, which obligation survives performance under this Contract. Installation, maintenance and any other services which relate to the Products are not included unless specifically set forth in the quotation. SELLER reserves the right to establish minimum order sizes and will advise BUYER accordingly. Any orders below the minimum order size are subject to a fee as set out by SELLER. If SELLER's delivery of Products surpasses one (1) year in length, then at least on an annual basis, or if changes to the Products are requested or needed, the parties shall conduct good faith discussions regarding changes to the prices for the Products, to reflect SELLER's increased costs for which SELLER shall be entitled to additional fair and appropriate compensation.

6. PAYMENTS: All payments must be made in agreed-to currency, normally Canadian or U.S. Dollars. Unless other payment terms are expressly set forth in the purchase order or otherwise required by the Seller, invoices are due and payable NET 30 DAYS from date of the invoice, without regard to delays for inspection or transportation, with payments to be made by check to SELLER at the address listed in the purchase order or by bank transfer to the account obtainable from SELLER's Accounts Receivable Manager. In the event payments are not made or not made in a timely manner, SELLER may, in addition to all other remedies provided at law, either: (a) declare BUYER's performance in breach and terminate this Contract for default; (b) withhold future shipments until delinquent payments are made; (c) deliver future shipments on a cash-with-order or cash-in-advance basis even after the delinquency is cured; (d) charge interest on the outstanding balance at a rate of 1.5% per month or the maximum rate permitted by law, if lower, for each month or part thereof that there is an outstanding balance plus applicable storage charges and/or inventory carrying charges; (e) repossess the Products for which payment has not been made; (f) pursue other collection efforts and recover all associated costs including reasonable attorney's fees; or (g) combine any of the above rights and remedies as is practicable and permitted by law. BUYER is prohibited from setting off any and all monies owed under this Contract from any other sums, whether liquidated or not, that are or may be due to the BUYER, which arise out of a different transaction with SELLER or any of its affiliates. Should BUYER's financial condition become unsatisfactory to SELLER in its discretion, SELLER may require payment in advance or other security. If BUYER fails to meet these requirements, SELLER may treat such failure as reasonable grounds for repudiation of this Contract, in which case reasonable cancellation charges shall be due to SELLER. BUYER hereby grants SELLER a security interest in the Products, wherever located, and whether now existing or hereafter arising or acquired from time to time, and in all accessions thereto and replacements or modifications thereof, as well as all proceeds of the foregoing, to secure payment in full of all amounts to Seller, which payment releases the security interest but only if such payment could not be considered an avoidable transfer under applicable laws. The security interest granted hereby constitutes a purchase money security interest under the applicable Uniform Commercial Code or Personal Property Security Act or other applicable law, and SELLER is authorized to make whatever registration or notification or take such other action as SELLER deems necessary or desirable to perfect such security interest. BUYER's insolvency, bankruptcy, assignment for the benefit of creditors, or dissolution or termination of the existence of BUYER, constitutes a default under this Contract and affords SELLER all of the remedies of a secured creditor under applicable law, as well as the remedies stated above for late payment or non-payment.

7. LIMITED WARRANTY: Unless specifically provided otherwise in SELLER's quotation, SELLER provides the following Limited Warranty. SELLER warrants that Products sold hereunder will be free from defects in material and workmanship and will, when used in accordance with the manufacturer's operating and maintenance instructions, conform to any express written warranty pertaining to the specific goods purchased, which for Products is for a period of twelve (12) months from delivery. SELLER warrants that services furnished hereunder will be free from defects in workmanship for a period of ninety (90) days from the completion of the services. Products repaired or replaced are not covered by any warranty except to the extent repaired or replaced by SELLER, an authorized representative of SELLER, or under specific instructions by SELLER, in which cases, the Products will be covered under warranty up to the end of the warranty period applicable to the original Products. The above warranties do not include the cost of shipping and handling of returned items. Parts provided by SELLER in the performance of services may be new or refurbished parts functioning equivalent to new parts. Any non-functioning parts that are repaired by SELLER shall become the property of SELLER. No warranties are extended to consumable items such as, without limitation, light bulbs, and for normal wear and tear. All other guarantees, warranties, conditions and representations, either express or implied, whether arising under any statute, law, commercial usage or otherwise, including implied warranties of merchantability and fitness for a particular purpose, are hereby excluded. The sole remedy for Products not meeting this Limited Warranty is replacement, credit or refund of the purchase price, as determined by SELLER in its sole discretion. This remedy will not be deemed to have failed of its essential purpose so long as SELLER is willing to provide such replacement, credit or refund. To make a warranty claim, BUYER must notify SELLER in writing within 5 days of discovery of the defect in question. This notification must include a description of the problem, a copy of the applicable operator's log, a copy of BUYER's maintenance record and any analytical results detailing the problem. Any warranty hereunder or performance guarantees shall only be enforceable if (a) all equipment is properly installed, inspected regularly, and is in good working order, (b) all operations are consistent with SELLER recommendations, (c) operating conditions at the installation site have not materially changed and remain within anticipated specifications, and (d) no reasonably unforeseeable circumstances exist or arise.

8. INDEMNIFICATION: Indemnification applies to a party and to such party's successors-in-interest, assignees, affiliates, directors, officers, and employees ("Indemnified Parties"). SELLER is responsible for and will defend, indemnify and hold harmless the BUYER Indemnified Parties against all losses, claims, expenses or damages which may result from accident, injury, damage, or death due to SELLER's breach of the Limited Warranty. BUYER is responsible for and will defend, indemnify and hold harmless SELLER Indemnified Parties against all losses, claims, expenses, or damages which may result from accident, injury, damage, or death due to the negligence or misuse or misapplication of any Products or the breach of any provision of this Contract by the BUYER or any third party affiliated or in privity with BUYER.

9. PATENT PROTECTION: Subject to all limitations of liability provided herein, SELLER will, with respect to any Products of SELLER's design or manufacture, indemnify BUYER from any and all damages and costs as finally determined by a court of competent jurisdiction in any suit for infringement of any U.S. or Canadian patent (or European patent for Products that SELLER sells to BUYER for end use in a member state of the E.U. or the U.K.) that has issued as of the delivery date, solely by reason of the sale or normal use of any Products sold to BUYER hereunder and from reasonable expenses incurred by BUYER in defense of such suit if SELLER does not undertake the defense thereof, provided that BUYER promptly notifies SELLER of such suit and offers SELLER either (i) full and exclusive control of the defense of such suit when Products of SELLER only are involved, or (ii) the right to participate in the defense of such suit when products other than those of SELLER are also involved. SELLER's warranty as to use patents only applies to infringement arising solely out of the inherent operation of the Products according to their applications as envisioned by SELLER's specifications. In case the Products are in such suit held to constitute infringement and the use of the Products is enjoined, SELLER will, at its own expense and at its option, either procure for BUYER the right to continue using such Products or replace them with non-infringing products, or modify them so they become non-infringing, or remove the Products and refund the purchase price (prorated for depreciation) and the transportation costs thereof. The foregoing states the entire liability of SELLER for patent

infringement by the Products. Further, to the same extent as set forth in SELLER's above obligation to BUYER, BUYER agrees to defend, indemnify and hold harmless SELLER for patent infringement related to (x) any goods manufactured to the BUYER's design, (y) services provided in accordance with the BUYER's instructions, or (z) SELLER's Products when used in combination with any other devices, parts or software not provided by SELLER hereunder.

10. TRADEMARKS AND OTHER LABELS: BUYER agrees not to remove or alter any indicia of manufacturing origin or patent numbers contained on or within the Products, including without limitation the serial numbers or trademarks on nameplates or cast, molded or machined components.

11. SOFTWARE AND INTELLECTUAL PROPERTY: All licenses to SELLER's separately provided software products are subject to the separate software license agreement(s) accompanying the software media. In the absence of such express licenses and for all other software, SELLER grants BUYER only a personal, non-exclusive license to access and use the software provided by SELLER with Products purchased hereunder solely as necessary for BUYER to enjoy the benefit of the Products. A portion of the software may contain or consist of open source software, which BUYER may use under the terms and conditions of the specific license under which the open source software is distributed. BUYER agrees that it will be bound by all such license agreements. Title to software remains with the applicable licensor(s). All SELLER contributions to the Products, the results of the services, and any other work designed or provided by SELLER hereunder may contain or result in statutory and non-statutory Intellectual Property, including but not limited to patentable subject matter or trade secrets; and all such Intellectual Property remains the sole property of SELLER; and BUYER shall not disclose (except to the extent inherently necessary during any resale of Product sold hereunder), disassemble, decompile, or any results of the Services, or any Products, or otherwise attempt to learn the underlying processes, source code, structure, algorithms, or ideas.

12. PROPRIETARY INFORMATION AND PRIVACY: "Proprietary Information" means any information, technical data, or know-how in whatever form, whether documented, contained in machine readable or physical components, mask works or artwork, or otherwise, which SELLER considers proprietary, including but not limited to service and maintenance manuals. BUYER and its customers, employees, and agents will keep confidential all such Proprietary Information obtained directly or indirectly from SELLER and will not transfer or disclose it without SELLER's prior written consent, or use it for the manufacture, procurement, servicing, or calibration of Products or any similar products, or cause such products to be manufactured, serviced, or calibrated by or procured from any other source, or reproduce or otherwise appropriate it. All such Proprietary Information remains SELLER's property. No right or license is granted to BUYER or its customers, employees or agents, expressly or by implication, with respect to the Proprietary Information or any patent right or other proprietary right of SELLER, except for the limited use licenses implied by law. In respect of personal data supplied by BUYER to SELLER, BUYER warrants that is duly authorized to submit and disclose these data, including but not limited to obtaining data subjects' informed consent. SELLER will manage BUYER's information and personal data in accordance with its Privacy Policy, a copy of which is available to Buyer upon request. In respect of other data and information that SELLER may receive in connection with BUYER's use of the Products including without limitation data that are captured by the Products and transmitted to SELLER, BUYER hereby grants SELLER a non-exclusive, worldwide, royalty-free, perpetual, non-revocable license to use, compile, distribute, display, store, process, reproduce, or create derivative works of such data as needed for Product operation and maintenance, and to aggregate such data for use in an anonymous manner, solely to facilitate marketing, sales and R&D activities of SELLER and its affiliates.

13. SPECIAL TOOLS, DIES, JIGS, FIXTURES AND PATTERNS: Any tools, dies, jigs, fixtures, patterns and similar items which are included or required in connection with the manufacture and/or supply of the Products will remain the property of SELLER without credit to the BUYER. SELLER assumes the cost for maintenance and replacement of such items and shall have the right to discard and scrap any such item after it has been inactive for a minimum of one year, without credit to the BUYER.

14. CHANGES AND ADDITIONAL CHARGES: SELLER reserves the right to make design changes or improvements to any products of the same general class as Products being delivered hereunder without liability or obligation to incorporate such changes or improvements to Products ordered by BUYER unless agreed upon in writing before the Products' delivery date.

15. SITE ACCESS / PREPARATION / WORKER SAFETY / ENVIRONMENTAL COMPLIANCE: In connection with services provided by SELLER, BUYER agrees to permit prompt access to equipment. BUYER assumes full responsibility to back-up or otherwise protect its data against loss, damage or destruction before services are performed. BUYER is the operator and in full control of its premises, including those areas where SELLER employees or contractors are performing service, repair, and maintenance activities. BUYER will ensure that all necessary measures are taken for safety and security of working conditions, sites, and installations during the performance of any services. BUYER is the generator of any resulting wastes, including without limitation hazardous wastes. BUYER is solely responsible to arrange for the disposal of any wastes at its own expense. BUYER will, at its own expense, provide SELLER employees and contractors working on BUYER's premises with all information and training required under applicable safety compliance regulations and BUYER's policies. SELLER has no responsibility for the supervision or actions of BUYER's employees or contractors or for non-SELLER items (e.g., chemicals, equipment) and disclaims all liability and responsibility for any loss or damage that may be suffered as a result of such actions or items, or any other actions or items not under SELLER's control.

16. LIMITATIONS ON USE: BUYER will not use any Products for any purpose other than those identified in SELLER's catalogs and literature as intended uses. Unless SELLER has advised the BUYER in writing, in no event will BUYER use any Products in drugs, food additives, food, or cosmetics, or medical applications for humans or animals. In no event will BUYER use in any application any Product that requires FDA 510(k) clearance unless and only to the extent the Product has such clearance. BUYER will not sell, transfer, export, or re-export any SELLER Products or technology for use in activities which involve the design, development, production, use, or stockpiling of nuclear, chemical, or biological weapons or missiles, nor use SELLER Products or technology in any facility which engages in activities relating to such weapons. Unless the "ship-to" address is in California, U.S.A., the Products are not intended for sale in California and may lack markings required by California Proposition 65; accordingly, unless BUYER has ordered Products specifying a California ship-to address, BUYER will not sell or deliver any SELLER Products for use in California. Any warranty granted by SELLER is void if any goods covered by such warranty are used for any purpose not permitted hereunder.

17. EXPORT AND IMPORT LICENSES AND COMPLIANCE WITH LAWS: Unless otherwise expressly agreed, BUYER is responsible for obtaining any required export or import licenses necessary for Product delivery. BUYER will comply with all laws and regulations applicable to the installation or use of all Product, including applicable import and export control laws and regulations of the U.S., E.U., and any other country having proper jurisdiction, and will obtain all necessary export or import licenses in connection with any subsequent export, re-export, transfer, and use of all Product and technology delivered hereunder. BUYER will not sell, transfer, export, or re-export any SELLER Product or technology for use in activities which involve the design, development, production, use or stockpiling of nuclear, chemical, or biological weapons or missiles, nor use SELLER Product or technology in any facility which engages in activities relating to such weapons. BUYER will comply with all local, national, and other laws of all jurisdictions globally relating to anti-corruption, bribery, extortion, kickbacks, or similar matters which are applicable to BUYER's business activities in connection with this Contract, including but not limited to the U.S. Foreign Corrupt Practices Act of 1977, as amended (the "FCPA"). BUYER agrees that no payment of money or provision of anything of value will be offered, promised, paid, or transferred, directly or indirectly, by any person or entity, to any government official, government employee, or employee of any company owned in part by a government, political party, political party official, or candidate for any government office or political party office to induce such organizations or persons to use their authority or influence to obtain or retain an improper business advantage for BUYER or for SELLER, or which otherwise constitute or have the purpose or effect of public or commercial bribery, acceptance of or acquiescence in extortion, kickbacks, or other unlawful or improper means of

obtaining business or any improper advantage, with respect to any of BUYER's activities related to this Contract. SELLER asks BUYER to "Speak Up!" if aware of any violation of law, regulation, or our Code of Conduct ("CoC") in relation to this Contract. See www.danaherintegrity.com and www.danaher.com/how-we-work/integrity-and-compliance for a copy of the CoC and for access to our Helpline portal.

18. RELATIONSHIP OF PARTIES: BUYER is not an agent or representative of SELLER and will not present itself as such under any circumstances, unless and to the extent it has been formally screened by SELLER's compliance department and received a separate duly-authorized letter from SELLER setting forth the scope and limitations of such authorization.

19. FORCE MAJEURE: SELLER is excused from performance of its obligations under this Contract to the extent caused by acts or omissions that are beyond its control, including but not limited to Government embargoes, blockages, seizures or freezing of assets, delays, or refusals to grant an export or import license, or the suspension or revocation thereof, or any other acts of any Government; fires, floods, severe weather conditions, or any other acts of God; quarantines; epidemics and pandemics; labor strikes or lockouts; riots; strife; insurrections; civil disobedience or acts of criminals or terrorists; war; material shortages or delays in deliveries to SELLER by third parties. In the event of the existence of any force majeure circumstances, the period of time for delivery, payment terms, and payments under any letters of credit will be extended for a period of time equal to the period of delay. If the force majeure circumstances extend for six months, SELLER may, at its option, terminate this Contract without penalty and without being deemed in default or in breach thereof.

20. NON-ASSIGNMENT AND WAIVER: BUYER will not transfer or assign this Contract or any rights or interests hereunder without SELLER's prior written consent. Failure of either party to insist upon strict performance of any provision of this Contract, or to exercise any right or privilege contained herein, or the waiver of any breach of the terms or conditions of this Contract, will not be construed as thereafter waiving any such terms, conditions, rights, or privileges, and the same will continue and remain in force and effect as if no waiver had occurred.

21. FUNDS TRANSFERS: BUYER and SELLER both recognize that there is a risk of banking fraud when individuals impersonating a business demand payment under new mailing or banking transfer instructions. To avoid this risk, BUYER must verbally confirm any new or changed mailing or banking transfer instructions by calling SELLER and speaking with SELLER's Accounts Receivable Manager before transferring any monies using the new instructions. Both parties agree that they will not institute mailing or banking transfer instruction changes and require immediate payment under the new instructions, but will instead provide a ten (10) day grace period to verify any mailing or banking transfer instruction changes before any new or outstanding payments are due using the new instructions.

22. LIMITATION OF LIABILITY: None of SELLER, its successors-in-interest, assignees, affiliates, directors, officers, and employees will be liable to any BUYER Indemnified Parties under any circumstances for any special, treble, incidental, or consequential damages, including without limitation, damage to or loss of property other than for the Products purchased hereunder; damages incurred in installation, repair, or replacement; lost profits, revenue, or opportunity; loss of use; losses resulting from or related to downtime of the Products or inaccurate measurements or reporting; the cost of substitute products; or claims of any BUYER's Indemnified Parties' customers for such damages, howsoever caused, and whether based on warranty, contract, and/or tort (including negligence, strict liability or otherwise). The total liability of SELLER, its successors-in-interest, assignees, affiliates, directors, officers, and employees arising out of the performance or nonperformance hereunder, or SELLER's obligations in connection with the design, manufacture, sale, delivery, and/or use of Products, will in no circumstance exceed the amount actually paid to SELLER for Products delivered hereunder.

23. APPLICABLE LAW AND DISPUTE RESOLUTION: All issues relating to the construction, validity, interpretation, enforcement, and performance of this agreement and the rights and obligations of SELLER and the BUYER hereunder shall be governed by the laws of the Province of Ontario and the federal laws of Canada applicable therein. Any provisions of the International Sale of Goods Act or any convention on contracts for the international sale of goods shall not be applicable to this agreement. The parties submit to and consent to the non-exclusive jurisdiction of courts located in the Province of Ontario.

24. ENTIRE AGREEMENT, TERM & MODIFICATION: These Terms & Conditions of Sale constitute the entire agreement between the parties and supersede any prior agreements or representations, whether oral or written. Upon thirty (30) days prior written notice, SELLER may, in its sole discretion, elect to terminate any order for the sale of Products and provide a pro-rated refund for any pre-payment of undelivered Products. No change to or modification of these Terms & Conditions shall be binding upon SELLER unless in a written instrument specifically referencing that it is amending these Terms & Conditions of Sale and signed by an authorized representative of SELLER. SELLER rejects any additional or inconsistent Terms & Conditions of Sale offered by BUYER at any time, whether or not such terms or conditions materially alter the Terms & Conditions herein and irrespective of SELLER's acceptance of BUYER's order for the described goods and services.

Terms and Conditions Covering Sales of Configured-to-Order Projects and Systems

In addition to all terms and conditions above, the following sections apply to sales of Configured-to-Order Projects, Systems, and the like:

101. PAYMENT.

101.1 Payments will be made per the schedule of payment events set forth in Seller's Quotation; provided that if the Start-Up Date (as defined below) is less than 30 days after the Acceptance Date, 90% of the purchase price is due on or before the Start-Up Date.

101.2. In the event that achievement of a scheduled payment event is delayed or suspended due to the Buyer's convenience or other reasons for which the Buyer or its representatives is responsible, such payment event will be deemed to have occurred and Seller shall be entitled to invoice Buyer as if achievement of such payment event had been achieved. In such circumstances, Buyer must notify Seller in writing of the reasons for the delay and anticipated duration of the delay. Seller will mark the Products (or parts thereof) as the Buyer's property and shall store the Products (or parts thereof) in a segregated area until actual delivery.

102. DELIVERY

102.1 SELLER will request the BUYER to provide a firm date for delivery of the Products to the project site (the "Delivery Date") which SELLER will then use to establish the production schedule for the Products. The Delivery Date will then be binding on the BUYER except for any changes made in accordance with the provisions below.

102.2 The BUYER can request a rescheduling of the Delivery Date on one occasion only by notifying SELLER in writing not less than four weeks prior to the scheduled Delivery Date. The BUYER may request that the Delivery Date be extended by a period up to six weeks, without penalty, but may not request that the Delivery Date be moved forward. The BUYER may also request that the Delivery Date be extended beyond a six-week period but, SELLER may not agree to such extension, beyond the maximum six-week extension period

102.3 SELLER may, in its sole discretion, agree to change the Delivery Date on more than one occasion or if less than four weeks' prior notice is provided of a requested change, but is under no obligation to do so.

102.4 SELLER reserves the right to reschedule the Delivery Date to a date prior to or subsequent to the scheduled Delivery Date in order to accommodate its shipping, production or other requirements. This right to reschedule will be applicable unless otherwise agreed in writing by an authorized officer of SELLER. SELLER will provide the BUYER or its representative with a minimum of 24 hours' notice of any such rescheduling.

102.5 Where any change to the Delivery Date is made at BUYER's request, for all purposes with respect to the warranty and payment provided by SELLER in connection with the Products, the initial Delivery Date will be considered to be the Delivery Date regardless of any change later made to the Delivery Date.

103. ACCEPTANCE

103.1 During the period between the Delivery Date and the Start-up Date, the BUYER shall prepare the Products and the project site for installation and start-up and, unless otherwise agreed in writing by an authorized representative of SELLER, shall complete acceptance testing with respect to the Products. The Products shall be deemed to be accepted on the earliest to occur of the following dates (the "Acceptance Date"): (a) that date on which the Products can function in either manual or automatic operation and provide disinfection in accordance with criteria specified in the Quotation, or (b) 60 days after the Delivery Date.

103.2 All amounts which remain owing by the BUYER for the Products, including any amount which is specified to be payable on the Acceptance Date, will be paid by the BUYER to SELLER within 30 days after the Acceptance Date, unless otherwise agreed in writing by an authorized representative of SELLER.

103.3 Written notification must be given by the BUYER to SELLER within seven days after the Acceptance Date listing any outstanding deficiencies with respect to the Products and SELLER will use all reasonable efforts to correct such deficiencies promptly.

104. START-UP

104.1 SELLER will request a firm date for start-up of the Equipment (the "Start-Up Date"). Trojan will then schedule its technician to be on-site for the Start-up Date. The Start-up Date is binding except for any changes made in accordance with the provisions below.

104.2 On the Start-up Date, BUYER must have the Equipment and site ready as provided in the Installation Preparation Checklist contained in the Contractor Installation Package sent to BUYER and must have paid all amounts then due and payable to SELLER.

104.3 BUYER can request a rescheduling of the Start-up Date by notifying SELLER in writing not less than three weeks prior to the Start-up Date. BUYER may request that the Start-up Date be extended but may not request that the Start-up Date be moved forward. SELLER requires a minimum extension period of two weeks between the existing Start-up Date and the requested new Start-up Date in order to reschedule its technician.

104.4 SELLER may, in its sole discretion, agree to reschedule the Start-up Date where a BUYER requests less than a two-week extension but is under no obligation to do so. In the event that SELLER does agree to less than a two-week extension or that BUYER requests more than two changes to the Start-up Date, BUYER will be charged an administration fee in an amount determined by SELLER.

104.5 SELLER reserves the right to reschedule the Start-up Date to a date which is prior to or subsequent to the scheduled Start-up Date in order to accommodate its resource availability. This right to reschedule will be applicable unless otherwise agreed in writing by an authorized officer of SELLER. SELLER will provide BUYER or its representative with a minimum of 72 hours' notice of any such change to the Start-up Date.

104.6 In the event that SELLER'S technician arrives at the project site and finds that the Equipment or the project site is not ready for start-up as defined in the Contractor Installation Package, or any amounts then due and payable to SELLER remain unpaid, BUYER may either:

(a) provided all amounts then due and payable to SELLER have been paid, issue a purchase order for all costs involved in having SELLER correct the deficiencies, or

(b) have SELLER'S technician leave the site and then reschedule the Start-up Date to a date when all deficiencies will be corrected, and the Equipment will be ready for start-up as defined in the Contractor Installation Package. If BUYER selects this option, the cost of rescheduling will be not less than a minimum amount specified by SELLER, with the final cost being determined by SELLER based on its costs and expenses incurred in connection with the rescheduling.

APPENDIX C

Geotechnical Report

July 25, 2023

Mr. David Gauker, Senior Design Engineer
Civil Engineering Consultants, Inc.
4994 Lower Roswell Road, Suite 18
Marietta, Georgia 30068

Re: Geotechnical Exploration Report
Spout Springs Water Reclamation Facility
Expansion to 1.6 MGD
Hall County, Georgia
GeoSystems Project No. 23-2892

Dear Mr. Gauker:

GeoSystems Engineering, Inc. (GeoSystems) has completed the authorized geotechnical exploration for the proposed expansion to the Spout Springs Water Reclamation Facility (WRF). The purpose of this exploration was to determine subsurface conditions at planned expansion structure locations and provide recommendations for foundation design and construction. The following report presents our exploration findings, evaluations and conclusions.

PROJECT INFORMATION

Our understanding of this project is based on the information provided in your emails of May 2 and 9, 2023, and our subsequent discussions. A topographic plan of the site showing existing and proposed WRF structures was provided. We have also reviewed historic aerial photos of the site, our previous geotechnical explorations performed in 2001 and 2002, ECS 2012 boring data and a soil survey report of shallow subsurface conditions at the site from the Natural Resource Conservation Service.

The existing WRF site is located in Hall County, Georgia on the western side of Spout Springs Road, approximately 3.5 miles southeast of Interstate Highway 985. An unnamed tributary to Lollis Creek lies immediately west of the existing plant. Topography within the proposed expansion areas ranges from nearly level to moderately sloping, with a total relief of about 44 feet, varying from a high elevation of 994 feet at the existing administration building on the east side to a low elevation near 950 feet along the existing storage pond on the west side.

The proposed new WRF structures include SBR No. 4, a post equalization basin, disc filters No.3/No. 4 and aerobic digesters. Modifications or additions are also included for the existing headworks, SBR blowers, flow meter vault, UV system, administration building, SBR 2A/2B, and VAC truck receiving station.

The following table shows the proposed expansion structures and includes the top of wall and bottom or finished floor elevations provided by Civil Engineering Consultants (CEC). GeoSystems estimated the approximate ground surface elevations and approximate cut depths required to achieve the proposed bottom or finished floor elevations from the available site topographic information.

Spout Springs WRF				
Structure	Existing Elevation (ft)	TW Elevation (ft)	TS/FF Elevation (ft)	Approx. Cut Depth (ft)
SBR 4	970-976	983.33	968.33	3-9
Post EQ Basin	961-966	967.00	953.75	8-13
Disc Filters	967-969	970.38	957.88	10-12
Aerobic Digesters	956-969	969.00	947.00	10-23
Alternate Aerobic Digesters	967-978	975.00	960.00	8-19

Notes: TW - Top of Wall
TS/FF – Top of Slab/Finished Floor
N/A – Not Applicable

Construction details concerning the proposed structures have not been provided; however, based on our previous experience with similar treatment facilities, we expect the structures will be constructed mainly of reinforced concrete. Maximum foundation pressures for the treatment structures are estimated to be on the order of 1,000 to 1,500 psf for slabs and 2,000 to 3,500 plf for walls. Relatively light foundation loading conditions are expected for the proposed administration building addition, based on anticipated one-story wood, metal or CMU construction.

EXPLORATION METHODOLOGY

Our services on this project were in accordance with GeoSystems Proposal No. 23-2892, dated May 22, 2023. Subsurface conditions at the existing water reclamation facility were investigated by drilling nineteen soil test borings (B-1 through B-13, B-1A, B-2A, B-6A, B-8A, B-9A and B-11A). Borings B-1A through B-11A were offset 5 to 10 feet from the original boring locations. Nine borings (B-1 through B-9) within the proposed structure locations were originally planned at the site. One boring (B-5) was planned at the south corner of SBR No. 4, one (B-6) at filters No.3/No.4, three (B-7 through B-9) at the aerobic digesters and four (B-1 through B-4) at the alternate aerobic digesters. Due to shallow auger refusal conditions encountered in the original borings, additional offset borings (B-1A through B-11A) and other borings (B-10 through B-13) were drilled to further investigate the shallow refusal conditions and possible relocation of the aerobic digesters.

The borings were located in the field by GeoSystems engineers by taping distances and estimating right angles from existing site structures. Boring elevations to the nearest 1.0 foot were interpolated from the contours shown on the provided site plan. Since these measures are not

precise, the boring locations and elevations should be considered approximate. All of the boring locations for this project, previous borings from our 2001 subsurface investigation report and two borings completed by ECS in 2012 are shown on the enclosed Boring Location Plan (Figure 1). Also shown are the locations of existing structures along with site topography and other site improvements.

The soil test borings for this exploration were advanced, utilizing hollow-stem auger drilling procedures, to auger refusal depths varying from 1 to 18 feet below the existing ground surface. All drilling and sampling operations were conducted in general accordance with ASTM standards. Standard penetration testing (SPT) and split-spoon sampling of the soils were conducted in each boring at regular intervals to evaluate relative density or consistency of the soils and obtain samples for classification. The split-spoon samples were obtained with a standard 1.4-inch I.D., 2-inch O.D. split-spoon sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler the final foot was recorded and is designated the “standard penetration resistance” or “N” value. Penetration resistance, when properly evaluated, is an index of the soil’s consistency or relative density.

The split-barrel samples from the borings were initially classified in the field and preliminary boring records were prepared by the driller. In the laboratory, each sample was examined by a geotechnical engineer and final detailed logs of the borings were prepared showing visual soil descriptions, unified soil classifications, groundwater conditions and graphical plots of the standard penetration resistances. The lines designating the interfaces between various strata on the boring logs represent approximate boundaries only, as transitions between materials may be gradual. The final soil test boring logs are included as attachments to this report.

AREA AND SITE GEOLOGY

Geologically, the Spout Springs WRF is located in the Winder Slope District of the southern section of the Piedmont Physiographic Province of Georgia. This area is characterized by gently rolling topography ranging approximately in elevation from 1000 feet along the western edge to 700 feet along the southern boundary, where a sharp break in regional slope occurs. The western boundary is the drainage divide that separates streams flowing to the Atlantic Ocean from those flowing to the Gulf of Mexico. The district is dissected by headwater tributaries of the streams flowing to the Atlantic. The streams are generally located in relatively deep, narrow valleys 100 to 200 feet below narrow, rounded ridgelines.

The southern section of the Piedmont consists of rocks southeast of the Brevard fault zone, which extends across Georgia from northeast of Montgomery, Alabama to near Mount Airy, North Carolina. The Brevard fault zone is located just northwest of the site. The Brevard zone contains numerous different types of inactive faults and discontinuities and is described as being warped by intense ductile shearing. Latest seismic activity in the Brevard likely occurred sometime between 190 and 280 million years ago. The faulting and weathering in the Brevard is complex and the soil conditions in the fault area are typically quite variable and may differ greatly from surrounding areas in the Piedmont.

Published geologic mapping indicates that Paleozoic age metamorphic rocks within the Sandy Springs Group, consisting of intercalated biotite gneiss, mica schist, and amphibolite underlie this area. Gneiss is usually found on the ridge lines and schist in the valleys. Gneiss is a foliated, quartz feldspar rock formed by regional metamorphism. Biotite is a silicate mineral that forms in sheets similar to mica and is found imbedded in many metamorphic and igneous rocks. Schist is a strongly foliated crystalline rock formed by dynamic metamorphism. Amphibolite is a hornblende bearing rock with varying amounts of feldspar.

The origin of the Paleozoic rocks, as sediments, has been obscured, due to their age and repeated cycles of weathering, metamorphism, folding, faulting, and injection with younger Paleozoic granites and Triassic diabase dikes. All of these rocks have weathered in place and are covered by a mantle of residual soils of varying thickness. Residual soils are formed insitu by chemical alteration of the underlying rocks. Normally, the weathering is most advanced near the ground surface and decreases with depth until unweathered parent rock is encountered. The boundary between soil and rock is generally not clearly defined, and a transitional zone termed “partially weathered rock” (PWR) is normally found above the parent bedrock. Partially weathered rock retains the relic structure of the parent rock and exhibits standard penetration resistances of 100 blows per foot or greater. A transition from clay to silt to silty sand to partially weathered rock to hard rock is typical; however, this order of weathering is not always present. The naturally developed soil profile may also be changed by erosion and/or man's grading activities, so that the upper more weathered zones may be completely stripped away. Also, residual soils may be covered by washed-in alluvial soils or manmade fill, or both.

Groundwater in the Piedmont generally occurs under water table conditions as a result of infiltration of surface waters through the somewhat permeable overburden. Fractures and other discontinuities in the underlying rock can affect groundwater conditions. In this geologic setting, the configuration of the groundwater table is generally expected to be a slightly subdued replica of the ground surface.

SUBSURFACE CONDITIONS

Subsurface conditions within the proposed WRF expansion areas consist of fill, residual soils, partially weathered rock and auger refusal materials. Groundwater was not encountered in any of the borings drilled at the site during this exploration. The following further describes the fill, residual soils, partially weathered rock and refusal conditions indicated by our exploration.

Soil Survey Findings

The custom NRCS soil report shows the shallow soils in the area of the existing WRF consist mostly of Gwinnett clay loam, 10 to 25 percent slopes, eroded (GwE2) soils with some Gwinnett clay loam, 6 to 10 percent slopes, eroded (GwC2) soils. The native soils in these mapping units are similar and consist of shallow, well drained soils on side slopes of the Piedmont uplands that are formed in residuum weathered from amphibolite and/or residuum weathered from gneiss. The typical soil profile consists of interbedded layers of clay loam and clay overlying weathered bedrock at a depth of 50 to 53 inches. Depth to a paralithic bedrock restrictive feature is 40 to 60 inches and depth to the water table is greater than 80 inches.

Fill

An upper layer of fill and/or cultivated soil was identified at boring locations B-3, B-4, B-5, B-10, B-12 and B-13. Fill is any material that has been placed by man's activities and cultivated soils are disturbed surficial soils associated with previous farming activities. The fill/cultivated soils layer was encountered to depths varying from 3 to 6 feet below the ground surface in the borings and appears to be composed of relatively clean silty sand (SM) or clayey sand (SC) with rock fragments. Standard penetration resistances in these soils varied from a minimum of 5 blows per foot (bpf) to a maximum of 25 bpf in our exploration borings.

Residual Soils/Partially Weathered Rock

Residual is a term used to describe soils formed in-place by the chemical weathering process of the underlying rocks. Partially weathered rock is similar to residual soils; however, the weathering is not as advanced as in the soil materials. Partially weathered rock can be penetrated by a power auger, but by definition standard penetration resistances in these materials must be a minimum of 100 bpf. Residual soils and/or partially weathered rock at this site were encountered below the fill/cultivated soils in the borings noted above and at or near the ground surface in the remaining borings. The residual soils and PWR are generally typical of the conditions described in the previous geology section and consist predominantly of fine to coarse silty sand (SM) with rock fragments. An upper stratum of clayey sand (SC) was also encountered in boring B-9. Standard penetration tests in the residual soils show mainly medium dense to dense relative densities with penetration values ranging between 11 and 50 bpf. Some penetration values of 8 to 10 bpf and greater than 50 bpf were also recorded.

Auger Refusal Material

Auger refusal material is material that cannot be penetrated by the soil drilling equipment and is normally indicative of a very hard or very dense material, such as boulders, rock lenses, or the upper surface of bedrock. At this site, auger refusal material was encountered in all borings at depths varying from 1 to 18 feet below the ground surface, which appears to be at or very near the top of bedrock. Rock coring procedures, which were beyond the scope of this investigation, would be required to determine the actual character and continuity of the refusal materials.

Groundwater

Groundwater was not observed in any of the borings at the time of this investigation. We note that groundwater is subject to subsurface conditions, runoff, climate, seasonal variations, and other factors; therefore, groundwater conditions at other locations or at other times may be different than that reported during this study.

EVALUATIONS AND CONCLUSIONS

This report has been prepared for the exclusive use of Civil Engineering Consultants for planning and design of the Spout Springs WRF expansion to 1.6 MGD. Evaluations, conclusions and recommendations in this report were based on our understanding of the project, the data gathered

during this exploration, and our experience with similar site and subsurface conditions. We note that regardless of the thoroughness of a geotechnical exploration, there is always the possibility that conditions between test locations will differ from those at the actual test locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. If conditions differing from those anticipated are encountered during the course of construction, GeoSystems should review the changed conditions to develop any required revisions to our recommendations. Also, should the project plans change substantially from those outlined in this report, we request the opportunity to review our recommendations in light of the changes.

Our professional services were performed, our findings derived, and our conclusions prepared consistent with the professional skill and care ordinarily provided by geotechnical engineers practicing in the same locality under the same or similar circumstances for projects of this type. We make no warranties or guarantees, either expressed or implied. GeoSystems is not responsible for the conclusions, opinions or recommendations of others based on our findings and evaluations.

Seismic Site Classification

Site classification for seismic design of the WRF expansion structures was determined in accordance with ASCE/SEI 7-22. Although subsurface conditions to a depth of 100 feet were not investigated at this site, the available boring data and our previous experience with similar subsurface conditions allow an estimation of the average shear wave velocity profile to a depth of 100 feet below the ground surface. The data indicates the shear wave velocity profile to a depth of 100 feet below the structures would be in the range of 2100 to 3000 ft/sec or greater. Therefore, we recommend Site Class BC (Soft Rock) for this site based on the ASTM definitions provided in Table 20.2-1.

Site Preparation

Initially, demolition of existing structures and relocation of underground utilities in the proposed construction areas must be performed and the site must be cleared and grubbed of all trees, vegetation, and root systems. All topsoil and other deleterious non-soil materials should then be stripped from the ground surface. Clean topsoil may be stockpiled and used later to top dress slopes and other disturbed areas prior to permanent seeding and or stabilization. On completion of the stripping and rough grading, the site should be carefully inspected by the project geotechnical engineer. At that time, the engineer should observe areas near finished grade that are intended to support the structures. Inspection is to confirm the subgrades have been properly prepared and to identify any soft, weak, or excessively wet soils which may be present. At the discretion of the engineer, proofrolling of the subgrade in some areas may be required utilizing a 20 to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. Depending on the weather and construction conditions, some stabilization measures and/or undercutting and replacement of weak or wet soils with structural fill and/or crushed stone may be required to provide adequate subgrade support conditions. The extent of any stabilization measures or undercutting required should be determined at the time of construction by the geotechnical engineer.

Difficult Excavation

The current and previous subsurface data at this site show that partially weathered rock and auger refusal materials (apparent rock) will be encountered in most excavations for the planned WRF expansion structures. Excavations to achieve foundation slab subgrade elevations for the SBR 4 and at the alternate aerobic digesters location will include both soil and difficult excavation materials. Subsurface conditions in the alternate aerobic digesters location with a top of slab elevation of 960 feet are more favorable from a difficult excavation standpoint than the aerobic digesters location at 947 feet.

We expect a significant amount of material will require removal by difficult excavation methods during construction. Additional unexpected PWR or rock may also be encountered in areas between boring locations or in other areas not investigated. Depending on the depths and locations of underground utilities, it is likely that difficult excavation conditions will also be encountered in the trenches.

The following table lists top of partially weathered rock, auger refusal (apparent top of rock) and top of foundation slab elevations at each of the boring locations to assist with evaluating the difficult excavation conditions and estimating removal quantities.

Structure	Boring	Top of PWR Elevation (ft)	Auger Refusal Elevation (ft)	Top of Slab Elevation (ft)
SBR 4	B-5	--	959	968.33
	B-6 (2001)	980	975	
	B-7 (2001)	964	959.5	
Post EQ Basin	B-2 (ECS 2012)	957	951	953.75
Disc Filters	B-6	965	962	957.88
Aerobic Digesters	B-1 (ECS 2012)	966.5	964	947.00
	B-7	967	959	
	B-8	--	953	
	B-9	947	945	
Alternate Aerobic Digesters	B-1	976	973	960.00
	B-2	967	965	
	B-3	--	956	
	B-4	958	955	
	B-10	--	954	
	B-11	970	969	
	B-12	961	958	
	B-13	957*	948	

* - Layer of PWR overlying very dense residual soil

In mass excavations for general site work, very hard or very dense soils and weathered rock can usually be removed by ripping with a single-tooth ripper attached to a large crawler tractor or by breaking the material out with a large front-end loader. In confined excavations, such as foundations and utility trenches, removal of weathered rock typically requires use of large backhoes, pneumatic spades, or light blasting. Refusal materials (apparent rock) usually require blasting for removal in both mass and confined excavations. Any blasting within structure subgrade areas or in foundation excavations must be done in a controlled manner to prevent damage to the bearing materials and to existing structures.

The definition of rock can be a source of conflict during construction. The following definitions have been incorporated into specifications on other projects and are provided for your general guidance:

1. General Excavation

- Rip Rock - Any material that cannot be removed by scrapers, loaders, pans, dozers, or graders; and requires the use of a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds.
- Blast Rock - Any material which cannot be excavated with a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds (Caterpillar D-8K or equivalent) or by a Caterpillar 977 front-end loader or equivalent; and occupying an original volume of at least one (1) cubic yard.

2. Trench/Foundation Excavation

- Blast Rock - Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 33,000 pounds and a stick crowd of not less than 29,000 pounds (Caterpillar 325 or equivalent), and occupying an original volume of at least one-half ($\frac{1}{2}$) cubic yard.

Earthwork

All fill required to achieve site grades, backfill excavations around structures or replace undercut areas should be clean soil, free of excessive organic matter and deleterious material. Material containing rocks or stones greater than 3 inches in diameter should not be used. Fill soils should also have a plasticity index (PI) typically less than 30. We note that moisture control is important in order to achieve adequate compaction and equipment should be available on-site during construction for both wetting and drying the fill soils, as required.

General site structural fill should be placed in maximum 6 to 8-inch lifts, loose measure, and compacted to at least 95 percent of the maximum dry density as determined by the standard Proctor compaction test (ASTM D-698). Compaction in the top 12 inches of pavement subgrades should be increased to 100 percent of the maximum dry density. Backfill in trenches or other confined spaces, where light portable compaction equipment is required, should be placed in maximum lift thicknesses of 3 to 4 inches, loose measure. All fill material should be placed in horizontal lifts and adequately keyed into the existing subgrade. In landscaped areas, where no structures are planned or anticipated in the future, the compaction criteria may be reduced to 90 percent of the standard Proctor maximum dry density.

Foundation Support

Based on the planned top of slab and finished floor elevations, the WRF expansion structures will be underlain primarily by PWR and auger refusal material (apparent rock) conditions at anticipated foundation bearing elevations. Support on undisturbed residual soils is also indicated in the southern portion of SBR 4 and northwest approximate one-half of the alternate aerobic digesters location. These conditions should provide adequate long-term shallow foundation support for the new WRF structures within the range of loadings anticipated, subject to the site preparation, earthwork, and inspection recommendations in this report. Shallow foundation support for the structures may consist of conventional slab-on-grade foundations, continuous footings or individual column footings. Allowable soil bearing capacities for design of the shallow foundations vary depending on the subgrade support conditions for each structure. In some cases, foundations may be supported entirely by PWR and/or rock and other cases by various combinations of PWR/rock and undisturbed residual soils. Where variable support conditions occur beneath a single structure, we recommend that a 4 to 6-inch thick layer of concrete sand or crushed stone be placed beneath the slab to reduce differential stresses from non-uniform support.

We recommend a maximum allowable soil bearing capacity of 4.0 ksf for design of foundations bearing in undisturbed residual soils and 10.0 ksf for bearing in PWR and/or bedrock. For eccentric loading conditions or retaining walls, foundation toe pressure can be increased by a maximum of 33 percent, as long as the average foundation contact pressure does not exceed the recommended bearing capacity and the resultant force is located within the center 1/3 of the footing. Minimum widths of 24 inches for individual column footings and 18 inches for continuous footings are recommended for practical construction considerations and to reduce the possibility of localized foundation shear failures. Exterior footings should be placed at least 12 inches below final exterior grades to assure that foundations bear below the possible frost penetration depth.

Building floor slabs-on-grade may be soil supported subject to site preparation and earthwork recommendations contained in this report. Floor slabs should be jointed around columns and along footing-supported walls to minimize cracking from possible differential movements between the slab and foundations. As an alternative to a flat grade slab and conventional spread footings, a monolithic turned-down slab-on-grade may be used. The turned-down slab should be thickened underneath columns and load bearing walls and have adequate reinforcement in order to minimize cracking between the thickened and flat portions of the slab.

A subdrainage system below the admin building addition floor slab-on-grade is not required. However, the use of a vapor barrier beneath the slab should be considered if the floor is covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or if the slab supports moisture sensitive equipment. When conditions warrant the use of a vapor barrier, the design and construction should conform to the requirements of ASTM E-1745, "Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs" and ASTM E 1643, "Standard Practice for Installation of Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs."

Retaining/Below Grade Walls

Earth pressures on walls below grade are influenced by the structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. The most common conditions assumed for earth retaining wall design are the active and at-rest conditions. Active conditions apply to relatively flexible earth retention structures, such as free-standing walls, where some movement and rotation may occur to mobilize soil shear strength. Development of the full active earth pressure case requires a magnitude of horizontal wall movement that often cannot be tolerated or cannot occur due to the rigidity of the wall or other design restrictions such as the impact on adjacent structures. In such cases, walls are often designed for either the at-rest condition or a condition intermediate of the active and at-rest conditions, depending on the amount of permissible wall movement. Walls that are rigidly restrained, such as basement, pit and tunnel walls, should be designed for the at-rest condition.

A third condition, the passive state, represents the maximum possible pressure when a structure is pushed against the soil, and is used in wall foundation design to help resist active or at-rest pressures. Passive conditions are typically assumed for portions of walls buried beneath the toe elevation. Since significant wall movements are required to develop the passive resistance, the total calculated passive pressure should be reduced a minimum of 50 percent for design purposes.

Our recommendations assume that below grade walls at this site will support insitu residual soils or backfill composed of silty sand similar to the residual soils and PWR encountered in the borings. Based on previous experience with similar soils, we recommend effective soil strength parameters of 0 psf for cohesion (c) and 28 degrees for the angle of internal friction (ϕ) be used in determining lateral earth pressures on below grade walls at this site. To calculate resistance to sliding, a value of 0.35 (includes a factor of safety of 1.5) should be used as the coefficient of friction between wall foundations and the underlying soil. A moist soil unit weight of 120 psf is recommended for wall design calculations. Below the water table, lateral earth pressures should be determined using the buoyant weight of the soil. A constantly functioning drainage system should be installed behind retaining walls to prevent additional hydrostatic pressure on the walls.

Using a ϕ -angle of 28 degrees results in the following earth pressure coefficients for design of temporary shoring and permanent retaining or below grade walls at this site:

Earth Pressure Condition	Coefficient
Active (K_A)	0.36
At-Rest (K_O)	0.53
Passive (K_P)	2.77

Tractors and other heavy equipment should not operate within 10 feet of below grade walls to prevent excessive lateral pressures on the walls. If footings or other surcharge loadings are located a short distance outside below grade walls, they may also exert appreciable additional lateral pressures. If an imaginary line projected downward at a 45-degree angle from the bottom near edge of the footing or surcharge load does not intersect the wall, the effect of the load on the wall may be neglected. Whenever this line intersects the wall, the effect of the surcharge loads should be added to the calculated earth pressures to determine total lateral stresses.

Slope Stability

Our investigation did not include analysis of slope stability for any temporary or permanent condition. However, we recommend that excavations less than 20 feet in height not exceed 1.5(H):1.0(V) for temporary slopes and 2.0(H):1.0(V) for permanent slopes constructed in undisturbed residual soils or structural fill placed in accordance with our recommendations. Steeper slopes may be used in PWR and rock conditions, subject to inspection by the project geotechnical engineer. A minimum setback from the top of all slopes of 10 feet is recommended for structures and 5 feet for pavements.

Temporary shoring or permanent retaining walls may be required if the recommended slopes and setbacks from existing structures cannot be achieved for the proposed construction. At this time, it appears that installation of SBR No. 4 and the post equalization basin should not impact adjacent structures; however, requirements for excavation shoring or other measures to protect nearby structures bearing at or near the existing ground surface should be carefully evaluated during the design process for all remaining structures.

During construction, temporary slopes should be regularly inspected for signs of movement or unsafe conditions and provisions should be made for protection of all slopes from erosion. Soil slopes should be covered to prevent erosion due to heavy rains and stormwater run-off should be diverted away from the slopes. A cover of grass or other suitable vegetation should be established on permanent soil slopes as soon as possible following final grading.

Inspection

We recommend that all foundation excavations be evaluated by the project geotechnical engineer to confirm that conditions are similar to those encountered in the borings and that the bearing soils are capable of supporting the design contact pressures. Other than the ground improvement measures noted previously, some additional stabilization and/or undercutting and replacement of weak or wet soils with crushed stone may be required in order to provide adequate foundation support. The extent of any stabilization measures or undercutting required should be determined at the time of construction by the inspecting geotechnical engineer.

Foundation excavations should be free of all soft or loose soil, mud, disturbed materials, and other deleterious materials prior to placement of concrete. In addition, foundation concrete should not be placed on a frozen subgrade. Any foundation bearing surfaces that have been disturbed due to construction activities or exposure to precipitation or run-off must be repaired prior to construction of the footings or foundation slabs. We recommend that foundation excavations be concreted as soon as practical after they are excavated, and storm water or runoff should be prevented from ponding on or infiltrating the bearing surface. If it is necessary to leave foundation excavations open for an extended period of time, we recommend that a thin mat of lean concrete be placed over the bottom for protection.

We appreciate the opportunity of working with you on this project and look forward to assisting during the construction phase. If you have any questions concerning this report or need anything further, please call me.

Sincerely,

GeoSystems Engineering, Inc.


















































Larry Mullins

Larry D. Mullins, P.E.
Principal Engineer



Enclosures: Boring Location Plan – Figure 1
Key to Symbols and Classifications
Soil Test Boring Logs

KEYS TO SYMBOLS AND CLASSIFICATIONS

<p style="text-align: center;">SPECIAL STRATIGRAPHY IDENTIFIERS USED TO HIGHLIGHT SPECIFIC LAYERS</p>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="text-align: center;">  FILL </div> <div style="text-align: center;">  TOPSOIL </div> <div style="text-align: center;">  PAVEMENT </div> <div style="text-align: center;">  PARTIALLY WEATHERED ROCK </div> <div style="text-align: center;">  ROCK (GENERAL) </div> <div style="text-align: center;">  WATER </div> <div style="text-align: center;">  ALLUVIUM </div> </div>						
<p style="text-align: center;">COARSE GRAINED SOIL - GRAVELS & SANDS</p> <p style="text-align: center;">(MORE THAN 50% OF MATERIAL IS RETAINED ON NO. 200 SIEVE)</p>	<table border="0" style="width: 100%;"> <tr> <td style="vertical-align: top;"> <p style="text-align: center;">CLEAN SANDS & GRAVELS</p> <p style="text-align: center;">(< 5% FINES CONTENT)</p> </td><td style="vertical-align: top;"> <div style="display: flex; flex-direction: column; align-items: flex-end;">  SP: Poorly graded sands  SW: Well graded sands  GP: Poorly graded gravels  GW: Well graded gravels </div> </td></tr> <tr> <td style="vertical-align: top;"> <p style="text-align: center;">SANDS & GRAVELS WITH HIGH FINES CONTENT</p> <p style="text-align: center;">(> 15% FINES CONTENT)</p> </td><td style="vertical-align: top;"> <div style="display: flex; flex-direction: column; align-items: flex-end;">  SM: Silty sands  GM: Silty gravels  SC: Clayey sands  GC: Clayey gravels </div> </td></tr> </table>	<p style="text-align: center;">CLEAN SANDS & GRAVELS</p> <p style="text-align: center;">(< 5% FINES CONTENT)</p>	<div style="display: flex; flex-direction: column; align-items: flex-end;">  SP: Poorly graded sands  SW: Well graded sands  GP: Poorly graded gravels  GW: Well graded gravels </div>	<p style="text-align: center;">SANDS & GRAVELS WITH HIGH FINES CONTENT</p> <p style="text-align: center;">(> 15% FINES CONTENT)</p>	<div style="display: flex; flex-direction: column; align-items: flex-end;">  SM: Silty sands  GM: Silty gravels  SC: Clayey sands  GC: Clayey gravels </div>		
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<p style="text-align: center;">SANDS & GRAVELS WITH HIGH FINES CONTENT</p> <p style="text-align: center;">(> 15% FINES CONTENT)</p>	<div style="display: flex; flex-direction: column; align-items: flex-end;">  SM: Silty sands  GM: Silty gravels  SC: Clayey sands  GC: Clayey gravels </div>						
<p style="text-align: center;">FINE GRAINED SOIL - SILTS & CLAYS</p> <p style="text-align: center;">(MORE THAN 50% OF MATERIAL PASSES NO. 200 SEIVE)</p>	<table border="0" style="width: 100%;"> <tr> <td style="vertical-align: top;"> <p style="text-align: center;">SILTS</p> </td><td style="vertical-align: top;"> <div style="display: flex; flex-direction: column; align-items: flex-end;">  ML: Low plasticity inorganic silts  MH: High plasticity inorganic silts </div> </td></tr> <tr> <td style="vertical-align: top;"> <p style="text-align: center;">CLAYS</p> </td><td style="vertical-align: top;"> <div style="display: flex; flex-direction: column; align-items: flex-end;">  CL: Low placticity inorganic clays  CH: High plasticity inorganic clays </div> </td></tr> <tr> <td style="vertical-align: top;"> <p style="text-align: center;">ORGANIC SILTS & CLAYS</p> </td><td style="vertical-align: top;"> <div style="display: flex; flex-direction: column; align-items: flex-end;">  OL: Low plasticity organic silts and clays  OH: High plasticity organic silts and clays </div> </td></tr> </table>	<p style="text-align: center;">SILTS</p>	<div style="display: flex; flex-direction: column; align-items: flex-end;">  ML: Low plasticity inorganic silts  MH: High plasticity inorganic silts </div>	<p style="text-align: center;">CLAYS</p>	<div style="display: flex; flex-direction: column; align-items: flex-end;">  CL: Low placticity inorganic clays  CH: High plasticity inorganic clays </div>	<p style="text-align: center;">ORGANIC SILTS & CLAYS</p>	<div style="display: flex; flex-direction: column; align-items: flex-end;">  OL: Low plasticity organic silts and clays  OH: High plasticity organic silts and clays </div>
<p style="text-align: center;">SILTS</p>	<div style="display: flex; flex-direction: column; align-items: flex-end;">  ML: Low plasticity inorganic silts  MH: High plasticity inorganic silts </div>						
<p style="text-align: center;">CLAYS</p>	<div style="display: flex; flex-direction: column; align-items: flex-end;">  CL: Low placticity inorganic clays  CH: High plasticity inorganic clays </div>						
<p style="text-align: center;">ORGANIC SILTS & CLAYS</p>	<div style="display: flex; flex-direction: column; align-items: flex-end;">  OL: Low plasticity organic silts and clays  OH: High plasticity organic silts and clays </div>						

CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY



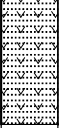
	NUMBER OF BLOWS, N	APPROXIMATE RELATIVE DENSITY
SANDS AND GRAVELS	0 - 4	Very Loose
	5 - 10	Loose
	11 - 30	Medium Dense
	31 - 50	Dense
	OVER 50	Very Dense
	NUMBER OF BLOWS, N	APPROXIMATE RELATIVE CONSISTENCY
SILTS AND CLAYS	0 - 1	Very Soft
	2 - 4	Soft
	5 - 8	Firm
	9 - 15	Stiff
	16 - 30	Very Stiff
	31 - 50	Hard
	OVER 50	Very Hard




LOG OF BORING B-1

NOTES: 1. No groundwater encountered at the time of boring (NGWE).

WATER LEVEL ∇ TOB (feet): NGWE \blacktriangledown 24HR (feet): NGWE

[illegible]

SPOUT SPRINGS WATER RECLAMATION FACILITY EXPANSION TO 1.6 MGD HALL COUNTY, GEORGIA					LOG OF BORING B-1A																
GEOLOGIST: NA			ELEVATION (feet): 976							NOTES: 1. No groundwater encountered at the time of boring (NGWE). 2. Boring location offset 5 feet north from boring B-1.											
DATE DRILLED: 6/8/2023			BORING DEPTH (feet): 5																		
DRILLER: GABLE DRILLING CO., INC.			WATER LEVEL  TOB (feet): NGWE  24HR (feet): NGWE																		
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER																					
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION					ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)												
									2	3	4	5	6	10	20	30	40	60	80		
0		Auger boring: No samples collected. (See log of boring B-1 for soil description)					976														
3		PARTIALLY WEATHERED ROCK: Sampled as very dense tan silty fine to coarse SAND (SM)					973														
		Auger refusal at 5 feet.					50/3														

SPOUT SPRINGS WATER RECLAMATION FACILITY EXPANSION TO 1.6 MGD HALL COUNTY, GEORGIA				LOG OF BORING B-2												
GEOLOGIST: NA		ELEVATION (feet): 970						NOTES: 1. No groundwater encountered at the time of boring (NGWE).								
DATE DRILLED: 6/9/2023		BORING DEPTH (feet): 5														
DRILLER: GABLE DRILLING CO., INC.		WATER LEVEL  TOB (feet): NGWE  24HR (feet): NGWE														
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER																
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)											
					2	3	4	5	6	10	20	30	40	60	80	
0		RESIDUUM: medium dense light brown silty fine SAND (SM), trace clay, rock fragments	970													
				21												
3		PARTIALLY WEATHERED ROCK: Sampled as very dense brown silty fine SAND (SM)	967													
		Auger refusal at 5 feet.	50/5"													

LOG OF BORING B-2A

NOTES: 1. No groundwater encountered at the time of boring (NGWE). 2. Boring location offset 5 feet north from boring B-2.

BORING DEPTH (feet): 4

WATER LEVEL ∇ TOB (feet): NGWE \blacktriangledown 24HR (feet): NGWE







DRILLING METHOD: *HOLLOW STEM AUGER WITH AUTOMATIC HAMMER*




[illegible]




**SPOUT SPRINGS WATER RECLAMATION FACILITY
EXPANSION TO 1.6 MGD
HALL COUNTY, GEORGIA**




LOG OF BORING B-3

GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>973</i>	NOTES: 1. No groundwater encountered at the time of boring (NGWE).
DATE DRILLED: <i>6/9/2023</i>	BORING DEPTH (feet): <i>17</i>	
DRILLER: <i>GABLE DRILLING CO., INC.</i>	WATER LEVEL ▾ TOB (feet): <i>NGWE</i> ▾ 24HR (feet): <i>NGWE</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)													
					2	3	4	5	6	10	20	30	40	60	80			
0		2" - TOPSOIL	973															
		FILL: Medium dense brown silty fine to coarse SAND (SM), rock fragments																
3		RESIDUUM: Medium dense brown silty fine to medium SAND (SM), moist	970															
6		Dense to medium dense dark brown silty fine to medium SAND (SM), moist	967															
9		Medium dense tan brown silty fine to medium SAND (SM), moist.	964															
12			961															
15			958															
		Auger refusal at 17 feet.																

SPOUT SPRINGS WATER RECLAMATION FACILITY EXPANSION TO 1.6 MGD HALL COUNTY, GEORGIA				LOG OF BORING B-4															
GEOLOGIST: NA		ELEVATION (feet): 970						NOTES: 1. No groundwater encountered at the time of boring (NGWE).											
DATE DRILLED: 6/8/2023		BORING DEPTH (feet): 15																	
DRILLER: GABLE DRILLING CO., INC.		WATER LEVEL  TOB (feet): NGWE  24HR (feet): NGWE																	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER																			
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)														
					2	3	4	5	6	10	20	30	40	60	80				
0		<u>FILL</u> : Medium dense brown silty fine to coarse SAND (SM), rock fragments	970																
3		<u>RESIDUUM</u> : Loose dark brown silty fine SAND (SM), wet	967	25															
6		Dense tan silty fine to medium SAND (SM), moist	964	8															
9		Very dense gray silty fine SAND (SM)	961	46															
12		<u>PARTIALY WEATHERED ROCK</u> : Sampled as very dense tan brown silty fine to medium SAND (SM), rock fragments	958	70															
		Auger refusal at 15 feet.	50/4"																

SPOUT SPRINGS WATER RECLAMATION FACILITY EXPANSION TO 1.6 MGD HALL COUNTY, GEORGIA				LOG OF BORING B-5																
GEOLOGIST: NA		ELEVATION (feet): 972				NOTES: 1. No groundwater encountered at the time of boring (NGWE).														
DATE DRILLED: 6/9/2023		BORING DEPTH (feet): 13																		
DRILLER: GABLE DRILLING CO., INC.		WATER LEVEL  TOB (feet): NGWE  24HR (feet): NGWE																		
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER																				
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)															
					2	3	4	5	6	10	20	30	40	60	80					
0		<u>FILL</u> : Medium dense gray brown silty clayey fine SAND (SC)	972																	
3		Firm orange brown fine sandy CLAY (CL)	969	16																
6		<u>RESIDUUM</u> : Loose dark brown silty fine SAND (SM)	966	6																
		Medium dense dark gray brown silty fine to coarse SAND (SM)		8																
9				963	12															
12		Auger refusal at 13 feet.	960																	

SPOUT SPRINGS WATER RECLAMATION FACILITY EXPANSION TO 1.6 MGD HALL COUNTY, GEORGIA				LOG OF BORING B-6																
GEOLOGIST: NA		ELEVATION (feet): 968				NOTES: 1. No groundwater encountered at the time of boring (NGWE).														
DATE DRILLED: 6/9/2023		BORING DEPTH (feet): 6																		
DRILLER: GABLE DRILLING CO., INC.		WATER LEVEL  TOB (feet): NGWE  24HR (feet): NGWE																		
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER																				
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)															
					2	3	4	5	6	10	20	30	40	60	80					
0		RESIDUUM: Medium dense dark brown silty fine to coarse SAND (SM)	968	13 965 50/5"																
3		PARTIALLY WEATHERED ROCK: Sampled as very dense dark brown silty fine to coarse SAND (SM)																		
		Auger refusal at 6 feet.																		

LOG OF BORING B-6A


NOTES: 1. No groundwater encountered at the time of boring (NGWE). 2. Boring location offset 10 feet south west from boring B-6.

location offset 10 feet south west from boring B-6.




WATER LEVEL ∇ TOB (feet): NGWE \blacktriangledown 24HR (feet): NGWE

[illegible]

SPOUT SPRINGS WATER RECLAMATION FACILITY EXPANSION TO 1.6 MGD HALL COUNTY, GEORGIA					LOG OF BORING B-7														
GEOLOGIST: NA			ELEVATION (feet): 967						NOTES: 1. No groundwater encountered at the time of boring (NGWE).										
DATE DRILLED: 6/9/2023			BORING DEPTH (feet): 8																
DRILLER: GABLE DRILLING CO., INC.			WATER LEVEL <input type="checkbox"/> TOB (feet): NGWE <input checked="" type="checkbox"/> 24HR (feet): NGWE																
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER																			
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION				ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)											
								2	3	4	5	6	10	20	30	40	60	80	
0		PARTIALLY WEATHERED ROCK: Sampled as very dense gray silty fine to medium SAND (SM)				967													
							50/5"												
3		Very dense light brown silty fine to coarse SAND (SM)				964													
							50/1"												
6		Very dense gray silty fine to coarse SAND (SM)				961													
							50/2"												
		Auger refusal at 8 feet.																	

SPOUT SPRINGS WATER RECLAMATION FACILTY EXPANSION TO 1.6 MGD HALL COUNTY, GEORGIA					LOG OF BORING B-8														
GEOLOGIST: NA			ELEVATION (feet): 956						NOTES: 1. No groundwater encountered at the time of boring (NGWE).										
DATE DRILLED: 6/9/2023			BORING DEPTH (feet): 3																
DRILLER: GABLE DRILLING CO., INC.			WATER LEVEL ▽ TOB (feet): NGWE ▼ 24HR (feet): NGWE																
DRILLING METHOD: HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER																			
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION				ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)											
								2	3	4	5	6	10	20	30	40	60	80	
0		RESIDUUM: Medium dense gray brown silty fine to coarse SAND (SM), rock fragments				956	24												
		Auger refusal at 3 feet.																	

SPOUT SPRINGS WATER RECLAMATION FACILITY EXPANSION TO 1.6 MGD HALL COUNTY, GEORGIA				LOG OF BORING B-8A																
GEOLOGIST: NA		ELEVATION (feet): 956						NOTES: 1. No groundwater encountered at the time of boring (NGWE). 2. Boring location offset 10 feet south west from boring B-8.												
DATE DRILLED: 6/9/2023		BORING DEPTH (feet): 3																		
DRILLER: GABLE DRILLING CO., INC.		WATER LEVEL ▽ TOB (feet): NGWE ▼ 24HR (feet): NGWE																		
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER																				
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)															
					2	3	4	5	6	10	20	30	40	60	80					
0		Auger boring: No samples collected. (See log of boring B-8 for soil description)	956																	
		Auger refusal at 3 feet.																		

SPOUT SPRINGS WATER RECLAMATION FACILITY EXPANSION TO 1.6 MGD HALL COUNTY, GEORGIA				LOG OF BORING B-9															
GEOLOGIST: NA		ELEVATION (feet): 950						NOTES: 1. No groundwater encountered at the time of boring (NGWE).											
DATE DRILLED: 6/9/2023		BORING DEPTH (feet): 5																	
DRILLER: GABLE DRILLING CO., INC.		WATER LEVEL  TOB (feet): NGWE  24HR (feet): NGWE																	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER																			
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)														
					2	3	4	5	6	10	20	30	40	60	80				
0		RESIDUUM: Medium dense brown to dark brown clayey SAND (SC)	950																
3		PARTIALLY WEATHERED ROCK: Sampled as very dense gray brown silty fine to medium SAND (SM), rock fragments	947																
		Auger refusal at 5 feet.	50/4"																

SPOUT SPRINGS WATER RECLAMATION FACILITY EXPANSION TO 1.6 MGD HALL COUNTY, GEORGIA					LOG OF BORING B-9A																
GEOLOGIST: NA			ELEVATION (feet): 950					NOTES: 1. No groundwater encountered at the time of boring (NGWE). 2. Boring location offset 10 feet northeast from boring B-9.													
DATE DRILLED: 6/9/2023			BORING DEPTH (feet): 12																		
DRILLER: GABLE DRILLING CO., INC.			WATER LEVEL ▽ TOB (feet): NGWE ▼ 24HR (feet): NGWE																		
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER																					
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)																
					2	3	4	5	6	10	20	30	40	60	80						
0		Auger boring: No samples collected. (See log of boring B-9 for soil description)	950																		
3			947																		
6		PARTIALLY WEATHERED ROCK: Sampled as very dense gray brown silty fine to medium SAND (SM), trace clay, rock fragments	944	50/5																	
9			941	50/4"																	
		Auger refusal at 12 feet.																			

LOG OF BORING B-10

NOTES: 1. No groundwater encountered at the time of boring (NGWE).

WATER LEVEL ▽ TOB (feet): *NGWE* ▼ 24HR (feet): *NGWE*

[illegible]

LOG OF BORING B-11

NOTES: 1. No groundwater encountered at the time of boring (NGWE).

WATER LEVEL ∇ TOB (feet): NGWE \blacktriangledown 24HR (feet): NGWE

[illegible]

LOG OF BORING B-11A

NOTES: 1. No groundwater encountered at the time of boring (NGWE). 2. Boring location offset 5 feet north from boring B-11.

WATER LEVEL ∇ TOB (feet): NGWE \blacktriangledown 24HR (feet): NGWE

[illegible]

LOG OF BORING B-12

NOTES: 1. No groundwater encountered at the time of boring (NGWE).

WATER LEVEL ▽ TOB (feet): *NGWE* ▼ 24HR (feet): *NGWE*

[illegible]

LOG OF BORING B-13

NOTES: 1. No groundwater encountered at the time of boring (NGWE).

WATER LEVEL ▽ TOB (feet): *NGWE* ▼ 24HR (feet): *NGWE*

[illegible]