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ADDENDUM NO. 1

Date: November 21, 2023

Project Name: Hilliard N. Fletcher WRRF Phase II Improvements

Tuscaloosa Project No.: File No. OCA-23-1043
Engineering Project No. 2024.702.001

Garver Project No.: 19W10160

This addendum shall be a part of the Plans, Contract Documents and Specifications to the same extent as though it were originally included therein, and it shall supersede anything contained in the Plans, Contract Documents, and Specifications with which it might conflict. This Addendum No. 1, including all attachments shall become part of the Contract and all provisions of the Contract shall apply thereto, with exception to the items listed under "Other Project Information" at the end of this Addendum, which are supplements provided for the Contractor's convenience. **The time provided for completion of the Contract has not been changed by this addendum.** Acknowledgement of receipt of this Addendum must be noted in the appropriate section of the Bid Proposal and included with the Contract Documents.

A. SPECIFICATIONS – Volumes 1 and 2

1. Remove the following specification sections in their entirety and replace with the same:
 - a. 01 14 00 – WORK RESTRICTIONS
 - b. 01 20 00 – PRICE AND PAYMENT PROCEDURES
 - c. 40 23 43 – PROCESS VALVES
 - d. 40 67 23 – CONTROL PANELS
 - e. 41 20 00 – HYDROGEN SULFIDE REMOVAL EQUIPMENT

B. STANDARD DETAILS – Volume 3

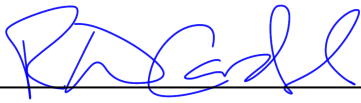
None

C. DRAWINGS – Volume 4

1. Revise Drawings 11-X102, 12-X102, and 13-X103 as follows:
 - a. Add the following general notes:
 5. Contractor shall remove all existing exposed conduit to cover mounted equipment, instrumentation, and other devices that is/will be no longer in service. Seal/patch any holes, as required.
 6. Contractor shall assess the structural stability of all exposed brick sections/facades on exterior of digester tank. Any additional repairs and/or demolition necessary to address these areas shall be paid from using the contingency allowance based on extent of repairs or additional demolition.

D. OTHER PROJECT INFORMATION (Non-Contract Documents)

1. Other project information (non-contract documents) has been made available for the Contractor's convenience and includes the following:
 - a. Questions and Answers No. 1
 - b. Prebid Meeting Information

By: 
Wes Cardwell, P.E.
Project Manager



Attachments:

1. Specifications:
 - a. 01 14 00 – WORK RESTRICTIONS
 - b. 01 20 00 – PRICE AND PAYMENT PROCEDURES
 - c. 40 23 43 – PROCESS VALVES
 - d. 40 67 23 – CONTROL PANELS
 - e. 41 20 00 – HYDROGEN SULFIDE REMOVAL EQUIPMENT
2. Standard Details:
 - a. None
3. Drawings:
 - a. None

END OF ADDENDUM NO.1

SECTION 01 14 00 – WORK RESTRICTIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Work restrictions.
 - 2. Work sequencing.

- B. Related Requirements:
 - 1. Section 01 20 00 – Price and Payment Procedures.
 - 2. Section 01 32 16 – Construction Progress Schedule.
 - 3. Section 01 50 00 – Temporary Facilities and Controls.
 - 4. Section 01 70 00 – Execution Requirements.
 - 5. Section 01 77 00 – Closeout Procedures.

1.2 GENERAL WORK RESTRICTIONS

- A. Wastewater Treatment Facilities
 - 1. The existing Hilliard N. Fletcher WRRF facility is the City of Tuscaloosa's only means of treating domestic and industrial wastewater prior to discharge. Impairing the operational capabilities of this facility will result in serious environmental damage and monetary fines.
 - 2. Contractor shall bear the cost of penalties imposed on the Owner for discharge violations or other violations caused by actions of the Contractor.
 - 3. Conduct work in a manner that will not impair the operational capabilities of essential elements of the treatment process or reduce the capacity of the entire treatment plant below levels sufficient to treat the quality of raw wastewater to the water quality limitations specified in the discharge permit.
 - 4. The status of the treatment plant shall be defined as "operational" when it is capable of treating the entire quantity of wastewater received to the water quality limits specified in the discharge permit.

- B. Time Restrictions for Performing Work: Regular operating hours as determined by the Owner are from 7 am to 5 pm Monday through Friday.

- C. On-Site Workday Restrictions: Do not perform Work on Site during Work blackout days indicated by Owner.

- D. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction (AHJ).

- E. Provide safe, continuous access to process control equipment for plant operations personnel.

- F. Noise, Vibration, Dust, and Odors: Coordinate with Owner operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy.
 - 1. Notify Engineer or Owner not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Engineer's or Owner's written permission before proceeding with disruptive operations.

- G. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, marijuana, and other controlled substances on Project Site, premises, or on Owner's property is not permitted.

- H. Employee Identification: Provide identification tags for Contractor personnel working on Project Site. Require personnel to use identification tags at all times.
- I. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project Site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

1.3 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Restricted Use of Site: Contractor shall have limited use of Project Site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Limits on Use of Site: Limit use of Project Site to Work in areas indicated. Do not disturb portions of Project Site beyond areas in which the Work is indicated.
- C. Limits on Use of Site:
 - 1. Limit use of Site and premises to allow:
 - a. Owner occupancy.
 - b. Work by Owner.
 - c. Work by Others.
 - d. Use by the public where required.
 - 2. Driveways, Walkways, and Entrances: Keep driveways, parking areas, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on Site.
- D. Construction Operations: Limited to areas indicated on Drawings.
 - 1. Noisy and Disruptive Operations (such as Use of Jack Hammers and Other Noisy Equipment): Not allowed in close proximity to existing building during regular hours of operation. Coordinate and schedule such operations with Owner to minimize disruptions.
- E. Sound Level Restrictions: Sound pressure level measured at boundary of Site shall not exceed levels required by local ordinances or codes, and at no time shall exceed 40 dBA.

1.4 FACILITY OPERATIONS

- A. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions, and only after arranging for temporary utility services according to requirements indicated:
 - 1. Notify Engineer and Owner not less than seven days in advance of proposed utility interruptions.
 - 2. Submit outage request plan to Engineer and Owner itemizing dates, times, and duration of each requested outage.
 - 3. Obtain Owner's written permission before proceeding with utility interruptions.
- B. Existing Operations Interruptions: Do not shutdown, interrupt, or otherwise impair the operational capability of treatment facilities or processes unless permitted under the following conditions. A facility or process shall be considered operational when it can achieve its defined treatment or process objective as defined by the Owner or Engineer.

1. Indicate required shutdowns of existing facilities or interruptions of existing operations on Construction Progress Schedule.
 2. Where required to minimize interruptions or impairments to systems operations while complying with specified work constraints, provide temporary treatment equipment, pumping, bypass systems, connections, power, lighting, controls, instrumentation, and safety devices.
 3. Do not remove or demolish systems required to keep the existing facilities operational at the capacities specified until the existing systems are replaced by temporary or new systems.
- C. Shutdown Constraints: Perform work within the following critical operational constraints:
1. Contractor shall coordinate all scheduled outages with the Engineer, the Plant Superintendent, and Chief Operator.
- D. Shutdown Definitions
1. Minor Shutdown: Any shutdown requiring less than four (4) hours.
 2. Major Shutdown: Any shutdown other than a minor shutdown.
 3. Dry Weather Period: Generally, June 1 to October 1. Final determination made by Owner based on weather, flows entering the plant, and plant operation requirements.
 4. Wet Weather Period: Any time not within the defined dry weather period.
 5. Low Flow Period: 2:00am to 6:00am.
- E. Shutdown Procedures
1. Notify Engineer and Owner not less than fourteen (14) days in advance of proposed minor shutdowns.
 2. Notify Engineer and Owner not less than thirty (30) days in advance of proposed major shutdowns.
 3. Contractor shall schedule a shutdown coordination meeting with Owner and Engineer one week prior to each shutdown.
 4. Any and all plant shutdowns shall require a shutdown plan, including detailed schedule, backup tools and equipment, personnel involved, contingency plan, and any procedures involved in restarting the process or facility.
 5. Obtain Engineer's or Owner's written permission before proceeding with proposed shutdowns.
 6. Shutdowns will only be allowed in dry weather periods. Shutdowns may be limited to low flow periods.

1.5 WORK SEQUENCE

- A. Use identified work sequences in this section as a guideline for scheduling and performing work. Perform work in a manner that will not prevent the facility from achieving the final treated water quality requirements established by regulation.
- B. Work sequence and constraints presented do not include all items affecting completion of the Work. They are intended to describe critical events necessary to minimize disruption to existing operations and to ensure compliance with treatment regulations and permit requirements.
- C. Construct Work in phases during construction period. Coordinate construction schedule and operations with Engineer and Owner:
1. North Aeration Basins Improvements
 - a. Field locate existing underground utilities through use of ground penetrating radar (GPR) and submit layout to Owner and Engineer for review and to confirm proposed layout of blower piping will not interfere with existing utilities.
 - b. The above grade piping system may be constructed without the need to take either basin out of service. More specifically, the blower discharge piping segments (not

- yet connected to blower equipment), main aeration blower header, pipe bridge, and blower discharge piping segments to each basin (not yet connected to aeration piping at basins) can be installed while the existing processes remain online.
- c. Once the above-grade piping system is in place, the Owner shall designate which basin shall be taken offline to begin rehabilitation of the diffuser system. The Owner will drain the desired tank. Once the tank has been drained, the Contractor assumes full responsibility for removing all remaining solids within the tank necessary to complete the Work and completing the necessary diffuser replacement. All work within the individual basin, including testing and system adjustments to the satisfaction of the Owner, must be completed and the basin placed back into service within 21 days.
 - d. In Aeration Basin No. 1, because the Nitrate Recycle Valve (NRCY) is stuck in an open position due to a broken stem, the effluent channel must also be taken offline at the same time the aeration basin is taken out of service. This channel cannot be offline for more than 12 hours and all Work related to this valve must be completed within this time window. Once repairs to the NRCY valve have been completed, the Owner will return this section of the effluent channel back into service. If necessary, the same procedure will apply to Aeration Basin No. 2 depending on the ability of the existing NRCY valve to fully close.
 - e. The corresponding effluent channel for the basin out of service will be taken out of service to allow the diffuser replacement and the necessary tie-in of the new above-grade aeration piping to be completed. All Work within each effluent channel segment must be completed within a 12-hour time window. Following this tie-in, the isolation valves on the aeration piping systems should be set into position such that all process air is still provided from the below-grade piping system.
 - f. Once all Work has been completed at the aeration basins and both segments of the proposed above-grade piping system have been connected to aeration piping at the basins, work can begin to connect blowers to the above-grade piping system. Blowers will be connected to the above-grade system in two phases. During the first phase, blowers currently in "STANDBY" status are to be disconnected from the existing piping system and connected to the new discharge piping system. Once these blowers are in place, all valves within the aeration piping systems will be set into position such that air is provided from the above-grade piping system and, simultaneously, the blowers providing air to the below grade system shall be turned off. At that time, the remaining blowers can now be connected to the new discharge piping system.
 - g. All existing mass-flow meters can be relocated to the new locations as indicated on the Drawings.
 - h. Upon completion of the work to bring the above-grade system online, work to complete the tie-in for the aeration piping to the Hydrologically Controlled Release structure and all necessary demolition and abandon-in-place tasks as detailed on the Drawings shall be performed.
 - i. To complete the required demolition of the below-grade piping system, the piping at each existing air meter box is to be disconnected and a blind flange installed.
2. Anaerobic Digesters
 - a. At all times, the Contractor shall exercise extreme caution when working around the digester facility and shall take all necessary precautions to maintain safe working conditions.
 - b. For the rehabilitation effort, no more than two anaerobic digesters may be taken out of service at any given time. At a minimum, one anaerobic digester and the digested sludge storage tank must remain functional and available for operations.
 - c. The digester rehabilitation effort should be completed as follows:

- 1) Prior to commencing the Work, the Owner shall remove and dewater as much of the solids from the digester as possible. When the Contractor is ready to begin Work, the Owner will stop dewatering from the specified digester to be cleaned out and formally turn this tank over to the Contractor. Existing operations will continue, as normal, for the remaining anaerobic digester(s).
 - 2) Contractor shall remove all solids from the digester tank and complete the cleanout effort in accordance with Section 44 10 00, DIGESTER CLEANING AND COVER INSPECTION.
 - 3) Once cleaned out, the Contractor shall begin demolition of interior systems as indicated on the drawings. Simultaneously, temporary scaffolding or other provisions necessary for the cover manufacturer to assess the existing cover shall be setup.
 - 4) Upon completion of the cover assessment, the Contractor shall submit the findings and recommendations prepared by the cover manufacturer and the Owner and Engineer will determine what, if any, cover repairs are to be added to the project. These repairs are to be paid out of the contingencies included in the Base Bid price.
 - 5) Additionally, the Owner and Engineer will determine if the protective coating system is to be removed and re-applied. If determined to be included in the rehabilitation effort, this effort will be paid from the bid item included in the Base Bid price for the cover system protective coating replacement. If the existing protective coating system is determined to be in acceptable condition, no payment will be made for this item.
 - 6) Contractor shall complete construction of all other improvements including, but not limited to, installation of the new mixing system, digester gas handling system modifications, construction of the gravity sludge transfer box and associated piping.
 - 7) When complete, Contractor shall coordinate with Owner and Engineer to bring the digester back into service to complete the performance testing effort.
3. Digester Control Building Improvements
 - a. Contractor to complete improvements to existing digester electrical control room including, but not limited to, replacement of motor control centers, control room isolation, HVAC upgrades, roof rehabilitation, transfer piping support, and roof access.
 - b. This effort must be coordinated with the Owner and Engineer to ensure process-critical equipment can be taken offline appropriately.
 4. Digester Gas Conditioning Improvements
 - a. Construction of the digester gas scrubber may occur simultaneously with any other improvements.

1.6 SEQUENCING OF CONSTRUCTION PLAN

- A. Before start of construction, post electronic file to Project website of construction plan regarding phasing of project and new Work for acceptance by Owner. After acceptance of plan, comply with accepted plan when coordinating construction sequencing unless deviations are accepted by Owner in writing.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 20 00 – PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Cash allowances.
 2. Contingency allowances.
 3. Testing and inspection allowances.
 4. Schedule of Values.
 5. Application for Payment.
 6. Partial Payments.
 7. Defect assessment.
 8. Unit prices.
 9. Alternates.

1.2 BID ITEM DESCRIPTIONS

- A. The Basis of Payment will be as established in the Contract Documents, as lump sums or as unit price amounts based on actual quantities, and as described below:
1. **Base Bid Item No. 1: Mobilization and Demobilization**
 - a. Payment shall be at the lump sum price and shall include all labor, materials, tools, equipment, permits, bonds, insurance, overhead and profit, and other required costs necessary to move personnel, equipment, materials, tools, supplies, and incidentals to the project site prior to beginning work and to move personnel, equipment, materials, tools, supplies, and incidentals from the project site immediately after project acceptance.
 - b. Total payment for this bid item shall not exceed 5 percent of the contractor's base bid price. Payments for mobilization shall not exceed 75% of the total item. A minimum of 25% will be retained until such time that demobilization is complete, and the areas disturbed have been fully restored and accepted by the Owner.
 2. **Base Bid Item No. 2: Facility 05 – Site Civil Improvements**
 - a. Payment shall be at the lump sum price and shall be full compensation for all work, labor, materials, start-up, training, commissioning, and other required costs necessary to complete the work indicated in the Facility 05 drawings and associated specifications, except those items listed separately. Any and all modifications necessary to complete this work but not listed herein shall be included in this bid item.
 3. **Base Bid Item No. 3: Facility 11 – Anaerobic Digester No. 1 Improvements**
 - a. Payment shall be at the lump sum price and shall be full compensation for all work, labor, materials, start-up, training, commissioning, and other required costs necessary to complete the work indicated in the Facility 11 drawings and associated specifications, except those items listed separately. Any and all modifications necessary to complete this work but not listed herein shall be included in this bid item.
 - b. Costs to complete the assessment of the digester cover, as described in Section 44 10 00, DIGESTER CLEANING AND COVER INSPECTION, by the cover manufacturer shall be incorporated into this bid item.
 4. **Base Bid Item No. 4: Anaerobic Digester No. 1 Cleaning**
 - a. Payment shall be for the full compensation, at the contract unit price per dry ton, for all work, labor, equipment, and materials to complete the digester cleanout effort as described in Section 44 10 00, DIGESTER CLEANING AND COVER INSPECTION.
 - b. Costs to complete the assessment of the digester cover shall be included in Base Bid Item No. 3.

- c. Costs for mobilization and demobilization specific to the digester cleaning shall be included in Base Bid Item No. 3.
- 5. **Base Bid Item No. 5: Anaerobic Digester No. 1 Cover System Protective Coating System Replacement**
 - a. Payment shall be at the lump sum price and shall be full compensation for all work, labor, materials, start-up, training, commissioning, and other required costs necessary to complete the replacement of the protective coating system on the underside of the Anaerobic Digester No. 1 cover system.
 - b. This work shall only be completed at the authorization by the Owner and Engineer, based on the recommendations of the cover manufacturer following the cover assessment.
 - c. If the existing protective coating system is determined to be in acceptable condition or the Owner and Engineer do not authorize this work, this bid item will not be paid and the amount indicated on the bid form will be credited back to the Owner by Change Order.
- 6. **Base Bid Item No. 6: Anaerobic Digester No. 1 Cover Repairs Contingency Allowance**
 - a. This contingency allowance is to be used for any repairs to the Anaerobic Digester No. 1 cover system based on the observations and recommendations of the cover manufacturer following the assessment.
 - b. This work shall only be completed at the authorization by the Owner and Engineer, based on the recommendations of the cover manufacturer following the cover assessment, and review of the costs prepared by the Contractor to address these recommendations.
 - c. Any additional costs for repairs, not covered by this contingency allowance, will be made from the general project contingency allowance or through a formal Change Order.
 - d. At closeout of the Contract, any funds remaining in this bid item will be credited to Owner by Change Order.
- 7. **Base Bid Item No. 7: Facility 12 – Anaerobic Digester No. 2 Improvements**
 - a. Payment shall be at the lump sum price and shall be full compensation for all work, labor, materials, start-up, training, commissioning, and other required costs necessary to complete the work indicated in the Facility 12 drawings and associated specifications, except those items listed separately. Any and all modifications necessary to complete this work but not listed herein shall be included in this bid item.
 - b. Costs to complete the assessment of the digester cover, as described in Section 44 10 00, DIGESTER CLEANING AND COVER INSPECTION, by the cover manufacturer shall be incorporated into this bid item.
- 8. **Base Bid Item No. 8: Anaerobic Digester No. 2 Cleaning**
 - a. Payment shall be for the full compensation, at the contract unit price per dry ton, for all work, labor, equipment, and materials to complete the digester cleanout effort as described in Section 44 10 00, DIGESTER CLEANING AND COVER INSPECTION.
 - b. Costs to complete the assessment of the digester cover shall be included in Base Bid Item No. 7.
 - c. Costs for mobilization and demobilization specific to the digester cleaning shall be included in Base Bid Item No. 7.
- 9. **Base Bid Item No. 9: Anaerobic Digester No. 2 Cover System Protective Coating System Replacement**
 - a. Payment shall be at the lump sum price and shall be full compensation for all work, labor, materials, start-up, training, commissioning, and other required costs necessary to complete the replacement of the protective coating system on the underside of the Anaerobic Digester No. 2 cover system.

- b. This work shall only be completed at the authorization by the Owner and Engineer, based on the recommendations of the cover manufacturer following the cover assessment.
 - c. If the existing protective coating system is determined to be in acceptable condition or the Owner and Engineer do not authorize this work, this bid item will not be paid and the amount indicated on the bid form will be credited back to the Owner by Change Order.
10. **Base Bid Item No. 10: Anaerobic Digester No. 2 Cover Repairs Contingency Allowance**
- a. This contingency allowance is to be used for any repairs to the Anaerobic Digester No. 2 cover system based on the observations and recommendations of the cover manufacturer following the assessment.
 - b. This work shall only be completed at the authorization by the Owner and Engineer, based on the recommendations of the cover manufacturer following the cover assessment, and review of the costs prepared by the Contractor to address these recommendations.
 - c. Any additional costs for repairs, not covered by this contingency allowance, will be made from the general project contingency allowance or through a formal Change Order.
 - d. At closeout of the Contract, any funds remaining in this bid item will be credited to Owner by Change Order.
11. **Base Bid Item No. 11: Facility 13 – Anaerobic Digester No. 3 Improvements**
- a. Payment shall be at the lump sum price and shall be full compensation for all work, labor, materials, start-up, training, commissioning, and other required costs necessary to complete the work indicated in the Facility 13 drawings and associated specifications, except those items listed separately. Any and all modifications necessary to complete this work but not listed herein shall be included in this bid item.
 - b. Costs to complete the assessment of the digester cover, as described in Section 44 10 00, DIGESTER CLEANING AND COVER INSPECTION, by the cover manufacturer shall be incorporated into this bid item.
12. **Base Bid Item No. 12: Anaerobic Digester No. 3 Cleaning**
- a. Payment shall be for the full compensation, at the contract unit price per dry ton, for all work, labor, equipment, and materials to complete the digester cleanout effort as described in Section 44 10 00, DIGESTER CLEANING AND COVER INSPECTION.
 - b. Costs to complete the assessment of the digester cover shall be included in Base Bid Item No. 3.
 - c. At closeout of the Contract, any funds remaining in this bid item will be credited to Owner by Change Order.
 - d. Costs for mobilization and demobilization specific to the digester cleaning shall be included in Base Bid Item No. 11.
13. **Base Bid Item No. 13: Anaerobic Digester No. 3 Cover System Protective Coating System Replacement**
- a. Payment shall be at the lump sum price and shall be full compensation for all work, labor, materials, start-up, training, commissioning, and other required costs necessary to complete the replacement of the protective coating system on the underside of the Anaerobic Digester No. 3 cover system.
 - b. This work shall only be completed at the authorization by the Owner and Engineer, based on the recommendations of the cover manufacturer following the cover assessment.
 - c. If the existing protective coating system is determined to be in acceptable condition or the Owner and Engineer do not authorize this work, this bid item will not be paid and the amount indicated on the bid form will be credited back to the Owner by Change Order.

14. **Base Bid Item No. 14: Anaerobic Digester No. 3 Cover Repairs Contingency Allowance**
 - a. This contingency allowance is to be used for any repairs to the Anaerobic Digester No. 1 cover system based on the observations and recommendations of the cover manufacturer following the assessment.
 - b. This work shall only be completed at the authorization by the Owner and Engineer, based on the recommendations of the cover manufacturer following the cover assessment, and review of the costs prepared by the Contractor to address these recommendations.
 - c. Any additional costs for repairs, not covered by this contingency allowance, will be made from the general project contingency allowance or through a formal Change Order.
 - d. At closeout of the Contract, any funds remaining in this bid item will be credited to Owner by Change Order.
15. **Base Bid Item No. 15: Facility 20 – Digester Control Building Improvements**
 - a. Payment shall be at the lump sum price and shall be full compensation for all work, labor, materials, start-up, training, commissioning, and other required costs necessary to complete the work indicated in the Facility 20 drawings and associated specifications, except those items listed separately. Any and all modifications necessary to complete this work but not listed herein shall be included in this bid item.
16. **Base Bid Item No. 16: Facility 35 – Digester Gas Scrubber Improvements**
 - a. Payment shall be at the lump sum price and shall be full compensation for all work, labor, materials, start-up, training, commissioning, and other required costs necessary to complete the work indicated in the Facility 35 drawings and associated specifications, except those items listed separately. Any and all modifications necessary to complete this work but not listed herein shall be included in this bid item.
17. **Base Bid Item No. 17: Facility 40 – North Aeration Basin Improvements**
 - a. Payment shall be at the lump sum price and shall be full compensation for all work, labor, materials, start-up, training, commissioning, and other required costs necessary to complete the work indicated in the Facility 40 drawings and associated specifications, except those items listed separately. Any and all modifications necessary to complete this work but not listed herein shall be included in this bid item.
18. **Base Bid Item No. 18: General Project Contingency Allowance**
 - a. Payment shall be at the lump sum price and shall be full compensation for all work, labor, materials, start-up, training, commissioning, and other required costs necessary for work identified during the project.
 - b. Expenditure of any portion of the contingency allowance shall only be done following written authorization by Owner and Engineer. Contingency allowances are estimated amounts and final payment shall be based on actual costs as authorized by Change Order and the Contract Prices shall be correspondingly adjusted.
 - c. At closeout of the Contract, any funds remaining in the contingency allowance will be credited to Owner by Change Order.

1.3 DEDUCTIVE BID ALTERNATES

- A. In addition to the Base Bid Project, Owner may elect to remove a combination of the following Deductive Bid Alternates for which payment is as described below:
 1. **Deductive Alternate Item No. 1: Facility 35 – Digester Scrubber**
 - a. Deductions shall be for the full compensation, at the lump sum price, for all work, labor and materials associated with the Work indicated for Facility 35, in its entirety.
 2. **Deductive Alternate Item No. 2: Facility 12 – Anaerobic Digester No. 2**

- a. Deductions shall be for the full compensation, at the lump sum price, for all work, labor and materials associated with the Work associated with cleanout, rehabilitation, and improvements to Facility 12, Anaerobic Digester No. 2.
- b. All individual base bid items associated with completing the Work specific to Anaerobic Digester No. 2 shall be included in the deductive alternate.
- 3. **Deductive Alternate Item No. 3: Facility 13 – Anaerobic Digester No. 3**
 - a. Deductions shall be for the full compensation, at the lump sum price, for all work, labor and materials associated with the Work associated with cleanout, rehabilitation, and improvements to Facility 13, Anaerobic Digester No. 3.
 - b. All individual base bid items associated with completing the Work specific to Anaerobic Digester No. 3 shall be included in the deductive alternate.
- 4. **Deductive Alternate Item No. 4: Facility 20 – Digester Control Building Roof Replacement**
 - a. Deductions shall be for the full compensation, at the lump sum price, for all work, labor and materials associated with replacement of the existing roof on the Digester Control Building.
 - b. The Contractor shall still be responsible for any repairs to the existing roof due to work associated with other improvements in other Facility drawings.
- 5. **Deductive Alternate Item No. 5: Panels FP-13-1, FP-15-1, and FP-16-7 Replacement**
 - a. Deductions shall be for the full compensation, at the lump sum price, for all work, labor and materials associated with replacement of control panels FP-13-1, FP-15-1, and FP-16-7 in the electrical room of the Digester Control Building and included in the Facility 20 drawings.

1.4 CONTINGENCY ALLOWANCES

- A. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead, and profit will be included in Change Orders authorizing expenditure of funds from the contingency allowance.
- B. Funds will be drawn from contingency allowance only by Change Order.
- C. At closeout of Contract, funds remaining in contingency allowance will be credited to Owner by Change Order.

1.5 SCHEDULE OF VALUES

- A. Submit electronic file to Project website of schedule on Progress Estimate schedule on EJCDC C-620 or form approved by Engineer and Owner. Document shall be a Microsoft Excel file type.
- B. Apparent "low-bidder" shall submit a preliminary Schedule of Values as electronic file within 2 days after bid opening.
- C. Submit complete Schedule of Values as electronic file to Project website within 10 days after date of Owner-Contractor Agreement.
- D. Format: Use Table of Contents of this Project Manual. Identify each line item with number and title of major Specification Section. Also identify mobilization, bonds and insurance, progress schedule development, startup and commissioning, contract close-out, and demobilization as separate line items.
- E. Include in each line item amount of allowances as specified in this Section. For unit cost allowances, identify quantities taken from Contract Documents multiplied by unit cost to achieve total for each item.

- F. Include within each line item, direct proportional amount of Contractor's overhead and profit.
- G. Revise schedule to list approved Change Orders with each Application for Payment.
- H. An unbalanced or front-loaded schedule of values, or a schedule of values substantially different than the preliminary schedule, will not be accepted.
- I. Summation of the complete schedule of values representing all Work shall equal the Contract Price.

1.6 APPLICATION FOR PAYMENT

- A. AIA G736 replaces G722CMA-1992. AIA G737 replaces G723CMA-1992.
- B. Submit electronic file to project management website of each Application for Payment on EJCDC C-620 - Contractor's Application for Payment or similar form approved by Engineer and Owner.
- C. Content and Format: Use Schedule of Values for listing items in Application for Payment.
- D. Submit updated construction schedule with each Application for Payment.
- E. Payment Period: Submit at intervals stipulated in the Agreement.
- F. Submit submittals with transmittal letter as specified in Section 01 33 00, SUBMITTAL PROCEDURES.
- G. Substantiating Data: When Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
 1. Current construction photographs specified in Section 01 33 00, SUBMITTAL PROCEDURES.
 2. Partial release of liens from major Subcontractors and vendors.
 3. Record Documents as specified in Section 01 77 00, CLOSEOUT PROCEDURES, for review by Owner, which will be returned to Contractor.
 4. Affidavits attesting to off-Site stored products.
 5. Construction Progress Schedule, revised and current as specified in Section 01 33 00, SUBMITTAL PROCEDURES.

1.7 PARTIAL PAYMENTS FOR STORED MATERIALS

- A. No payments will be made for materials and equipment delivered or stored unless shop drawings and preliminary operations and maintenance manuals are accepted by Engineer. Thereafter, partial payments for materials and equipment delivered and stored, but not yet incorporated into the Work, shall not exceed 90% of the material value.
- B. Storage must meet the requirements of the General Conditions, be deemed acceptable by the Engineer and Owner, be located on the Site or a location agreed to by the Engineer and Owner and meet the documented storage recommendations from the material manufacturer.

1.8 PARTIAL PAYMENTS FOR UNDELIVERED FABRICATED EQUIPMENT

- A. No partial payments will be made for project-specific fabricated equipment except those specifically listed below and under the terms listed herein. Undelivered "Off the shelf" or catalog items are not eligible for partial payment.

- B. Payment shall not exceed 15% of the equipment value, not including shipping and handling charges.
- C. Payment will only be made when the following conditions are met:
 - 1. Shop drawing and preliminary operations and maintenance manual acceptance by Engineer.
 - 2. Equipment is adequately insured, maintained, stored, and protected by appropriate security measures.
 - 3. Each equipment item is clearly marked and segregated from other items to permit inventory and accountability.
 - 4. Authorization has been provided access to storage site for Engineer and Owner.

1.9 DEFECT ASSESSMENT

- A. This Article may be used to address Work performed in stipulated sum/price Contracts or in unit price Contracts; edit accordingly.
- B. Replace the Work, or portions of the Work, not conforming to specified requirements.
- C. If, in the opinion of Engineer or Owner, it is not practical to remove and replace the Work, Engineer or Owner will direct appropriate remedy or adjust payment. Potential remedies may include:
 - 1. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Engineer or Owner.
 - 2. Defective Work will be partially repaired according to instructions of Engineer or Owner, and unit sum/price will be adjusted to new sum/price at discretion of Engineer or Owner.
- D. Individual Specification Sections may modify these options or may identify specific formula or percentage sum/price reduction.
- E. Authority of Engineer or Owner to assess defects and identify payment adjustments is final.
- F. Nonpayment for Rejected Products: Payment will not be made for rejected products for any of the following reasons:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from transporting vehicle.
 - 4. Products placed beyond lines and levels of the required Work.
 - 5. Products remaining on hand after completion of the Work.
 - 6. Loading, hauling, and disposing of rejected products.

1.10 UNIT PRICES

- A. This Article describes measurement and payment criteria applicable to Unit Price Work, whether unit price items are part of unit price Contract or part of Stipulated Sum/Price Contract.
- B. This Article should only be used with Work paid for by unit price payment method.
- C. Engineer will take measurements and compute quantities accordingly. Provide assistance in taking of measurements.
- D. Unit Quantities:
 - 1. Quantities and measurements indicated on Bid Form are for Contract purposes only. Quantities and measurements supplied or placed in the Work shall determine payment. Actual quantities provided shall determine payment.

2. When actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at contracted unit sum/prices.
 3. When actual Work requires 25 percent or greater change in quantity than those quantities indicated, Owner or Contractor may claim a Contract Price adjustment.
- E. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application, or installation of item of the Work; overhead and profit.
- F. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Engineer multiplied by unit sum/price for Work incorporated in or made necessary by the Work.
- G. Measurement of Quantities:
1. Weigh Scales: Inspected, tested, and certified by applicable Alabama weights and measures department within past year.
 2. Platform Scales: Of sufficient size and capacity to accommodate conveying vehicle.
 3. Metering Devices: Inspected, tested, and certified by applicable Alabama department within past year.
 4. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel, or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
 5. Measurement by Volume: Measured by cubic dimension using mean length, width, and height or thickness.
 6. Measurement by Area: Measured by square dimension using mean length and width or radius.
 7. Linear Measurement: Measured by linear dimension, at item centerline or mean chord.
 8. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the Work.

1.11 ALTERNATES

- A. Alternates are used when Owner or Architect/Engineer wants to competitively bid additional Work or bid different product or system compared to product or system specified as an integral part of base Project requirements. Submitted Bids for Alternates are expressed as cost increase or decrease to base Bid.
- B. This Article describes the scope of each Alternate and refers to the respective product Sections covering Work under each Alternate.
- C. When an Alternate requires products not covered under the base Bid Specifications, include separate Sections for required products in Project Manual. Concurrently, additional Drawings may be necessary to adequately illustrate some Alternates.
- D. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement. The Owner-Contractor Agreement may identify certain Alternates to remain an Owner option for a stipulated period of time.
- E. Coordinate related Work and modify surrounding Work. Description for each Alternate is recognized to be abbreviated but requires that each change shall be complete for scope of Work affected.
1. Coordinate related requirements among Specification Sections as required.
 2. Include as part of each Alternate: Miscellaneous devices, appurtenances, and similar items incidental to or necessary for complete installation.

3. Coordinate Alternate with adjacent Work and modify or adjust as necessary to ensure integration.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 40 23 43 – PROCESS VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: Basic requirements for Process Valves.
- B. Related sections:
 - 1. Section 01 33 00 – Submittal Procedures.
 - 2. Section 01 40 00 – Quality Requirements.
 - 3. Section 01 60 00 – Product Requirements.
 - 4. Section 01 75 00 – Startup Testing and Training.
 - 5. Section 01 77 00 – Closeout Procedures.
 - 6. Section 09 90 00 – Painting and Protective Coatings.
 - 7. Section 40 23 39 – Process Piping, General.
 - 8. Section 40 92 16 – Manual Valve and Gate Operators.

1.2 GENERAL

- A. See Section 40 23 39, PROCESS PIPING, GENERAL, which contains information and requirements that apply to the work specified herein and are mandatory for this project.
- B. Certain valves are specified in Division 44 to be furnished by equipment manufacturer as part of their equipment package and/or system. These valves are to be installed by the Contractor as specified herein. In addition to installation, the Contractor shall be responsible for test, inspection, and assisting the equipment suppliers in startup services as required to the place the valves into continuous, reliable operation.

1.3 SUBMITTALS

- A. Submittals shall be made as required in Section 01 33 00, SUBMITTALS. The following specific information shall be provided:
 - 1. Shop Drawings:
 - a. Product data sheets for make and model.
 - b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
 - c. Refer to specific valve type for additional submittal requirements.
 - 2. Quality requirements Submittals:
 - a. Tests and inspection data.
 - b. Manufacturer's Certificate of Proper Installation.
 - c. Manufacturer's printed installation instructions.
 - d. Special shipping, storage and protection, and handling instructions.
 - e. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
 - f. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

1.4 OPERATION AND MAINTENANCE DATA

- A. O&M Manuals: Content, format, and schedule for providing as specified in Section 01 77 00, CLOSEOUT PROCEDURES.
- B. Maintenance Summary Forms: As specified in Section 01 77 00, CLOSEOUT PROCEDURES.

1.5 WARRANTY

- A. The valve(s) shall be covered by a minimum three year warranty against defects in materials and workmanship. The electrical components shall have a minimum one year warranty. The stainless steel seat shall be covered by a lifetime replacement warranty.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Valve to include operator, actuator, hand wheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and accessories for a complete operation. For operator specifications, see Section 40 92 16, MANUAL VALVE AND GATE OPERATORS.
- B. Valve shall be suitable for intended service. Renewable parts not to be of a lower quality than specified.
- C. Valve shall be the same size as adjoining pipe.
- D. Valve ends to suit adjacent piping.
- E. Valve shall open by turning counterclockwise unless otherwise specified.
- F. Operator, actuator, and accessories shall be factory mounted.
- G. EFFECTIVE JANUARY 4, 2014 ANY VALVE, PIPE, FITTING, SOLDER, OR FLUX USED OR IN CONTACT WITH POTABLE WATER SHALL COMPLY WITH THE REDUCTION OF LEAD IN DRINKING WATER ACT, AN AMENDMENT TO SECTION 1417 OF THE SAFE DRINKING WATER ACT (SDWA). VALVES SPECIFIED IN THIS SECTION MAY NOT MEET REQUIRMENTS OF THIS ACT, HOWEVER THIS DOES NOT RELIEVE THE CONTRACTOR FROM PROVIDING A VALVE TO MEET REQUIREMENTS OF THE (SDWA) AND THE SAME FUNCTIONAL REQUIREMENTS OF THIS SPECIFICATION.

2.2 SCHEDULE

- A. Requirements relative to this section for certain type of actuated or process valves are shown on the Valve Schedules attached as Supplements to the related Sections.

2.3 MATERIALS

- A. Brass and bronze valve components and accessories that have surfaces in contact with water shall be alloys containing less than 16% zinc and 2% aluminum.
- B. Approved alloys are of the following ASTM designations:
 - 1. B61, B62, B98 (Alloy UNS No.C65100, C65500, or C66100), B139 (Alloy UNS No.C51000), B584 (Alloy UNS No.C90300 or C94700), B164, B194, and B127.
 - 2. Stainless steel, AISI Type 316 may be substituted for bronze.

2.4 FACTORY FINISHING

- A. Epoxy Lining and Coating:
 - 1. In accordance with AWWA C550 unless otherwise specified. Coating shall be either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as "fusion" or "fusion bonded" epoxy.
 - 2. Minimum 7-mil dry film thickness except where limited by valve operating tolerances.

- B. Exposed Valves Field Finish:
 1. Final paint coating shall be in accordance with Section 09 90 00, PAINTING AND PROTECTIVE COATINGS. System and color shall match adjacent piping system.
 2. Safety isolation valves and lockout valves with handles, hand wheels, or chain wheels "safety yellow."

2.5 VALVES

- A. Gate Valves:
 1. Not Used.
- B. Globe Valves:
 1. Not Used.
- C. Ball Valves:
 1. Not Used.
- D. Plug Valves:
 1. Type V405: Eccentric Plug Valve, 4-inches through 12-inches
 - a. Water and Wastewater Applications: Non-lubricating type rated 175 psig CWP, drip-tight shutoff with pressure from either direction, cast iron body, or stainless steel body where indicated, with flanged ends or grooved ends in accordance with AWWA C606 for rigid joints, mechanical joint ends for buried valve. Plug cast iron with round or rectangular port of no less than 80% of connecting pipe area and coated with Buna-N or Hycar, seats nickel, stem bearing self-lubricating stainless steel, stem seal multiple V -rings or V-cups of nitrile rubber, grit seals on stem.
 - b. Digester Gas Applications: Valves shall be suitable for operation in a wet anaerobic digester gas stream with moderate concentrations of hydrogen sulfide. The body materials shall be of ASTM B26 aluminum, Alloy 7130, Temper T5 or ASTM A743, Type 316 stainless steel, Grade CF-8M. The eccentric plug shall be fabricated from the same material as the body of the valve. The bottom bearing shall be Type 316 stainless steel. The top bearing shall be Type 316 stainless steel, sintered. The valve bonnet shall be fabricated from the same material as the body of the valve. The bonnet screws shall be 18-8 stainless steel. Packing shall be NBR acrylonitrile-butadiene, V-type. Thurst bearing ring shall be PTFE.
 - c. Valves 4-inches or less to be provided with wrench lever manual operator. Valves 6-inches through 12-inches to be provided with totally enclosed, geared, manual operator with hand wheel, 2-inch nut, or chain wheel.
 - d. Manufacturers:
 - 1) DeZurik.
 - 2) Henry Pratt.
 - 3) Val-Matic.
 - 4) Crispin Valve.
 2. Type V406: Eccentric Plug Valve, 14-inches and Larger
 - a. Non-lubricating type rated 150 psig CWP, drip-tight shutoff with pressure from either direction, cast iron body with flanged ends or grooved ends in accordance with AWWA C606 for rigid joints, mechanical joint ends for buried valve. Plug cast iron with round or rectangular port of no less than 80% of connecting pipe area and coated with Buna-N or Hycar, seats nickel, stem bearing self-lubricating stainless steel, stem seal multiple V -rings or V-cups of nitrile rubber, grit seals on stem.
 - b. Provide with totally enclosed, geared, manual operator with hand wheel, 2-inch nut, or chain wheel.
 - c. Manufacturers:
 - 1) DeZurik.
 - 2) Henry Pratt.
 - 3) Val-Matic.

4) Crispin Valve.

E. Butterfly Valves:

1. Provide valves designed and manufactured in accordance with AWWA C504, Class 150B or Class 250B, AWWA C516, and the following requirements:
 - a. Valve class shall meet the requirements of the connecting line or as indicated in valve schedule or as indicated on the drawings.
 - b. Suitable for throttling operations and infrequent operation after periods of inactivity.
 - c. Elastomer seats bonded to body shall have adhesive integrity of bond between seat and body assured by testing with minimum 75-pound pull in accordance with ASTM D429, Method B. Seat may be retained by mechanical means on valves 24-inches and larger. No epoxy attachment method shall be allowed.
 - d. Bubble-tight with rated pressure, or any pressure lower than rated, applied from either side with the valve mounted in any orientation.
 - e. No travel stops for the disc on interior of the body.
 - f. Shaft seal shall include V-type packing for self-adjusting and wear compensation.
 - g. Isolate metal-to-metal thrust bearing surfaces from flow stream.
 - h. Valves intended for air service shall meet ANSI B16.104 and ANSI B16.5.
2. Type V510: Lug-style Butterfly Valves, 2-inches and Larger
 - a. General:
 - 1) Minimum Rated Working Pressure: 150 psig in compliance with ASME Class 150.
 - 2) Maximum Process Fluid Temperature: 250°F.
 - 3) Suitable for air and/or water service.
 - b. Construction and Materials:
 - 1) Body:
 - a) Type: Lugged.
 - b) ASTM A536 Grade 65-45-12 ductile iron.
 - 2) Disc:
 - a) Material: ASTM A351 Grade CF8N stainless steel.
 - b) No disc stops shall be installed on the interior of the valve body.
 - 3) Seat:
 - a) Type: Resilient and replaceable. Shall have a full 360-degree circumference around the valve body without interruption. Seat shall cover the entire inner surface of the valve body and extend over the outside face of the valve body to form a flange gasket.
 - b) Mounting: On the valve body.
 - c) Seats shall have adhesive integrity of bond between seat and body or seat and disc assured by testing with minimum 75-pound pull in accordance with ASTM D429 Method B.
 - d) Material: EPDM.
 - 4) Shafts: ASTM A582 Type 416 stainless steel or ASTM A582 Type 420 stainless steel.
 - 5) Packing: V-type and replaceable without dismantling valve.
 - 6) Bearings: Shall be sleeve type that is PTFE lined and self-lubricating. Metal-to-metal thrust bearings shall not be installed on the interior of the valve body.
 - 7) Hardware: ASTM A276 Type 304 or 316 stainless steel.
 - 8) End Connections: Lug pattern (flanged), comply with ASME B16.1 Class 125.
 - 9) Finishes: Factory primer, field finish to match connecting pipe.
 - c. Manufacturers:
 - 1) DeZurik: On-Center, Resilient Seated Butterfly Valves BOS-CL
 - 2) Henry Pratt: BF Series
3. Type V513: High-Performance Butterfly Valves, 2-inches and Larger
 - a. General:

- 1) Minimum Rated Working Pressure: 150 psig in compliance with ASME Class 150.
 - 2) Maximum Process Fluid Temperature: 500 degrees Fahrenheit.
 - 3) Maximum Process Fluid Velocity: 20 feet per second.
- b. Construction and Materials:
- 1) Body:
 - a) Type: Lugged.
 - b) Material: ASTM A351 Grade CF8M Stainless Steel.
 - 2) Disc:
 - a) Material: ASTM A351 Grade CF8M Stainless Steel.
 - b) No disc stops shall be installed on the interior of the valve body.
 - 3) Seat:
 - a) Type: Resilient and replaceable. Shall have a full 360-degree circumference around the valve body without interruption.
 - b) Mounting: ASTM A351 Grade CF8N stainless steel seat retainer held in place by 316 stainless steel retaining screws.
 - c) Material: Reinforced PTFE seat.
 - 4) Shafts: ASTM A479 Type 316 stainless steel.
 - 5) Packing: V-type and replaceable without dismantling valve.
 - 6) Bearings: Shall be sleeve type that is PFTE lined and self-lubricating. Metal-to-metal thrust bearings shall not be installed on the interior of the valve body.
 - 7) Hardware: ASTM A276 Type 316 stainless steel.
 - 8) End Connections: Lug pattern (flanged), comply with ASME B16.1 Class 125.
 - 9) Finishes: Field finish to match connecting pipe.
- c. Manufacturers:
- 1) DeZurik: High Performance Butterfly Valves BHP.
 - 2) Bray Valve: High Performance Butterfly Valves McCannalok Series 41.
 - 3) Henry Pratt.

F. Check and Flap Valve:

1. Not Used.

G. Self-Contained Automatic Valves:

1. Type V752: Wastewater Combination Air Valves, 1-inch and Larger
 - a. Valve shall be automatic float operated valve designed to exhaust large quantities of air during the filling of a piping system and close upon liquid entry. The valve shall open during draining or if a negative pressure occurs. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure.
 - b. Valve shall perform functions of both air release and Air/Vacuum valves and be furnished as a single body.
 - c. Valve shall be suitable for use with domestic sewage.
 - d. Valve body and structure shall be constructed of cast iron or ductile iron. Float, guide shafts and bushings shall be stainless steel.
 - e. Manufacturers:
 - 1) Val-Matic.
 - 2) DeZurik.
 - 3) Crispin Valve.
 - 4) Henry Pratt.

H. Miscellaneous Valves:

1. Type V910: Telescoping Valve, 4-inches and Larger
 - a. Valve configuration shall be as shown on the Drawings and detailed within the Supplements following End of Section.

- b. Complete assembly consisting of rising stem, slip tube, seal flange, lifting bail, valve stand with indicator and motor, when required, and Type 316 stainless steel anchor bolts and mounting hardware.
- c. Slip tube shall be Type 304 stainless steel, manufactured from seamless pipe or tube, with a minimum wall thickness of 1/8-inch and shall be of sufficient length to facilitate valve travel and maintain an appropriate insert depth.
- d. A stainless steel companion flange and neoprene slip seal gasket shall be provided. The gasket shall be a minimum 1/4-inch thick, mounted to allow sliding and shall be watertight throughout the travel of the slip tube.
- e. Lift shall be handwheel type and stem shall be of the rising type, stainless steel, thrust bearings, automatic self-locking, and provide infinite valve positioning. A clear plastic Butyrate stem cover shall be provided with a mylar strip type position indicator, calibrated in 1/4-inch increments to illustrate valve position.
- f. Manufacturers:
 - 1) Troy Valve
 - 2) Waterman; TS-2
 - 3) Golden Harvest
 - 4) Amwell; Type RP
 - 5) Trumbull.

2.6 TAGGING REQUIREMENTS

- A. The tags shall be attached to the valves by soldered split key rings so that ring and tag cannot be removed. The tag shall bear the 1/4-inch die-stamped equipment identification number as indicated in the Contract Documents.

2.7 ACCESSORIES

- A. T-Handled Operating Wrench:
 - 1. Two each, galvanized operating wrenches, 4-feet long.
 - 2. Manufacturers:
 - a. Mueller; No. A-24610.
 - b. Clow No.; F-2520.
 - 3. Two each, galvanized operating keys for cross handled valves.
- B. Cast Iron Valve Box: Designed for traffic loads, sliding type, with minimum of 6-inch ID shaft.
 - 1. Box: Cast iron with minimum depth of 9-inches.
 - 2. Lid: Cast iron, minimum depth 3-inches, marked for the appropriate service.
 - 3. Extensions: Cast iron.

PART 3 - EXECUTION

3.1 SHIPPING, STORAGE, HANDLING, AND PROTECTION

- A. As specified in Section 01 60 00, PRODUCT REQUIREMENTS.

3.2 INSTALLATION

- A. Flange Ends:
 - 1. Flanged valve bolt holes shall straddle vertical centerline of pipe.
 - 2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.
- B. Screwed Ends:
 - 1. Clean threads by wire brushing or swabbing.

2. Apply joint compound.
- C. Valve Orientation:
1. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4.5-feet or less above finished floor, unless otherwise shown.
 2. Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 4.5-feet and 6.75-feet above finish floor, unless otherwise shown.
 3. Orient butterfly valve shaft so that unbalanced flows or eddies are equally divided to each half of the disc, i.e., shaft is in the plane of rotation of the eddy.
 4. If no plug valve seat position is shown, locate as follows:
 - a. Horizontal Flow: The flow shall produce an “unseating” pressure, and the plug shall open into the top half of valve.
 - b. Vertical Flow: Install seat in the highest portion of the valve.
- D. Install a line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flow meters, for isolation during maintenance.
- E. Install safety isolation valves on compressed air.
- F. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.
- G. Extension Stem for Operator: Where the depth of the valve is such that its centerline is more than 3-feet below grade. Furnish an operating extension stem with 2-inch operating nut to bring the operating nut to a point 6-inches below the surface of the ground and/or box cover.
- H. Torque Tube: Where operator for quarter-turn valve is located on floor stand. Furnish extension stem torque tube of a type properly sized for maximum torque capacity of the valve.
- I. Floor Box and Stem: Steel extension stem length shall locate operating nut in floor box.

3.3 TESTS AND INSPECTION

- A. Valve may be either tested while testing pipelines, or as a separate step.
- B. Test that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, in both directions for two-way valve and applications.
- C. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.
- D. Count and record number of turns to open and close valve; account for any discrepancies with Manufacturer’s data.
- E. Set, verify, and record set pressures for all relief and regulating valves.
- F. Automatic valve to be tested in conjunction with control system testing.
- G. Test hydrostatic relief valve seating; record leakage. Adjust and retest to maximum leakage of 0.1 gpm per foot of seat periphery.

3.4 MANUFACTURER’S SERVICES

- A. A Manufacturer’s representative for the equipment specified herein shall be present at the jobsite for the minimum person-days listed for the services herein under, travel time excluded:

1. 2 person-days for installation assistance, inspection, and certification of the installation. Provide certificate.
2. 2 person-days for functional and performance testing.
3. 2 person-days for pre-startup classroom or jobsite training of Owner's personnel.

B. Training of Owner's personnel shall be at such times and at such locations as requested by Owner.

C. See Section 01 75 00, STARTUP TESTING AND TRAINING.

3.5 MANUFACTURER'S CERTIFICATE(S)

A. Provide Manufacturer's certificate(s) in accordance with Section 01 75 00, STARTUP TESTING AND TRAINING.

3.6 SUPPLEMENTS

A. The supplements listed below, following "END OF SECTION," are a part of this Specification.

1. None.

END OF SECTION

SECTION 40 67 23 – CONTROL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. This specification covers all control panels provided as part of the project, including those provided as part of a manufacturer supplied system specified in other Divisions.
- B. Furnish and install functional control panels to operate control systems manually or automatically as specified in the detailed requirements of this section and related sections.
- C. Related Sections:
 - 1. Section 40 61 13 – Process Control System General Provisions

1.2 SUBMITTALS

- A. Submittals shall contain information on related equipment to be furnished under this Specification but described in the related Sections listed in the Related Work paragraph above. Incomplete submittals not containing the required information on the related equipment will also be returned un-reviewed.
- B. All submittals for control panels provided as part of an equipment vendor's scope shall be submitted as a part of the Process Equipment manufacturer's submittal.
- C. All submittals for control panels provided by the Control System Specialist shall be submitted as a part of the Control System Specialist's submittals.
- D. The equipment manufacturer shall create all equipment shop drawings, including all wiring diagrams, in the manufacturer's Engineering department. All equipment shop drawings shall bear the mechanical equipment manufacturer's logo, drawing file numbers, and shall be maintained on file in the mechanical equipment manufacturer's archive file system.
- E. Submit to the Owner/Engineer, shop drawings and product data, for the following:
 - 1. Custom unit elementary drawings. Drawings shall include all schematics for control logic as described in the Process Equipment Specifications, and any associated control schematics shown on the Engineer's Drawings for this project. Show interconnections between components and to remotely mounted devices. Include and identify all connecting equipment and remote devices on the schematics. The notation "Remote Device" will not be acceptable. Show wire and terminal numbers. Indicate special identifications for devices as required by the mechanical equipment manufacturer or as may be shown on the Drawings.
 - 2. Equipment outline drawings showing elevation, plan and interior views, front panel arrangement, dimensions, weight, shipping splits, conduit entrances and anchor bolt pattern. Indicate all options, special features, ratings, and deviations from this Section.
 - 3. Power and control schematics including external connections. Show wire and terminal numbers and color-coding.
 - 4. Network interface diagrams showing all panel network components and how they are interconnected.
 - 5. Instruction and replacement parts books, including manufacturer's part numbers and selections of component ratings.
 - 6. As-built final drawings.
 - 7. Documentation that the panel assembly facility is a UL-508 certified facility.
 - 8. Furnish complete Bill of Materials indicating manufacturer's name and part numbers.

9. Manufacturer's cut sheets for every component used in the panel assembly adequately marked to show the items being included. The manufacturer's name shall be clearly visible on each cut sheet submitted.
10. Assembly ratings including:
 - a. Short-circuit rating.
 - b. Voltage
 - c. Continuous current
11. Major component ratings including:
 - a. Voltage
 - b. Continuous current
 - c. Interrupting ratings
12. Cable terminal sizes.
13. Instruction and renewal parts books.

F. Factory Tests. Submittals shall be made for factory tests specified herein.

G. Field Test Reports. Submittals shall be made for field tests specified herein.

H. Operation and Maintenance Manuals.

1. Operation and Maintenance Manuals shall include the following information:
 - a. Manufacturer's contact address and telephone number for parts and service.
 - b. Instruction books and/or leaflets
 - c. Recommended renewal parts list
 - d. Record Documents for the information required by the Submittals paragraph above.

I. The manufacturer shall submit for approval, a training agenda for all training specified herein. Training agenda shall not be submitted until final approval of the Operation and Maintenance Manual.

1.3 REFERENCE CODES AND STANDARDS

A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. NEMA Standard ICS 2 – 2000 Industrial Control and Systems
2. NFPA 70 – National Electrical Code (NEC)
3. NFPA 70E – Standard for Electrical Safety in the Workplace
4. NFPA 79 – Electrical Standard for Industrial Machinery
5. UL 508/508A – Industrial Control Enclosures

B. All equipment components and completed assemblies specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.4 QUALITY ASSURANCE

A. The manufacturer of the control panels shall have produced similar equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. The control panels shall be assembled in a UL-508 certified facility. A submittal of documentation certifying that the panel fabrication facility is a UL-508 certified facility, is required. A UL label shall be affixed to the inside of the external door by the panel fabrication assembly.

- C. All components and material shall be new and of the latest field proven design and in current production. Obsolete components or components scheduled for immediate discontinuation shall not be used.
- D. Control panels submitted shall fit within the space shown on the Drawings. Equipment which does not fit within the space is not acceptable.
- E. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

1.5 JOBSITE DELIVERY, STORAGE AND HANDLING

- A. Prior to jobsite delivery, the Contractor shall have successfully completed all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, onsite factory work, or failed factory tests will not be permitted.
- B. Equipment shall be handled and stored in accordance with manufacturer's instructions. Two (2) copies of these instructions shall be included with the equipment at time of shipment and shall be made available to the Contractor and Owner/Engineer.
- C. Shipping groups shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately.
- D. Where space heaters are provided in equipment, provide temporary electrical power, and operate space heaters during storage, and after equipment is installed in permanent location, until equipment is placed in service.

1.6 WARRANTY

- A. The Manufacturer shall warrant the equipment to be free from defects in material and workmanship for the same length of time as the associated mechanical equipment, but not less than 1 year from the date of final acceptance of the equipment by the Owner and Engineer. Within such period of warranty, the Manufacturer shall promptly furnish all material and labor necessary to return the equipment to new operating condition. Any warranty work, requiring shipping or transporting of the equipment, shall be performed by the Manufacturer, at no expense to the Owner.

PART 2 - PRODUCTS

2.1 RATINGS

- A. The service voltage shall be as specified and as shown on the Drawings. The overall short circuit with stand and interrupting rating of the equipment and devices shall be not less than 22,000 amperes RMS symmetrical for panels operating at 480/277 Volts, and equal to or greater than the overall short circuit withstand and interrupting rating of the feeder device immediately upstream of the Control Panel. This includes all circuit breakers and combination motor starters. Systems of motor controllers employing series connected ratings for main and feeder devices shall not be used. Motor starter units shall be tested and UL 508A labeled for the specified short circuit duty in combination with the motor branch circuit protective device. The overall short circuit rating of the panel shall be not less than 10,000 amperes RMS symmetrical for panels operating at 120VAC.
- B. There shall be selective device coordination between the Main Breaker, Feeder Breakers, and control circuit protective devices. When using a circuit breaker or fuses as a main protective device, the instantaneous trip levels of the main protective device shall be higher than the

available fault current to the control panel. If fuses are utilized in the control panel design, the protective devices for 3 phase loads shall contain single phase protection of such equipment. If a fault occurs in the circuit of one load of a design with a backup load, the feeder protective device shall not remove both loads from the control system.

- C. The complete control panel assembly shall be UL certified and carry a UL listing for "Industrial Control Panels".
- D. The control panel shall meet all applicable requirements of the National Electrical Code.
- E. The control panel enclosure shall be NEMA rated as specified herein.
- F. Motor controllers, including associated devices, shall be designed for continuous operation at rated current in a 50 degree C ambient temperature.
- G. For additional ratings and construction notes, refer to the mechanical equipment specifications and the Drawings.

2.2 CONSTRUCTION

A. General

1. Submit actual layout and location of equipment and components; current ratings of devices, bus bars, components; protective relays, voltage ratings of devices, components, and assemblies; and other required details. NEMA ratings of all devices shall meet or exceed the rating of each panel.
2. Control units shall be arranged as shown on the Drawings.
3. Nameplates
 - a. Exterior
 - 1) Nameplates shall be engraved, laminated impact acrylic. Nameplates shall be 316 SS screw mounted to all enclosures except for NEMA 4 and 4X. Nameplates for NEMA 4 and 4X enclosures shall be attached with double faced adhesive strips. Prior to installing the adhesive nameplates, the metal surface shall be thoroughly cleaned with 70% alcohol until all residues have been removed. Epoxy adhesive or foam tape is not acceptable.
 - 2) There shall be a master nameplate that indicates supply voltage equipment ratings, short circuit current rating, manufacturer's name, shop order number and general information. Cubicle nameplates shall be mounted on the front face, on the rear panel and inside the assembly, visible when the rear panel is removed.
 - 3) Provide permanent warning signs as follows:
 - 4) "Danger- High Voltage- Keep Out" on all doors.
 - 5) "Warning- Hazard of Electric Shock - Disconnect Power Before Opening or Working on This Unit" on Main Power Disconnect or Disconnects.
 - b. Internal
 - 1) Provide the panel with a UL 508A label.
 - 2) Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification, corresponding to appropriate designations on manufacturer's wiring diagrams.
4. Control Devices and Indicators
 - a. All operating control devices, indicators, and instruments shall be securely mounted on the panel door. All controls and indicators shall be 30mm, NEMA 4X/13 for outdoor panels, NEMA 4/13 for indoor panels, anodized aluminum or reinforced plastic. Booted control devices are not acceptable. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by the detailed mechanical and electrical equipment requirements.

- b. Indicator lamps shall be LED type. For all control applications, indicator lamps shall incorporate a push-to-test feature.
 - c. Mode selector switches (HAND-OFF-AUTO, LOCAL-OFF-REMOTE, etc.) shall have the number of positions and contact arrangements, as required. Each switch shall have an extra dry contact for remote monitoring.
 - d. Panel meters for digital display of analog signal values shall be provided where indicated. Panel meters shall be 4-20mA loop powered, 1/8 DIN LCD displays, Precision Digital Model PD 6600 series or equal.
 - e. Panel Interface Connector (PIC): Each control panel with a PLC shall include a PIC mounted on the outside of the enclosure for providing an Ethernet connection to internal devices. The PIC shall include a 120 VAC single phase duplex receptacle with 3 Ampere externally resettable circuit breaker and an RJ45 pass-through connector.
 - f. Furnish nameplates for each device. All nameplates shall be laminated plastic, black lettering on a white background, attached with stainless steel screws. Device mounted nameplates are not acceptable.
 - g. The manufacturer shall not remove, reuse, alter, or replace original equipment nameplates or equipment tags associated with equipment or components supplied by the manufacturer's suppliers and sub-suppliers.
5. Control Relays
- a. Provide relays as required to implement indicated control functions. General purpose, alternating and time delay relays may be used within their ratings for logic, timing and sequencing but shall not be used to drive loads in excess of 80% of their contact "make" or "break" ratings. Provide interposing power relays to drive loads such as starters larger than NEMA size 1 and all other utilization equipment with loads greater than specified for general purpose and time delay relays. Provide relays rated to drive the load as required. Relays shall be provided with an LED status indicator.
 - b. Discrete Input and Output Relays: Terminal block style interposing relays shall be used for all controller inputs and outputs. Devices shall be PLC-RSC series as manufactured by Phoenix Contact or equal. Provide pull-up or pull-down resistors on all digital outputs as required for the application.
6. Control and Instrument Power Transformers.
- a. Control power transformers shall be provided. Transformer shall be sized for the entire load, including space heaters, plus 25% spare capacity, and shall be not less than 100VA.
 - b. Control power transformers shall be 120 volts grounded secondary. Primary side of the transformer shall be fused in both legs. One leg of the transformer secondary shall be solidly grounded, and the other leg shall be fused.
 - c. Control power transformers shall be installed inside the control panel that they serve. They shall not be mounted exterior to the panel.
7. Power Supplies
- a. When required, the control panel shall be furnished with a separate DC power supply to provide DC power for control panel components and the loop power for 2-wire instruments. The power supplies shall be DIN rail mounted, 120VAC input, 24VDC output, with output load rated as required for the connected loads. Power supplies shall be provided by Phoenix Contact, Allen-Bradley, or Sola.

B. Enclosures

1. General

- a. Each enclosure shall incorporate a removable back panel, and side panels, on which control components shall be mounted. Back panel shall be secured to the enclosure with collar studs for wall mounted enclosures, and 316 SS hardware for free standing enclosures.
- b. All free-standing enclosures shall be provided with feet of the same construction as the enclosure.

- c. Back panel shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any components.
 - d. All enclosure doors shall have bonding studs. The enclosure interior shall have a bonding stud.
 - e. Each enclosure shall be provided with a documentation pocket on the inner door.
 - f. Enclosures shall not have holes or knockouts.
 - g. Provide manufacturer's window kits where shown on the Drawings.
 - h. All enclosures shall be pad-lockable.
2. NEMA 4X
- a. NEMA 4X panels shall be provided for all outdoor locations, or indoor locations where directly exposed to process or wash-down water.
 - b. NEMA 4X 316 Stainless Steel
 - c. Type 316 stainless steel, body, and door
 - d. Stainless steel continuous hinge
 - e. Foam gasket
 - f. Single point quarter turn latches (20"x24" and below). All others 3-point latch.
 - g. Manufacturers
 - 1) Hoffman Comline Series
 - 2) EMF Company
 - 3) NEMA Enclosures Company
 - 4) Hammond Company
 - 5) Approved Equal
3. NEMA 12
- a. NEMA 12 panels shall be provided for clean and dry indoor locations.
 - b. NEMA 12 Painted Steel.
 - c. Painted steel, body, and door
 - d. Continuous hinge
 - e. Foam gasket
 - f. Single point quarter turn latches (20"x24" and below). All others 3-point latch.
 - g. Manufacturers
 - 1) Hoffman Comline Series
 - 2) EMF Company
 - 3) NEMA Enclosures Company
 - 4) Hammond Company
 - 5) Approved Equal
- C. Environmental Conditioning
1. Air Conditioning
- a. A panel air conditioner shall be provided where panels include variable frequency drives and are installed outdoors or unconditioned indoor spaces.
 - b. The air conditioner shall be powered from the panel. A separate power source shall not be required.
 - c. The enclosure cooling system shall not compromise the enclosure's NEMA rating and shall be sized for the environment in which the control panel will be installed.
 - d. The air conditioner shall be sized to provide cooling to maintain the interior temperature of the panel to meet VFD manufacturer recommendations for maximum ambient temperature.
2. Ventilation
- a. Where air conditioning is not required, panel fans and louvers shall be provided where panels are installed in unconditioned indoor spaces.
 - b. Panel ventilation shall also be provided in indoor conditioned spaces where the panel manufacturer has determined it necessary in order to maintain the interior temperature of the panel within manufacturer recommended limits.
 - c. The fans shall be powered from the panel. A separate power source shall not be required.

- d. The enclosure ventilation system shall not compromise the enclosure's NEMA rating and shall be sized for the environment in which the control panel will be installed.
 - e. The ventilation shall be sized to maintain the interior temperature of the panel to meet manufacturer recommendations for maximum ambient temperature of all electronic components.
3. Condensation Control
- a. A self-contained enclosure condensation heater with thermostat and fan shall be mounted inside control panels if panel is mounted outdoors or in a non-air-conditioned space.
 - 1) Enclosure heaters shall be energized from 120 volt, single-phase power supply and sized to prevent condensation within the enclosure.
 - 2) Locate enclosure heaters to avoid overheating electronic hardware or producing large temperature fluctuations on the hardware.
 - 3) Enclosure heaters shall have an internal fan for heat distribution and shall be controlled with adjustable thermostats. The thermostat shall have an adjustment range of 40 degrees Fahrenheit to 90 degrees Fahrenheit. Provide a circuit breaker or fused disconnect switch within the enclosure.
 - 4) Enclosure heaters shall be Hoffman type DAH or equal.
 - b. Strip heaters may be provided if they are 240 volt rated, powered at 120 volts AC, and do not have a surface temperature higher than 60°C. Strip heaters and thermostats shall be as manufactured by Chromalox or equal.
 - c. Each panel shall have a 1/2" stainless steel condensate drain.

D. Internal Wiring

- 1. Power and control wiring shall be tinned stranded copper, minimum size No. 16 AWG, with 600 Volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation. Line side power wiring shall be sized for the full rating or frame size of the connected device.
- 2. Analog signal wires shall be 600 Volt Class, insulated stranded tinned copper, twisted shielded #18 AWG pair.
- 3. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks. Field wiring shall not be terminated directly on any panel-mounted device.
- 4. All wiring shall be tagged and coded with an identification number as shown on the Drawings. Coding shall be typed on a heat shrinkable tube applied to each end showing origination and destination of each wire. The marking shall be permanent, non-smearing, solvent-resistant type similar to Raychem TMS-SCE, or equal.
- 5. All wiring shall be enclosed in PVC wire trough with slotted side openings and removable cover. Plan wire routing such that no low twisted shielded pair cable conducting analog 4-20 mA signals or low voltage analog signals are routed in the same wire trough as power conductors carrying greater than 120V.
- 6. All control panel wiring shall use the following color code.
 - a. Black: AC power at line voltage
 - b. Red: switched AC power
 - c. Orange: May be energized while the main disconnect is in the off position
 - d. White: AC neutral
 - e. Orange/white stripe or white/orange stripe: separate derived neutral
 - f. Red/white stripe or white/red stripe: switched neutral.
 - g. Green or green w/ yellow tracer: ground/earth ground
 - h. Blue: Ungrounded DC power
 - i. Blue/white stripe or white/blue stripe: DC grounded common
 - j. Brown: 480V AC 3 phase - phase A
 - k. Orange: 480V AC 3 phase - phase B
 - l. Yellow: 480V AC 3 Phase - phase C
 - m. Purple: common for analog signal wiring
 - n. Brown: positive leg of an analog signal

- E. Field Installed Internal Wiring
1. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed. In addition, low signal wiring (millivolt and milliamp) shall be bundle separately from the rest of the control wiring.
 2. All field wiring shall be tagged and coded with an identification number. Coding shall be typed on a heat shrinkable tube applied to each end of the wire. The marking shall be a permanent, non-smearing, solvent-resistant type similar to Raychem TMS-SCE, or equal.
 - a. Where existing field wiring is being used to connect to a new panel, provide new labels. Where an existing wiring identifier is present that differs from the wiring identifier documented on the panel drawings, provide label for both identification numbers.
 3. In general, all conduit entering or leaving outdoor panels shall be stubbed up into the bottom of the enclosure to the greatest extent possible.
- F. Terminal Blocks
1. Terminal blocks shall be DIN-rail-mounted one-piece molded plastic blocks with tubular-clamp-screw type and end barriers. Terminal blocks shall be rated for 600 volts except for control and instrumentation circuits, or 4-20 mA analog signal conductors.
 2. Provide 600 volt rated terminal blocks for any conductor carrying any voltage over 120 volts to ground.
 3. Provide 600 volt rated strap screw terminal blocks for any power conductors carrying over 20 amps, at any voltage. Terminals shall be double sided and supplied with removable covers to prevent accidental contact with live circuits.
 4. Power conductors carrying over 20 amps, at any voltage shall be terminated to strap-screw type terminal blocks with crimp type, pre-insulated, ring-tongue lugs. Lugs shall be of the appropriate size for the terminal block screws and for the number and size of the wires terminated. Do not terminate more than one conductor in any lug, and do not land more than two conductors under any strap-screw terminal point.
 5. Terminals shall have permanent, legible identification, clearly visible with the protective cover removed. Each terminal block shall have 20 percent spare terminals, but not less than two spare terminals.
 6. Use the manufacturer's provided bridge connectors to interconnect terminal blocks terminating common or ground conductors.
 7. Twisted shielded pair or triad cables shall have each individual conductor and shield drain wire landed on individual terminal blocks. Use the manufacturer's provided bridge connectors to interconnect terminal blocks terminating the shield drain wire conductors.
 8. Control circuits, 120 volts and below, and 4-20 mA analog signal conductors shall be terminated with manufacturer's recommended insulated connectors.
 9. Current Loop Surge Protection Devices: The 4-20mA signal loop channels on analog inputs and outputs shall be protected against static discharge, lightning, and faulty wiring with three stage surge protection terminal block devices. Devices shall be pluggable with indication status lights. Devices shall be PLUGTRAB series as manufactured by Phoenix Contact or equal.
 10. All wiring to hazardous locations shall terminate in intrinsically safe barrier devices.
 11. Provide an AC ground bar bonded to the panel enclosure (if metal) with 20 percent spare terminals.
 12. Provided ground terminal blocks for each twisted-shielded pair drain wire.

2.3 MAIN CIRCUIT PROTECTIVE DEVICE

- A. For panels operating at 480VAC, unless otherwise shown on the Drawings, the main circuit protective device shall be a molded case (MCCB), 3 Pole, 600 Volt, fixed type, manually operated with stored energy closing mechanism. For MCCBs 200A and larger, trip device shall be solid state with adjustable long time pickup, and delay; adjustable short time pickup and delay; and short time i^2t switch. Provide ground fault pickups where indicated on the drawings.

1. Provide a flange mounted main power disconnect operating handle with mechanical interlock having a bypass that will allow the panel door to open only when the switch is in the OFF position. Where panels are shown or specified with inner and outer doors, disconnecting handles and controls shall be located on the inner door.

2.4 ACROSS THE LINE MOTOR CONTROLLERS

A. General

1. Provide the NEMA size starter, circuit breaker trip ratings, control power transformers and thermal overload heater element ratings matched to the motors and control equipment actually supplied, in compliance with the NEC and the manufacturer's heater selection tables. All variations necessary to accommodate the motors and controls as actually furnished shall be made without extra cost to the Owner.
2. Furnish lugs for incoming wiring. Allow adequate clearance for bending and terminating of cable size and type specified.
3. A NEMA rated magnetic motor starter shall be furnished for each motor. Each motor starter shall be provided with a motor circuit protector, or circuit breaker, and equipped to provide undervoltage release and overload protection on all three phases. The short circuit protective device shall have an adjustable magnetic trip range up to 1400 percent of rated continuous current and a trip test feature. MCPs shall be labeled in accordance with UL489. NEMA starter sizes and breaker trip ratings shall be as required for the horsepower indicated but shall be in no case less than NEMA Size 1. If the manufacturer of the equipment utilizing the motor, supplies a motor horsepower larger than that shown on the Drawings, the Contractor shall supply a motor starter sufficient in size to control the motor supplied.
4. A mechanical disconnect mechanism, with bypass, shall be installed on each motor circuit protector, capable of being locked in the "OFF" position to provide a means of disconnecting power to each motor. Disconnects mechanisms shall be located inside the enclosure such that the main circuit breaker handle is the only device interlocked with the panel door.
5. Each motor starter shall have a 120-volt operating coil unless otherwise noted.
6. Overload relays shall be electronic type with adjustable features and remote reset. A normally closed contact shall be directly used in the start circuit and a normally open contact shall be wire to a terminal board for overload alarm.
7. All interfaces between control panel and remote devices shall be isolated via an interposing relay. Interposing relays shall have contacts rated for 250 VAC and 10 Amps continuous. Relays shall be Control Relays as specified herein.

B. Magnetic Motor Starters

1. Motor starters shall be 2 or 3 pole, single or 3 phase as required, 60 Hertz, 600 volt, magnetically operated, full voltage non reversing. NEMA sizes shall be as required for the horsepower shown on the Drawings.
2. Each motor starter shall have a 120-volt operating coil, and control power transformer. Starters shall have motor overload protection in each phase. Auxiliary contacts shall be provided as shown on the Drawings. A minimum of one N.O. and one N.C. auxiliary contacts shall be provided in addition to the contacts required.
3. Overload relays shall be electronic, adjustable, with remote and local reset.
4. Built in control stations and indicating lights shall be furnished where shown on the Drawings.
5. All wires shall be terminated on terminal blocks and shall be tagged.
6. Provide as built wiring diagram and post it in a protective cover inside the cell.

C. Contactors

1. Contactors shall be a circuit breaker and contactor, 600 Volt, 3 Pole, 60 Hz, magnetically operated. NEMA size shall be as required for the kilowatt ratings required for the equipment provided but shall be not less than NEMA size 1.

2. Contactors shall have a 120 Volt operating coil and control power transformer. Furnish the control power transformer with extra capacity for the unit heater fan.

D. Control Relays

1. Control relays shall be 300-volt, industrial rated, plug-in socket type, housed in a transparent polycarbonate dust cover, designed in accordance with UL Standard 508 for motor controller duty. Continuous contact rating shall be 10 amperes resistive, ¼ HP at 120 VAC, operating temperature minus 10 to plus 55 degrees C. Provide spare N.O. & N.C. contacts. Relays shall be Potter & Brumfield KRP Series or equal with neon coil indicator light. Timing relays shall be 300 Volt, solid state type, with rotary switch to select the timing range.

E. Elapsed Time Meter

1. A six-digit, non-resettable elapsed time meter shall be installed on the face of each motor starter.

2.5 VARIABLE FREQUENCY DRIVE MOTOR CONTROLLERS

- A. Where variable frequency drives (VFDs) are provided for motor starting and control, comply with requirements of Division 26 specifications for VFDs.

2.6 INSTRUMENTATION DEVICES

- A. Where instrumentation devices are specified or shown on the Drawings, refer to Division 40 Instrumentation specifications.

2.7 REMOTE MONITORING AND CONTROL INTERFACE

- A. General: All control and interconnection points from the equipment to the plant control and monitoring system shall be brought to dedicated terminal blocks. No field connections shall be made directly to the equipment control devices. Functions to be brought out shall be as specified in related specification sections and the contract drawings.
- B. Discrete control or status functions shall be from C relays with contacts rated at 120 volts AC. Analog signals shall be isolated from each other.

2.8 PROGRAMMABLE LOGIC CONTROLLERS (PLC)

- A. Provide a CompactLogix PLC consisting of the following basic components:
 1. Power supply module properly sized for the I/O load. The power supply input shall be 120VAC single phase.
 2. 1769-L30ER processor with a minimum of 1MB memory.
 3. Integral Ethernet/IP communication ports.
 4. The following I/O modules as required for the application.
 - a. Analog Input Modules for 4-20mA signals
 - b. Analog Output Modules for 4-20mA signals
 - c. Digital Input Modules for discrete signals
 - d. Digital Relay Output Modules for discrete signals
- B. Provide I/O points as indicated in the drawings.
- C. Each PLC shall be installed with a minimum of 20% spare I/O points of each type utilized in its I/O structure.

- D. Each PLC shall have a removable nonvolatile memory card installed with capacity greater than or equal to processor internal memory. The controller shall be configured to load a copy of the program from nonvolatile memory whenever there is no project in the controller and power is applied.
- E. The PLCs shall be capable of and shall be configured to provide stand-alone operation in the event of a communications link failure.
- F. The necessary interface cables, communications cables, power cables, bus extension cables, modular card slot fillers, and other ancillary parts shall be furnished and installed as integral parts of the control system.
- G. Nameplates shall be provided for each module, device, and other equipment with appropriate data such as the equipment number, rating, serial number, and manufacturer.
- H. All I/O cards shall be furnished with removable terminal blocks to simplify card wiring and replacement.

2.9 OPERATOR INTERFACE TERMINALS (OIT)

- A. General: Where indicated on drawings or within an equipment specification, an OIT shall be mounted on the front of the control panel for display and control of process-specific graphics. OITs shall meet the following requirements:
 1. Allen-Bradley Panelview Plus 7.
 2. Minimum Screen Size: 10" diagonal.
 3. Provide Ethernet/IP communication capability compatible with Allen-Bradley family PLCs.
 4. Provide devices with 2GB memory card.
 5. Provide non-glare screen protector. For HMIs installed outdoors, provide hinged weatherproof cover.
 6. OITs may also be referred to throughout contract documents as Human Machine Interface (HMI).

2.10 NETWORK DEVICES

- A. Ethernet Switches
 1. Switches installed in control panels shall be DIN-rail mounted managed switches with RJ-45 and fiber ports as required for the application. Provide a minimum of two (2) spare RJ-45 ports and two (2) fiber ports for future connections. Provide at least two (2) fiber ports whether or not fiber connections are required.
 2. Switches shall support gigabit connection speeds.
 3. Provide power supply as required.
 4. Switches shall be manufactured by Red Lion, Hirschmann, Moxa, Cisco, or equal.
- B. Media Converters
 1. Provide copper to fiber media converters where shown on the drawings or where required to interface with external cabling. Provide power supply as required.
- C. Surge Protection
 1. Copper Ethernet cables entering control panels from other sources shall be protected against static discharge, lightning, and faulty wiring with network surge protective devices. The devices shall have integral RJ-45 connectors with all lines protected.

2.11 UNINTERRUPTIBLE POWER SUPPLY (UPS)

- A. Each control panel provided with a PLC shall contain a UPS to provide seamless and continuous operation of control panel equipment during power outages. The UPS shall provide backup power meeting the following requirements:
1. True sine wave output with on-line double conversion configuration
 2. Fault, overload, and replace batteries indicators.
 3. Voltage input: 120 VAC single phase
 4. Voltage output: 120VAC single phase
 5. Output power capacity: 1000 watts / 1500VA minimum
 6. Internal or external bypass.
 7. Hot-swap batteries ≥ 2 min. (at 25 °C, full load = 600W, p.f. between 0.6 – 0.75)
 8. UPS to be manufactured by Allen Bradley, or equal.

2.12 SPARE PARTS

- A. Provide the following spare parts in the quantities specified. For plant-wide PLC control panels provided by the Control System Specialist, provide 1 set of spare parts that are common to multiple panels. For equipment manufacturer supplied systems, provide one set of spare parts for each control panel.
1. One (1) PLC processor module of each type furnished.
 2. Two (2) PLC I/O modules of each type furnished.
 3. One (1) communication module of each type furnished.
 4. One (1) OIT of each type furnished.
 5. Six replacement fuses, all types and sizes.
 6. One replacement lamp of each color, for pilot lights.
 7. One of each color replacement lens caps for pilot lights.
 8. One starter coil for each NEMA size furnished.
 9. One, 3-pole set of replacement overload heaters of each size range used.
 10. One, 3-pole set of starter contacts of each NEMA size used.
- B. Spare parts shall be boxed or packaged for long term storage. Identify each item with manufacturer's name, description, and part number on the exterior of the package.

2.13 FACTORY TESTING

- A. The entire control panel shall be completely assembled, wired, and adjusted at the factory and shall be given the manufacturer's routine shop tests and any other additional operational test to insure the workability and reliable operation of the equipment.
- B. Factory test equipment and test methods shall conform with the latest applicable requirements of ANSI, IEEE, UL, and NEMA standards.
- C. The operational test shall include the proper connection of supply and control voltage and, as far as practical, a mockup of simulated control signals and control devices shall be fed into the boards to check for proper operation.
- D. Factory test equipment and test methods shall conform to the latest applicable requirements of ANSI, IEEE, UL, and NEMA standards, and shall be subject to the Owner/Engineer's approval.

PART 3 - EXECUTION

3.1 INSTALLER'S QUALIFICATIONS

- A. Installer shall be specialized in installing this type of equipment, with minimum 5 years documented experience. Experience documentation shall be submitted for approval prior to beginning work on this project.

3.2 EXAMINATION

- A. Examine installation area to assure there is enough clearance to install the equipment.
- B. Housekeeping pads shall be included for the floor mounted motor controllers as detailed on the Drawings with the exception of motor controllers which are to be installed adjacent to an existing unit. Housekeeping pads for these (if used) should match the existing installation.
- C. Check concrete pads and baseplates for uniformity and level surface.
- D. Verify that the equipment is ready to install.
- E. Verify field measurements are as instructed by manufacturer.

3.3 INSTALLATION

- A. The Contractor shall install all equipment per the manufacturer's recommendations and Contract Drawings.
- B. Install required safety labels.
- C. All wiring shall be neatly installed, and wire ways shall be used wherever possible. All wiring shall be identified at all terminating locations by Tag ID as identified in Drawings.

3.4 FIELD QUALITY CONTROL

- A. Inspect installed equipment for anchoring, alignment, grounding, and physical damage.
- B. Check tightness of all accessible electrical connections. Minimum acceptable values are specified in manufacturer's instructions.
- C. Provide one set of as-built panel drawings laminated, in each panel pocket.

3.5 FIELD ADJUSTING

- A. Adjust all circuit breakers, switches, access doors, operating handles for free mechanical and electrical operation as described in manufacturer's instructions.

3.6 FIELD TESTING

- A. Perform all electrical field tests recommended by the manufacturer. Disconnect all connections to solid-state equipment prior to testing.
- B. Megger and record phase to phase and phase to ground insulation resistance. Megger, for 1 minute, at minimum voltage of 1000 VDC. Measured Insulation resistance shall be at least 100 megohms. In no case shall the manufacturer's maximum test voltages be exceeded.

- C. Test each key interlock system for proper functioning.
- D. Test all control logic before energizing the motor or equipment.

3.7 CLEANING

- A. Remove all rubbish and debris from inside and around the motor controllers. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.8 EQUIPMENT PROTECTION AND RESTORATION

- A. Touch-up and restore damaged surfaces to factory finish, as approved by the manufacturer. If the damaged surface cannot be returned to factory specification, the surface shall be replaced.

END OF SECTION

SECTION 41 20 00 – HYDROGEN SULFIDE REMOVAL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Work necessary to furnish all labor, materials, equipment, and incidentals required to manufacture, completely install, adjust, protect, put in operation, and test the hydrogen sulfide removal equipment as shown on the Drawings and as specified herein.
- B. Related Sections:
 - 1. Section 01 33 00 – Submittals Procedures.
 - 2. Section 01 40 00 – Quality Requirements.
 - 3. Section 01 60 00 – Product Requirements.
 - 4. Section 01 75 00 – Startup Testing and Training.
 - 5. Section 40 23 43 – Process Valves.

1.2 GENERAL

- A. General Requirements: See Division 01, GENERAL REQUIREMENTS, which contains information and requirements that apply to the Work specified herein and are mandatory for this project.
- B. Like items of equipment provided hereinafter shall be the end products of one Manufacturer to achieve standardization of appearance, operation, maintenance, spare parts, and Manufacturer's services.
- C. Unit Responsibility: The Work requires the hydrogen sulfide removal equipment, complete with all accessories and appurtenances, be the end product of one responsible Manufacturer. The Manufacturer shall furnish all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment in operation in conformance with the specified performance, features and functions without altering or modifying the Contractor's responsibilities under the Contract Documents.
- D. The equipment specified herein is included in form ATTACHMENT B – LIST OF MANUFACTURERS provided in the front-end documents. Contractor shall identify the proposed manufacturer of the equipment specified on this form with the submitted bid.

1.3 SUBMITTALS

- A. General: Administrative, shop drawings, samples, quality requirements, and contract closeout submittals shall conform to the requirements of Section 01 33 00, SUBMITTAL PROCEDURES.
- B. In addition to the requirements of Section 01 33 00, SUBMITTAL PROCEDURES, submit the following additional specific information:
 - 1. Complete assembly and installation drawings, together with detailed specifications and data covering materials used and accessories forming a part of the equipment furnished. The data and specifications shall include, but shall NOT be limited to, the following, where applicable:
 - a. Manufacturer and model.
 - b. Performance data, including flow curves.
 - c. Electrical schematics.
 - d. Dimensions.
 - e. Connection sizes and locations.
 - f. Pressure drops through each vessel.

- g. Weight, shipping and operating.
- h. Clearance requirements.
- i. Temperature rise and insulation rating
- j. Type of bearings and method of lubrication
- k. Efficiency at nameplate rating and at operating point.
- 2. Structural design calculations and drawings for vessels including ladder signed and sealed by a professional engineer licensed in the State of Alabama.
- 3. Controls
 - a. Wiring Diagram, if applicable
- 4. Quality requirements Submittals:
 - a. Certified copies of the results of all Factory Functional and field Performance Test reports.
 - 1) Submit for the Engineer's approval a copy of the proposed startup testing log sheet.
 - b. Special shipping, storage and protection and handling instructions.
 - c. Manufacturer's printed installation instructions.
 - d. List special tools, materials and supplies furnished with equipment for use prior to and during startup and for future maintenance.
 - e. Special tools/spare parts shall NOT be used during the warranty period.
- 5. Contract Closeout Submittals: Service records for maintenance performed during construction.

1.4 QUALITY REQUIREMENTS

- A. Where practical, factory performance tests shall be conducted for each item furnished under this Section. Each shall be operated to test the functionality.
- B. Tests shall be in accordance with the latest applicable codes and standards, including by ASHRAE, ASME, AMCA, AHRI, ASTM, IBC, and NFPA.
- C. Submit six copies of certified test results to the Engineer for approval.

1.5 OPERATION AND MAINTENANCE DATA

- A. O&M Manuals: Content, format, and schedule for providing as specified in Section 01 77 00, CLOSEOUT PROCEDURES.
- B. Maintenance Summary Forms: As specified in Section 01 77 00, CLOSEOUT PROCEDURES.

1.6 WARRANTY

- A. Provide warranty for a period of 12 months after the final acceptance of the equipment by the Owner and Engineer. The warranty shall stipulate that the equipment furnished is suitable for the purpose intended and free from defects of material and workmanship for the duration of the warranty. In the event the equipment fails to perform as specified, the Manufacturer shall promptly repair or replace the defective equipment without additional cost to the Owner.
- B. Spare parts identified within this specification shall not be used to address warranty repairs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Where a Manufacturer's standard equipment name and/or model number is listed, the equipment shall be provided as modified to conform to the performance, functions, features, and materials of construction as specified herein.
- B. The basis of design for the hydrogen sulfide removal system is the proposed system by Unison Solutions. Contractor shall be responsible for any modifications required for use of an alternative manufacturer including coordination of interconnecting piping, equipment pad size, ancillary connections, and any other differences between systems at no additional cost to Owner.
- C. Manufacturers of components and accessories specified herein shall be as follows:
 - 1. Unison Solutions.
 - 2. MARCAB.

2.2 GENERAL REQUIREMENTS

- A. See Section 01 60 00, PRODUCT REQUIREMENTS, for specific requirements related to the equipment specified herein.
- B. All equipment shall be supplied complete. Parts shall have liberal strength, stability and stiffness and shall be especially adapted for the intended service. Ample room and facilities shall be provided for inspection, repairs, and adjustments.
- C. Stainless steel nameplates giving the name of the Manufacturer, the serial number, model number, horsepower, speed, and any other pertinent data shall be attached to the item.

2.3 SERVICE CONDITIONS AND DESIGN REQUIREMENTS

- A. The hydrogen sulfide removal equipment shall remove hydrogen sulfide from digester gas produced by an anaerobic digestion process and shall meet the following design requirements:
 - 1. Number of Vessels: 1
 - 2. Design Flow: 350 SCFM
 - 3. Average Inlet Hydrogen Sulfide Concentration: 300 ppmv
 - 4. Maximum Pressure Drop: 1-inch water column
 - 5. Maximum Outlet Hydrogen Sulfide Concentration: < 10 ppmv
 - 6. Gas: Saturated anaerobic digester gas
 - 7. Inlet Pressure Range: 2 to 14-inches water column
 - 8. Average Inlet Pressure: 5 inches water column
 - 9. Gas Temperature Range: 0 to 120-degree F
 - 10. Media: Pelletized iron hydroxide
 - 11. Average Media Life: 12 months
 - 12. Vessel Diameter: 10-feet
 - 13. Minimum Media Depth: 12-feet
 - 14. Maximum Allowable Working Pressure: 5 psig
 - 15. Maximum Allowable External Working Pressure: 1 psig

2.4 MATERIALS

- A. Scrubber Vessel
 - 1. The vessel shall be fabricated of minimum 3/16-inch Type 304L stainless steel. Vessel shall be designed and hydrostatically tested to 10 psig before shipment.

2. All stainless steel surfaces shall be precleaned, descaled, passivated, and inspected.
3. The vessel shall be provided with 6-inch diameter ANSI Class 125 flanged inlet and outlet for connection to digester gas piping.
4. Vessel shall be provided with ladder and platform to access accessories on top of the vessel. Platform shall be designed for dead load plus live load of 100 psf over the entire span with a maximum live load deflection of L/360. Both platform and ladder shall be aluminum construction and di-electrically separated from the stainless steel vessel. Platform shall have handrail on all sides with spring loaded gate.
5. Vessel shall have the following additional accessories:
 - a. Pressure/vacuum relief valve with flame arrester.
 - b. Minimum 30-inch diameter flanged top manway.
 - c. Minimum 30-inch diameter flanged side manway.
 - d. Bottom manual condensate drain with stainless steel ball valve.
 - e. Dual top vents with stainless steel ball valves.
 - f. Inlet/discharge pressure gauges.
 - g. Inlet/discharge temperature gauges.

B. Piping

1. Piping shall be Type 304L stainless steel, minimum Schedule 10S. Threaded pipe shall be minimum Schedule 40S.
2. Flange connections shall be ANSI Class 150.
3. Gaskets shall be 1/16-inch nitrile bound non-asbestos ring gaskets.

C. Scrubber Media

1. Scrubber media shall be pelletized iron hydroxide.

2.5 TOOLS AND SPARE PARTS

A. None.

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01 60 00, PRODUCT REQUIREMENTS.
- B. No shipment shall be made until the Contractor has an approved shop drawing submittal.
- C. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- D. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.
- E. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment with anti-friction or sleeve bearings shall be stored in weathertight and heated storage facilities prior to installation. For extended storage periods, plastic equipment wrappers shall not be used to prevent accumulation of condensate in gears and bearings.

3.2 INSTALLATION

- A. All equipment shall be installed in accordance with the Manufacturer's instructions and as shown on the Drawings.
- B. All piping, valves, fittings, conduit, wiring, etc. required to interconnect system components shall be furnished and installed by the Contractor. Unless otherwise noted, piping shall be Type 304L stainless steel.
- C. Contractor to coordinate with Manufacturer to size and provide all fasteners and anchor bolts. All fasteners and anchor bolts shall be Type 316 stainless steel.
- D. Care shall be exercised to ensure that piping stresses are not transmitted to the equipment. Contractor shall provide supports, as necessary.
- E. Each item shall be operated, adjusted, and tested after installation as required to ensure proper adjustment and operation of all controls.
- F. Each item shall be leveled, plumbed, aligned, and wedged into position to fit connecting piping.

3.3 FIELD QUALITY CONTROL

- A. Field testing shall be performed in accordance with Section 01 75 00, STARTUP TESTING AND TRAINING.
- B. One month after start-up, the Manufacturer shall sample inlet and outlet hydrogen sulfide concentrations to confirm performance requirements are achieved. All costs for sampling and sample analysis shall be included in the Manufacturer's scope of supply. If outlet concentrations are not achieved as specified herein, modifications to the system shall be performed at no additional cost to the Owner and new samples shall be taken until the performance requirements are achieved.

3.4 MANUFACTURER'S SERVICES

- A. A Manufacturer's representative for the equipment specified herein shall be present at the jobsite for the minimum person-days listed for the services here under, travel time excluded:
 - 1. (1) person-day for installation assistance, inspection, and certification of the installation. Provide Certificate.
 - 2. (1) person-day during operational field testing.
 - 3. (1) person-day for pre-startup classroom or jobsite training of Owner's personnel.
- B. Training of Owner's personnel shall be at such times and at such locations as required and approved by the Owner.
- C. See Section 01 75 00, STARTUP TESTING AND TRAINING.

END OF SECTION