

# COLLIER COUNTY, FLORIDA

BIDDING REQUIREMENTS  
AND  
CONTRACT DOCUMENTS

for the construction of the

## **SOUTH COUNTY REGIONAL WATER TREATMENT PLANT SULFURIC ACID MODIFICATIONS**

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JACOBS ENGINEERING GROUP

**Naples, FL 34108**

**September 2018**

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Project No. 675279

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**END OF SECTION**

**SECTION 01 11 00**  
**SUMMARY OF WORK**

**PART 1      GENERAL**

1.01      WORK COVERED BY CONTRACT DOCUMENTS

- A.    The completed Work will provide the County with a modified sulfuric acid piping system that connects the existing bulk tanks to the existing day tanks and sulfuric acid pumps with tubing in carrier pipes at the existing South County Regional Water Treatment Plant (SCRWTP). The work is described below and as shown and detailed on the Drawings.
  
- B.    The Project includes modifications, repairs, replacement of existing facilities and installation of new equipment in accordance with the following.
  
- C.    Scope:
  - 1.    Demolish existing piping between bulk tanks, day tanks, and acid pumps.
  - 2.    Demolish existing electrical conduit connected to existing actuators and instrumentation on the bulk tanks, day tanks and pump skids.
  - 3.    Pour a concrete pad and install an owner furnished sulfuric acid pump skid, referred to as odor control blowdown pump and associated magnetic flow meter.
  - 4.    Replace existing manual butterfly valves with diaphragm valves.
  - 5.    Install new ball valves on the bulk tank outlet with electric actuators relocated from the existing day tank fill valves.
  - 6.    Install new fill ball valves and actuators on the existing day tank fill lines.
  - 7.    Install tubing in carrier piping connecting the two bulk tanks to the three day tanks.
  - 8.    Install tubing in carrier piping connecting the three day tanks to the existing sulfuric acid pump skid and the new sulfuric acid pump skid.
  - 9.    Install tubing in carrier piping connecting the two sulfuric acid pump skids to the existing sulfuric acid feed lines exiting the sulfuric acid room.
  - 10.    Install secondary containment basins at termination points of carrier piping as shown in the Drawings.
  - 11.    Extend electrical wiring from existing odor control blowdown pump to new odor control blowdown pump. Run new signal wiring from control panel to new odor control blowdown pump.
  - 12.    Modify existing control panels to incorporate bulk tank actuators as shown in the Drawings.
  - 13.    Route new electrical and signal wiring from modified panels to relocated actuators on the bulk tanks.
  - 14.    Provide programming and screen changes including:

- a. New automatic and manual bulk tank valve control from the existing sulfuric acid control screen
  - b. Add alarms to alert operations of potential overfeed of sulfuric acid to RO post-treatment.
  - c. Modify control screen to reflect piping and valve changes.
15. Details are contained on the contract drawings and in further sections of these specifications.

## **PART 2 PRODUCTS**

### 2.01 PRODUCTS

- A. Shall be as specified herein.

## **PART 3 EXECUTION**

### 3.01 GENERAL

- A. Continuous operation of county's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously. taking a sulfuric acid pump out of service will impact facility operation. A written request with at least 48 hours notice is required prior to a plant shutdown. Notice is not a guarantee of plant shutdown and may need further coordination. Schedule work activities to minimize shutdown period.
- B. Do not close lines, open or close valves, or take other action which would affect the operation of existing systems, except as specifically required by design documents and after authorization by County.
- C. Contractor shall provide submittals to the county and engineer prior to purchasing equipment and materials. County and Engineer will transmit response to contractor not later than 21 days after receipt, unless otherwise specified. Contact for county shall be:

ALICIA ABBOTT  
COLLIER COUNTY GOVERNMENT  
PUBLIC UTILITIES ENGINEERING & PROJECT MANAGEMENT  
3339 TAMiami TRAIL EAST, SUITE 303  
NAPLES, FL 34112  
239-252-5344  
ALICIA.ABBOTT@COLLIERCOUNTYFL.GOV

- D. Contractor to field verify all dimensions prior to shop drawing submittal.
- E. County shall provide a staging area, Contractor to coordinate with the owner for details.

- F. Electrical power and water facilities will be available on site and the cost will be borne by Owner. Temporary facilities to obtain and transport these services to the point of application shall be borne by Contractor.
- G. The Contractor shall provide portable toilet facilities for the field staff. Coordinate with County for placement.
- H. The Engineer will schedule physical arrangements for meetings throughout progress of the Work, prepare meeting agenda with Contractor's input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes. Contractor shall produce a detailed schedule at the pre-construction meeting and shall provide updates at each progress meeting.
- I. Contractor shall provide electronic submittals of materials and equipment used for the work, for approval, to Engineer. If not approved by Owner, Contractor shall provide re-submittals. Prior to transport of materials and equipment to site and installation in the Work, the submittals shall be approved by Owner.
- J. As part of the close-out, contractor shall provide record drawings of the finished Work.
- K. In case of damage to existing facilities, Owner shall be notified immediately, and the Contractor shall be responsible for the repairs.
- L. Contractor shall obtain all required permits and regulatory approvals for the execution of the Work.
- M. The Contractor's staff shall have obtained Owner's security clearance and shall require wearing their ID badges at work on site at all times.
- N. Each day, the Contractor's field staff shall sign-in and sign-out at the visitor's desk in the Operations Building.
- O. The Contractor's field staff shall participate in a chemical safety walk through orientation with the Owner's Operational Staff from SCRWTP
- P. Allowable work times are 7:00 am to 5:00 pm Monday through Friday. The NCRWTP Owner's Project Manager shall pre-approve Saturday work with 24-hour notice of the request for approval.
- Q. The piping assemblies shall be disinfected after they have been cleaned, completed and accepted in terms of internal coating, hydrostatic pressure/leakage tested as a gravity pipe using potable water. Disinfection shall be performed with spraying sodium hypochlorite in accordance with method described in AWWA C652. The Contractor shall be responsible for disposal of test waters and shall neutralize the sodium hypochlorite solution.

### 3.02 SEQUENCE OF OPERATION

1. Pour pad for odor scrubber blowdown pump.
2. Install carrier piping and tubing to day tanks and acid pumps where possible (interferences may exist prior to demolition).
3. After pad is cured, install owner furnished odor control blowdown pump skid and magnetic flowmeter.
4. Drain acid day tank and bulk tank 1, coordinate with County
5. Install new valves and piping to day tank 1 and bulk tank 1. Install electrical and signal wiring to day tank 1 and bulk tank 1.
6. Connect bulk tank 1 and day tank 1 piping to acid pumps.
7. Pressure test new equipment (between isolation valves).
8. Modify day tank 1 control panel.
9. Re-run electrical and signal conduit to day tank 1.
10. Connect new day tank 1 actuator to rerouted electrical and signals.
11. Re-connect day tank 1 level indicators to rerouted signal wires.
12. Route new electrical and signals to new bulk tank 1 actuator.
13. Extend electrical from pre-existing odor control pump to new odor control pump.
14. Re-run signal wiring to odor control pump.
15. Update controls to provide alarms and valves for bulk tank operation.
16. Test new feed piping system in operation prior to starting continued demolition.
17. Repeat process for bulk tank 2 and day tank 2. Coordinate with County.
18. Demolish acid piping to bulk tank 2, day tank 2 and day tank 3
19. Install new valves and piping to bulk tank 2, day tank 2 and day tank 3. install new electrical and signal wiring to bulk tank 2.
20. Connect bulk tank 2, day tank 2, and day tank 3 piping to acid pumps.
21. Pressure test new equipment (between isolation valves).
22. Demolish sulfuric acid pretreatment pump discharge piping to wall connection.
23. Connect sulfuric acid pretreatment pump discharge piping to wall connection with tubing.
24. Patch repair floor, perform final demolition and finishing.

**END OF SECTION**

**SECTION 01 61 00**  
**PROJECT REQUIREMENTS**

**PART 1      GENERAL**

1.01      PAYMENT PROCEDURES

A.      Schedule of Values

1.      Prepare a separate Schedule of Values for each schedule of the Work under the Agreement.
2.      Upon request of Engineer, provide documentation to support the accuracy of the Schedule of Values.
3.      Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.

B.      Application for Payment

1.      Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment for each schedule and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.
2.      Use detailed Application for Payment Form provided by Owner.
3.      Provide separate form for each schedule as applicable.
4.      Include accepted Schedule of Values for each schedule or portion of lump sum Work and the unit price breakdown for the Work to be paid on a unit priced basis.
5.      Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by Engineer.'

1.02      PROJECT MEETINGS

- A.      The Engineer will schedule physical arrangements for meetings throughout progress of the Work, prepare meeting agenda with regular participant input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within two days after each meeting to participants and parties affected by meeting decisions.

B.      Preconstruction Conference

1.      Contractor shall be prepared to discuss the following subjects, as a minimum:
  - a.      Required schedules.
  - b.      Status of Bonds and insurance.
  - c.      Sequencing of critical path work items.
  - d.      Progress payment procedures.

- e. Project changes and clarification procedures.
  - f. Use of Site, access, office and storage areas, security and temporary facilities.
  - g. Major product delivery and priorities.
  - h. Contractor's safety plan and representative.
- C. Progress Meetings
- 1. Owner will schedule regular progress meetings at Site, conducted weekly to review the Work progress, Progress Schedule, Schedule of Submittals, Application for Payment, contract modifications, and other matters needing discussion and resolution.
- D. Preinstallation Meetings
- 1. When required in individual Specification sections, convene at Site prior to commencing the Work of that section.
  - 2. Require attendance of entities directly affecting, or affected by, the Work of that section.
  - 3. Notify Owner 4 days in advance of meeting date.
  - 4. Provide suggested agenda to Owner to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.
- E. Facility Startup Meetings
- 1. Schedule and attend a minimum of two facility startup meetings. The first of such meetings shall be held prior to submitting Facility Startup Plan, as specified in Section 01 91 14, Equipment Testing and Facility Startup, and shall include preliminary discussions regarding such plan.
  - 2. Agenda items shall include, but not be limited to, content of Facility Startup Plan, coordination needed between various parties in attendance, and potential problems associated with startup.

### 1.03 CONSTRUCTION PROGRESS DOCUMENTATION

- A. Preliminary Progress Schedule
- 1. Submit at least 7 days prior to preconstruction conference.
- B. Detailed Progress Schedule:
- 1. Submit initial Detailed Progress Schedule within 30 days after Effective Date of the Agreement.
  - 2. Show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by Contractor.



3. When accepted by Engineer, Detailed Progress Schedule will replace Preliminary Progress Schedule and become Baseline Schedule. Subsequent revisions will be considered as Updated Progress Schedules.

C. Adjustment of Contract Times

1. Reference County General Conditions.
2. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of proposed adjustment or claimed delay.
3. Claims Based on Contract Times:
  - a. Where Engineer has not yet rendered formal decision on Contractor's Claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in Progress Schedule, Contractor shall reflect an interim adjustment in the Progress Schedule as acceptable to Engineer.
  - b. It is understood and agreed that such interim acceptance will not be binding on either Contractor or Owner, and will be made only for the purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.
  - c. Contractor shall revise Progress Schedule prepared thereafter in accordance with Engineer's formal decision.

1.04 SUBMITTALS

A. Procedures

1. Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.

B. Transmittal of Submittal

1. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form attached at end of this section.
2. Identify each submittal with the following:
  - a. Numbering and Tracking System:
    - 1) Sequentially number each submittal.
    - 2) Resubmission of submittal shall have original number with sequential alphabetic suffix.
  - b. Specification section and paragraph to which submittal applies.
  - c. Project title and Engineer's project number.
  - d. Date of transmittal.
  - e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.

3. Identify and describe each deviation or variation from Contract Documents.
- C. Format:
1. Do not base Shop Drawings on reproductions of Contract Documents.
  2. Package submittal information by individual Specification section. Do not combine different Specification sections together in submittal package, unless otherwise directed in Specification.
  3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
  4. Index with labeled tab dividers in orderly manner.
- D. Informational Submittals
1. General:
    - a. Copies: Submit three copies, unless otherwise indicated in individual Specification section.
    - b. Refer to individual Specification sections for specific submittal requirements.
    - c. Engineer will review each submittal. If submittal meets conditions of the Contract, Engineer will forward copy to appropriate parties. If Engineer determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Engineer will retain one copy and return remaining copy with review comments to Contractor, and require that submittal be corrected and resubmitted.
  2. Operation and Maintenance Data: As required in Division 1, General Requirements.
  3. Payment:
    - a. Application for Payment: In accordance with Section 01 29 00, Payment Procedures.
    - b. Schedule of Values: In accordance with Section 01 29 00, Payment Procedures.
    - c. Schedule of Estimated Progress Payments: In accordance with Section 01 29 00, Payment Procedures.
  4. Schedules:
    - a. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01 32 00, Construction Progress Documentation.
      - 1) Show for each, at a minimum, the following:
        - a) Specification section number.
        - b) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
        - c) Estimated date of submission to Engineer, including reviewing and processing time.

- 2) On a monthly basis, submit updated Schedule of Submittals to Engineer if changes have occurred or resubmittals are required.
- b. Progress Schedules: In accordance with Section 01 32 00, Construction Progress Documentation.

## 1.05 COMMON PRODUCT REQUIREMENTS

### A. Installation

1. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.
2. No shimming between machined surfaces is allowed.
3. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.
4. Repaint painted surfaces that are damaged prior to equipment acceptance.
5. Do not cut or notch any structural member or building surface without specific approval of Engineer.
6. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified. Retain a copy of manufacturers' instruction at Site, available for review at all times.
7. For material and equipment specifically indicated or specified to be reused in the Work:
  - a. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
  - b. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

### B. Field Finishing

1. In accordance with Section 09 90 00, Painting and Coating, and individual Specification sections.

### C. Adjustment and Cleaning

1. Perform required adjustments, tests, operation checks, and other startup activities.

## 1.06 CLOSEOUT PROCEDURES

### A. Submit prior to application for final payment.

1. Record Documents: As required in General Conditions.
2. Final Application for Payment: Submit in accordance with procedures and requirements stated in Section 01 29 00, Payment Procedures.

## B. Record Documents

1. Making Entries on Drawings:
  - a. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
    - 1) Color Coding:
      - b. Green when showing information deleted from Drawings.
      - c. Red when showing information added to Drawings.
      - d. Blue and circled in blue to show notes.
2. Date entries.
3. Call attention to entry by “cloud” drawn around area or areas affected.
4. Legibly mark to record actual changes made during construction, including, but not limited to:
  - a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
  - b. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
  - c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
  - d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
  - e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, and Engineer’s written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.
5. Dimensions on Schematic Layouts: Show on record drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
  - a. Clearly identify the item by accurate note such as “cast iron drain,” “galv. water,” and the like.
  - b. Show, by symbol or note, vertical location of item (“under slab,” “in ceiling plenum,” “exposed,” and the like).
  - c. Make identification so descriptive that it may be related reliably to Specifications.

## C. Final Cleaning

1. At completion of the Work or of a part thereof and immediately prior to Contractor’s request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor’s notice of completion, clean entire Site or parts thereof, as applicable.
2. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to Owner.

3. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.
4. Repair, patch, and touchup marred surfaces to specified finish and match adjacent surfaces.
5. Clean all windows.
6. Clean and wax wood, vinyl, or painted floors.
7. Broom clean exterior paved driveways and parking areas.
8. Hose clean sidewalks, loading areas, and others contiguous with principal structures.
9. Rake clean all other surfaces.
10. Remove snow and ice from access to buildings.
11. Replace air-handling filters and clean ducts, blowers, and coils of ventilation units operated during construction.
12. Leave water courses, gutters, and ditches open and clean.
13. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

## 1.07 OPERATIONS AND MAINTENANCE DATA

### A. Electronic Media Format:

1. Portable Document Format (PDF):
2. After all preliminary data has been found to be acceptable to Engineer, submit Operation and Maintenance data in PDF format on CD.
3. Files to be exact duplicates of Engineer accepted preliminary data. Arrange by specification number and name.
4. Files to be fully functional and viewable in most recent version of Adobe Acrobat.

### B. Product Data:

1. Include only those sheets that are pertinent to specific product.
2. Clearly annotate each sheet to:
  - a. Identify specific product or part installed.
  - b. Identify data applicable to installation.
  - c. Delete references to inapplicable information.
3. Function, normal operating characteristics, and limiting conditions.
4. Performance curves, engineering data, nameplate data, and tests.
5. Complete nomenclature and commercial number of replaceable parts.
6. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
7. Spare parts ordering instructions.
8. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).
9. As-installed, color-coded piping diagrams.

10. Charts of valve tag numbers, with the location and function of each valve.
11. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:
  - a. Format:
    - 1) Provide reinforced, punched, binder tab; bind in with text.
    - 2) Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.
    - 3) Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
    - 4) Identify Specification section and product on Drawings and envelopes.
  - b. Relations of component parts of equipment and systems.
  - c. Control and flow diagrams.
  - d. Coordinate drawings with Project record documents to assure correct illustration of completed installation.
12. Instructions and Procedures: Within text, as required to supplement product data.
  - a. Format:
    - 1) Organize in consistent format under separate heading for each different procedure.
    - 2) Provide logical sequence of instructions for each procedure.
    - 3) Provide information sheet for Owner's personnel, including:
      - a) Proper procedures in event of failure.
      - b) Instances that might affect validity of guarantee or Bond.
  - b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.
  - c. Operating Procedures:
    - 1) Start-up, break-in, routine, and normal operating instructions.
    - 2) Test procedures and results of factory tests where required.
    - 3) Regulation, control, stopping, and emergency instructions.
    - 4) Description of operation sequence by control manufacturer.
    - 5) Shutdown instructions for both short and extended duration.
    - 6) Summer and winter operating instructions, as applicable.
    - 7) Safety precautions.
    - 8) Special operating instructions.
  - d. Maintenance and Overhaul Procedures:
    - 1) Routine maintenance.
    - 2) Guide to troubleshooting.
    - 3) Disassembly, removal, repair, reinstallation, and re-assembly.
13. Format: Follow format provided in supplement, Document Section Requirements.

C. Content for Each Electric or Electronic Item or System:

1. Description of Unit and Component Parts:
  - a. Function, normal operating characteristics, and limiting conditions.
  - b. Performance curves, engineering data, nameplate data, and tests.
  - c. Complete nomenclature and commercial number of replaceable parts.
  - d. Interconnection wiring diagrams, including control and lighting systems.
2. Circuit Directories of Panelboards.
3. Electrical service.
4. Control requirements and interfaces.
5. Communication requirements and interfaces.
6. List of electrical relay settings, and control and alarm contact settings.
7. Electrical interconnection wiring diagram, including as applicable, single-line, three-line, schematic and internal wiring, and external interconnection wiring.
8. As-installed control diagrams by control manufacturer.
9. Operating Procedures:
  - a. Routine and normal operating instructions.
  - b. Start-up and shutdown sequences, normal and emergency.
  - c. Safety precautions.
  - d. Special operating instructions.
10. Maintenance Procedures:
  - a. Routine maintenance.
  - b. Guide to troubleshooting.
  - c. Adjustment and checking.
  - d. List of relay settings, control and alarm contact settings.
11. Manufacturer's printed operating and maintenance instructions.
12. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
13. Format: Follow format provided in supplement, Document Section Requirements.

D. Maintenance Summary Forms:

1. Compile individual Maintenance Summary Forms for each applicable equipment item, respective unit or system, and for components or sub-units.
2. Format:
  - a. Use Maintenance Summary Form bound with this section or electronic facsimile of such.
  - b. Each Maintenance Summary may take as many pages as required.
  - c. Use only 8-1/2-inch by 11-inch size paper.
  - d. Complete using typewriter or electronic printing.

3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
4. Recommended Spare Parts:
  - a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
  - b. "Unit" is the unit of measure for ordering the part.
  - c. "Quantity" is the number of units recommended.
  - d. "Unit Cost" is the current purchase price.

## **PART 2 PRODUCTS – NOT USED**

## **PART 3 EXECUTION**

### **3.01 DISINFECTION OF WATER FACILITIES**

#### **A. SEQUENCING**

1. Commence disinfection after completion of following:
2. Cleaning of piping assemblies.
3. Completion and acceptance of internal painting of system(s).
4. Hydrostatic and pneumatic testing, pressure testing, functional and performance testing and acceptance of pipelines, pumping systems, structures, and equipment.

**B. Components and Materials in Contact with Water for Human Consumption:** Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

**C. Conform to AWWA C651 for pipes and pipelines, C652 for tanks and reservoirs and C653 for water treatment plants and filters, except as modified in these Specifications.**

**D. Contractor's Equipment:**

**E. Furnish chemicals and equipment, such as pumps and hoses, to accomplish disinfection.**

**F. Water used to fill pipeline may be supplied using a temporary connection to existing distribution system. Provide protection against cross-connections as required by AWWA C651.**

**G. Disinfect the following items installed or modified under this Project, intended to hold, transport, or otherwise contact potable water:**



- H. Fittings and valves.
- I. Pipelines: Disinfect new pipelines that connect to existing pipelines up to point of connection.
- J. Disinfect surfaces of materials that will contact finished water, both during and following construction, using one of the methods described in AWWA C652 and AWWA C653. Disinfect prior to contact with finished water. Take care to avoid recontamination following disinfection.
- K. Prior to application of disinfectants, clean pipeline assemblies of loose and suspended material.
- L. Allow freshwater and disinfectant solution to flow into pipe or vessel at a measured rate so chlorine-water solution is at specified strength. Do not place concentrated liquid commercial disinfectant in pipeline or other facilities to be disinfected before it is filled with water.
- M. Piping
  - 1. Cleaning:
    - a. Before disinfecting, clean foreign matter from pipe in accordance with AWWA C651.
    - b. If continuous feed method or slug method of disinfection, as described in AWWA C651, are used flush pipelines with potable water until clear of suspended solids and color. Provide hoses, temporary pipes, ditches, and other conduits as needed to dispose of flushing water without damage to adjacent properties.
    - c. Flush service connections and hydrants. Flush distribution lines prior to flushing hydrants and service connections. Operate valves during flushing process at least twice during each flush.
    - d. Flush pipe through flushing branches and remove branches after flushing is completed.
    - e. Pipeline shall be cleaned by use of a pipe pig specifically designed for cleaning. Observe material removed by pig on each pass. Repeat process until pipe has been cleaned to the satisfaction of Engineer.
  - 2. Disinfecting Procedure: In accordance with AWWA C651, unless herein modified.
  - 3. Pipelines larger than 24-inch may be disinfected by spraying in accordance with method described in AWWA C652.
- N. Disposal of Chlorinated Water
  - 1. Do not allow flow into a waterway without neutralizing disinfectant residual.
  - 2. See appendix of AWWA C651, C652 and C653 for acceptable neutralization methods.

## O. Testing

1. Collection of Samples:
  - a. Coordinate activities to allow Samples to be taken in accordance with this Specification.
  - b. Provide valves at sampling points.
  - c. Provide access to sampling points.
2. Test Equipment:
  - a. Clean containers and equipment used in sampling and make sure they are free of contamination.
  - b. Obtain sampling bottles with instructions for handling from Owner's laboratory.
3. Chlorine Concentration Sampling and Analysis:
  - a. Collect and analyze Samples in accordance with AWWA standard.
  - b. Sampling Frequency and Sampling Locations shall be agreed with Owner.
  - c. Owner's laboratory shall be used for chlorine residual measurements.
4. After piping assembly has been cleaned, disinfected, and refilled with potable water, Owner will take water Samples and have them analyzed for conformance to bacterial limitations for public drinking water supplies.
5. Minimum Samples required above are bacterially positive, disinfecting procedures and bacteriological testing shall be repeated until bacterial limits are met.

### 3.02 PIPING LEAKAGE TESTING.

#### A. Preparation

1. Notify Engineer in writing 5 days in advance of testing. Perform testing in presence of Engineer.
2. Pressure Piping:
  - a. Install temporary restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.
  - b. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
  - c. New Piping Connected to Existing Piping:
    - 1) Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Engineer.
    - 2) Test joint between new piping and existing piping by methods that do not place entire existing system under test load, as approved by Engineer.
3. Items that do not require testing include: Equipment seal drains, tank overflows to atmospheric vented drains, and tank atmospheric vents.
4. Test Pressure: 1.5 times working pressure to be confirmed with Engineer

## B. Hydrostatic Test for Pressure Piping

1. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.
2. Exposed Piping:
  - a. Perform testing on installed piping prior to application of insulation.
  - b. Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.
  - c. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.
  - d. Maintain hydrostatic test pressure continuously for 60 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.
  - e. Examine joints and connections for leakage.
  - f. Correct visible leakage and retest as specified.
  - g. Empty pipe of water prior to final cleaning or disinfection.

## C. Field Quality Control

1. Test Report Documentation:
2. Test date.
3. Description and identification of piping tested.
4. Test fluid.
5. Test pressure.
6. Remarks, including:
7. Leaks (type, location).
8. Repair/replacement performed to remedy excessive leakage.
9. Signed by Contractor and Engineer to represent that test has been satisfactorily completed.

**END OF SECTION**

**SECTION 09 90 00  
PAINTING AND COATING**

**PART 1 GENERAL**

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Occupational Safety and Health Act (OSHA).
2. The Society for Protective Coatings (SSPC):
  - a. PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
  - b. PA 3, Guide to Safety in Paint Applications.
  - c. SP 1, Solvent Cleaning.

1.02 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils or square feet per gallon.
2. HCl: Hydrochloric Acid.
3. MDFT: Minimum Dry Film Thickness, mils.
4. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
5. Mil: Thousandth of an inch.
6. PDS: Product Data Sheet.
7. PSDS: Paint System Data Sheet.
8. PVC: Polyvinyl Chloride.
9. SFPG: Square Feet per Gallon.
10. SFPGPC: Square Feet per Gallon per Coat.
11. SP: Surface Preparation.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
  - a. Data Sheets:
    - 1) Furnish a Product Data Sheet (PDS), the manufacturer's technical data sheets, and proposed paint color. The PDS form is appended to the end of this section.
    - 2) Furnish a Paint System Data Sheet (PSDS). The PSDS form is appended to the end of this section.

- 3) Technical and performance information that demonstrates compliance with Specification.

B. Informational Submittals:

1. Applicator's Qualification: List of references substantiating experience.
2. Coating manufacturer's Certificate of Compliance, in accordance with Section 01 33 99, Common Product Requirements.
3. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.
4. Manufacturer's written verification that submitted material is suitable for the intended use.
5. Manufacturer's written instructions and special details for applying each type of paint.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: Minimum 5 years' experience in application of specified products.

1.05 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.
2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS

- A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions.
- B. Minimum of 5 years' verifiable experience in manufacture of specified product.
- C. Each of the following manufacturers is capable of supplying most of the products specified herein:
1. Tnemec.
  2. Sherwin-Williams

## 2.02 PAINT MATERIALS

### A. General:

1. Manufacturer's highest quality products suitable for intended service.
2. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.
3. Thinners, Cleaners, Driers, and Other Additives: As recommended by coating manufacturer.

### B. Products:

| <b>Product</b>       | <b>Definition</b>                    |
|----------------------|--------------------------------------|
| Acrylic Latex        | Single-component, finish as required |
| Acrylic Latex (Flat) | Flat latex                           |

## PART 3 EXECUTION

### 3.01 PROTECTION OF ITEMS NOT TO BE PAINTED

- A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.
- B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.
- C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.
- D. Mask openings in motors to prevent paint and other materials from entering.
- E. Protect surfaces adjacent to or downwind of Work area from overspray.

### 3.02 SURFACE PREPARATION

#### A. Plastic Surface Preparation:

1. Hand sand plastic surfaces to be coated with medium grit sandpaper to provide tooth for coating system.
2. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material.

### 3.03 SURFACE CLEANING

#### A. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.
2. Meet requirements of SSPC SP 1.

### 3.04 APPLICATION

#### A. General:

1. Apply coatings in accordance with these Specifications and paint manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.
2. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.
3. Keep paint materials sealed when not in use.
4. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.

#### B. Film Thickness and Coverage:

1. Number of Coats:
  - a. Minimum required without regard to coating thickness.
  - b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
2. Application Thickness:
  - a. Do not exceed coating manufacturer's recommendations.
  - b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.
3. Visually inspect plastic surfaces to ensure proper and complete coverage has been attained.

3.05 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

A. System No. 25 Exposed CPVC:

| <b>Surface Prep.</b>   | <b>Paint Material</b> | <b>Min. Coats, Cover</b> |
|--|-----------------------|--------------------------|
| In accordance with Paragraph Plastic and FRP Surface Preparation | Acrylic Latex         | 2 coats, 320 SFPGPC      |

1. Use on the following items or areas:
  - a. All exposed-to-view CPVC surfaces.

3.06 COLORS

- A. Provide in accordance with County preference and OSHA standards for Sulfuric Acid.

3.07 FIELD QUALITY CONTROL

- A. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer. Provide additional staging and lighting as requested by Engineer.
- B. Unsatisfactory Application:
1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
  2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
  3. Repair defects in accordance with written recommendations of coating manufacturer.
- C. Damaged Coatings, Pinholes, and Holidays:
1. Feather edges and repair in accordance with recommendations of paint manufacturer.
  2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.



3. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

### 3.08 CLEANUP

- A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.
- B. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.
- C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

### 3.09 SUPPLEMENTS

- A. The supplements listed below, following “End of Section,” are a part of this Specification:
  1. Paint System Data Sheet (PSDS).
  2. Product Data Sheet (PDS).

**END OF SECTION**

**PAINT SYSTEM DATA SHEET**

Complete this PSDS for each coating system, include all components of the system (surface preparation, primer, intermediate coats, and finish coats). Include all components of a given coating system on a single PSDS.

| Paint System Number (from Spec.): |                                      |                      |
|-----------------------------------|--------------------------------------|----------------------|
| Paint System Title (from Spec.):  |                                      |                      |
| Coating Supplier:                 |                                      |                      |
| Representative:                   |                                      |                      |
| Surface Preparation:              |                                      |                      |
| Paint Material<br>(Generic)       | Product Name/Number<br>(Proprietary) | Min. Coats, Coverage |
|                                   |                                      |                      |
|                                   |                                      |                      |
|                                   |                                      |                      |
|                                   |                                      |                      |
|                                   |                                      |                      |
|                                   |                                      |                      |
|                                   |                                      |                      |

## PAINT PRODUCT DATA SHEET

Complete and attach manufacturer's Technical Data Sheet to this PDS for each product submitted. Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

| Temperature/RH   | 50/50 | 70/30 | 90/25 |
|------------------|-------|-------|-------|
| Induction Time   |       |       |       |
| Pot Life         |       |       |       |
| Shelf Life       |       |       |       |
| Drying Time      |       |       |       |
| Curing Time      |       |       |       |
| Min. Recoat Time |       |       |       |
| Max. Recoat Time |       |       |       |

Provide manufacturer's recommendations for the following:

Mixing Ratio: \_\_\_\_\_

Maximum Permissible Thinning: \_\_\_\_\_

Ambient Temperature Limitations:    min.: \_\_\_\_\_ max.: \_\_\_\_\_

Surface Temperature Limitations:    min.: \_\_\_\_\_ max.: \_\_\_\_\_

Surface Profile Requirements:        min.: \_\_\_\_\_ max.: \_\_\_\_\_

Attach additional sheets detailing manufacturer's recommended storage requirements and holiday testing procedures.

**SECTION 09 96 35**  
**CHEMICAL-RESISTANT COATINGS**

**PART 1 GENERAL**

1.01 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:

- a. List materials in proposed system.
- b. Manufacturer's product specification.
- c. Chemical resistance test results for exposure to service conditions.
- d. Application instructions.
- e. Configuration details of materials at terminations, construction joints, floor drains, and trenches.

B. Informational Submittals:

1. Letter from manufacturer stating applicator is qualified to do the Work and meets the quality assurance minimum experience requirements.
2. Sample of warranty, prior to starting the Work.
3. Installation instructions.
4. Field inspection and test reports.
5. Special guarantee.

1.02 QUALITY ASSURANCE

A. Manufacturer's Experience: Minimum 5 years manufacturing proposed products.

B. Applicator's Experience: Minimum 3 years applying proposed products. Trained and certified by the Manufacturer.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened containers.

B. Storage: Maintain materials in clean and dry condition. Follow manufacturer's instructions.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Temperature: Apply coating only when substrate, ambient air, and coating material are 65 degrees F or above.

- B. Substrate: Not wet or have standing water.
- C. Ventilation: Provide during and after application to meet all applicable safety and health regulations.
- D. Apply coating only when the conditions will not produce off-gassing or blistering of the material.

#### 1.05 SPECIAL GUARANTEE

- A. Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the Owner, removal and replacement of Work specified in this Specification section found defective during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in the General Conditions.

### **PART 2 PRODUCTS**

#### 2.01 SERVICE CONDITIONS

- A. Location: Indoors, ambient temperature conditions.
- B. Surface: Concrete floors for chemical storage and handling.
- C. Traffic: Foot.
- D. Chemicals Stored in Containment Areas:
  - 1. Sulfuric acid, 93 percent solutions.

#### 2.02 COATING SYSTEMS

- A. Chemical-Resistant Coatings: A mixture of liquid resin-based material, setting agent, and filler designed to be troweled into place to cure to a hard state.
- B. Polyurethane lining (System CRC-1):
  - 1. 80 mils minimum, two-component, 100 percent solids, exothermic, rapid curing, elastomeric polyurethane lining system.
  - 2. Manufacturer and product: Rhino Lining Corporation, Hi-Chem 21-70.
- C. Epoxy (System CRC-2):

1. Primer and 40 mils minimum topcoat of flake-filled vinylester resin with Teflon fillers. Finished system shall be rolled, brushed, or sprayed. Suitable for intended service.
  2. Manufacturer:
    - a. Rhino Lining Corporation.
    - b. Atlas Minerals and Chemicals.
    - c. Dudick Inc.
    - d. International Paint, Ceilcote Division.
- D. Novolac Epoxy (System CRC-3):
1. Primer and 40 mils minimum topcoat of 100 percent solids, lake –filled novolac epoxy, reinforced with silica or other suitable reinforcements. Finished System shall be rolled, brushed, or sprayed. Suitable for intended service.
  2. Manufacturer:
    - a. Rhino Lining Corporation.
    - b. Atlas Minerals and Chemicals.
    - c. Dudick Inc.
    - d. International Paint, Ceilcote Division.

### 2.03 MIXING

- A. Thoroughly mix until homogeneous following manufacturer’s instructions.
- B. Mix only components furnished by coating manufacturer.

## **PART 3 EXECUTION**

### 3.01 EXAMINATION

- A. Surface Preparation:
  1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of the system manufacturer whose product is to be applied.
  2. The coating Manufacturer’s representative shall inspect the surface preparation and furnish written certification to the Engineer that the substrate surface has been prepared in accordance with Specifications and per manufacturer’s instructions.

### 3.02 PREPARATION

- A. In accordance with Section 09 90 00, Painting and Coating and the manufacturer’s printed directions and recommendations.

- B. Fill holes and cracks with manufacturer's recommended materials to produce even surface for application of systems.
- C. Concrete Surfaces:
  - 1. Remove grease, oil, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent, or other suitable cleaning methods.
  - 2. Brushoff blast clean to remove loose concrete and provide a tooth for binding. Upon approval by Engineer, surface may be acid etched with muriatic acid solution. Approval, subject to producing desired profile.
  - 3. Secure coating manufacturer's recommendations for additional preparation if required for excessive bug holes exposed after blasting.
  - 4. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to painting.
- D. Masonry Surfaces:
  - 1. Remove oil, grease, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent washing, or other suitable cleaning methods. Confirm that all efflorescence-causing conditions have been eliminated.
  - 2. Clean masonry surfaces of mortar and grout spillage and other surface deposits using one of the following:
    - a. Nonmetallic fiber brushes and commercial muriatic acid followed by rinsing with clean water.
    - b. Brushoff blasting.
    - c. Water blasting.
  - 3. Do not damage masonry mortar joints or adjacent surfaces.
  - 4. Leave surfaces clean and, unless otherwise required for proper adhesion, dry prior to painting.
  - 5. Masonry Surfaces to be Coated: Uniform texture and free of surface imperfections which would impair the intended finished appearance.

### 3.03 APPLICATION

- A. Install coating systems in accordance with manufacturer's printed instructions.
- B. Install coating systems on vertical and horizontal surfaces, including caps, within containment wall for storage tanks, pumps, and piping.
- C. Extend surfacing completely under structures and equipment located within the containment area. Install at construction joints in substrate and floor drains, trenches, and other components within the containment area.

### 3.04 FIELD QUALITY CONTROL

- A. Inspection:
  - 1. Inspect finished system for complete, uniform coverage of specified area. Evidence of defects include improper thickness, hardness, and appearance.
- B. The Contractor shall provide and maintain protection of the coating system after the application and inspection until the date of Substantial Completion. During startup, if there is any discoloring or damage of the coating due to chemical leaks, the Contractor shall repair the discolored or damaged coating to match intact coating.

### 3.05 APPLICATION SCHEDULE

- A. Unless otherwise shown or specified, apply coatings in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting Work in question.
- B. System CRC-1: Use in Containment areas in the chemical storage area and in the chemical room for sulfuric acid, corrosion inhibitor and scale inhibitor, including all surfaces at or below the elevation of the top of the containment wall, the sides and tops of all equipment and tank pads, and the sides and bottoms of sumps
- C. Coating System CRC-2: Use in the following areas: Containment area in the chemical storage area and in the chemical room for sodium hydroxide and sodium hypochlorite, including all surfaces at or below the elevation of the top of the containment wall, the sides and tops of all equipment and tank pads, and the sides and bottoms of sumps.
- D. Coating System CRC-3: Use in the following areas:
  - 1. Containment areas in the chemical storage area and in the chemical room hydrofluosilicic acid, including all surfaces at or below the elevation of the top of the containment wall, the sides and tops of all equipment and tank pads, and the sides and bottoms of sumps.
  - 2. RO Building Pipe Trench Sump interior sides and bottom.
  - 3. Backwash pump station interior sides and bottoms.

**END OF SECTION**



**SECTION 26 05 01**  
**ELECTRICAL**

**PART 1 GENERAL**

1.01 COORDINATION

- A. Contractor shall visit the site and become familiar with all aspects of this project. Contractor shall coordinate with OWNER and ENGINEER a site visit to become familiar with project scope, Existing Equipment, project conditions, operational needs for area where modifications will take place

1.02 SCOPE

- A. Electrical scope includes but not limited to the demolition of existing flow control valve branch circuits, instrumentation and control circuits and removal and repair of existing raceway racks, fasteners holes etc. The supply and installation of new elevated raceway rack system, branch circuits , control circuits, instrumentation circuits, associated raceway, conductors, grounding, fasteners, hardware, circuit breakers, and materials to provide a complete power, control, and instrumentation interconnections for a functioning complete system for the operation of valve actuators, signal interfacing, level transmitters, local and remote-control interconnections, and control panel and PLC panel modifications
- B. Details are contained on the contract drawings and in further sections of these specifications.

1.03 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
  - 1. American Association of State Highway Transportation Officials (AASHTO).
  - 2. ASTM International (ASTM):
    - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
    - b. A240/A240M, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
    - c. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
    - d. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
    - e. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.

3. Electronic Industries Association (EIA/TIA): 569, Commercial Building Standard for Telecommunications Pathways and Spaces.
4. Federal Specifications (FS):
  - a. W-C-596, Connector, Electrical, Power, General Specification for.
  - b. W-S-896, Switch, Toggle (Toggle and Lock), Flush Mounted (General Specification).
5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - a. C62.41, Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits.
  - b. PC62.41.1, Draft Guide on the Surge Environment in Low Voltage (1000 V and less) AC Power Circuits.
  - c. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
  - d. 114, Standard Test Procedures for Single-Phase Induction Motors.
6. International Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
7. National Electrical Contractors Association, Inc. (NECA): 1, Standard Practices for Good Workmanship in Electrical Contracting.
8. National Electrical Manufacturers Association (NEMA):
  - a. C80.1, Rigid Steel Conduit-Zinc Coated.
  - b. C80.3, Electrical Metallic Tubing-Zinc Coated.
  - c. C80.6, Intermediate Metal Conduit-Zinc Coated (IMC).
  - d. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
  - e. CC1, Electrical Power Connectors for Substations.
  - f. ICS 1, Industrial Control and Systems: General Requirements.
  - g. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
  - h. ICS 2.3, Industrial Control and Systems: Instructions for the Handling, Installation, Operation and Maintenance of Motor Control Centers.
  - i. MG 1, Motors and Generators.
  - j. PB 1, Panel boards.
  - k. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  - l. ST 20, Dry Type Transformers for General Applications.
  - m. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
  - n. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.
  - o. WC 55, Instrumentation Cables and Thermocouple Wire.
  - p. WC 70, Standard for Non-Shielded Power Cables Rated 2000 V or Less for the Distribution of Electrical Energy.
  - q. WC 71, Standard for Non-Shielded Cables Rated 2001-5000 Volts for use in the Distribution of Electrical Energy.
  - r. WC 74, 5-46 KV Shielded Power Cable for use in the Transmission and Distribution of Electric Energy.
  - s. WD 1, General Color Requirements for Wiring Devices.

9. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
10. Underwriters Laboratories, Inc. (UL):
  - a. 1, Flexible Metal Conduit.
  - b. 6, Electrical Rigid Metal Conduit—Steel.
  - c. 13, Power-Limited Circuit Cables.
  - d. 44, Thermoset Insulated Wires and Cables.
  - e. 62, Flexible Cord and Fixture Wire.
  - f. 67, Panel boards.
  - g. 98, Enclosed and Dead-Front Switches.
  - h. 198C, High Interrupting Capacity Fuses, Current Limiting Types.
  - i. 198E, Class R Fuses.
  - j. 360, Liquid-Tight Flexible Steel Conduit.
  - k. 486A, Wire Connectors and Soldering Lugs for Use with Copper Conductors.
  - l. 486C, Splicing Wire Connectors.
  - m. 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
  - n. 508, Industrial Control Equipment.
  - o. 510, Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
  - p. 514B, Fittings for Cable and Conduit.
  - q. 651, Schedule 40 and 80 PVC Conduit.
  - r. 674, Electric Motors and Generators for use in Division 1 Hazardous (Classified) Locations.
  - s. 797, Electrical Metallic Tubing.
  - t. 854, Service-Entrance Cables.
  - u. 870, Wireways, Auxiliary Gutters, and Associated Fittings.
  - v. 943, Ground-Fault Circuit Interrupters.
  - w. 1059, Terminal Blocks.
  - x. 1242, Intermediate Metal Conduit.
  - y. 1277, Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
  - z. 1449, Transient Voltage Surge Suppressors.
  - aa. 1561, Dry-Type General Purpose and Power Transformers.
  - bb. 2111, Overheating Protection for Motors.

#### 1.04 SUBMITTALS

##### A. Action Submittals:

1. Raceway Rack System
2. Circuit Breakers
3. Transformers
4. Control Panel Modifications
5. Raceway
6. Conductors
7. Pull and Junction Boxes
8. Hangers and Hardware

9. Basic Materials
  10. Terminations, terminal strips and compression fittings
  11. Fittings, nipples, lock nuts, bushings.
  12. Heat Shrink and Heat Shrink and wire markers
  13. Raceway Markers
- B. Informational Submittals:
1. Field test reports.
  2. Job Photographs
  3. Sequence of installation plan.
  4. Record Drawings including terminal numbers in AutoCAD 2016 DWG file electronic format
  5. Schedule
  6. Signed permits indicating Work is acceptable to regulatory authorities having jurisdiction.
  7. Operation and Maintenance Data:
    - a. Provide record drawing and operation and maintenance manuals for new equipment installed under this contract.
    - b. Minimum information shall include manufacturer's preprinted instruction manual, one copy of the approved submittal information for the item, tabulation of any settings, and copies of any test reports.

#### 1.05 APPROVAL BY AUTHORITY HAVING JURISDICTION (WHEN REQUIRED)

- A. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.
- B. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark or label.

#### 1.06 QUALIFICATIONS

- A. Journeyman Electrician with proven track record in the installation of industrial water plant equipment. Provide resumes upon request.
- B. Testing Qualifications: Electrician NETA Certified.

## **PART 2 PRODUCTS**

### 2.01 GENERAL

- A. Products shall comply with all applicable provisions of NFPA 70.

- B. Like Items of Equipment: End products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.
  - C. Hazardous Areas: Products shall be acceptable to the regulatory authority having jurisdiction for the class, division, and group of hazardous area indicated.
  - D. Equipment Finish:
    - 1. Manufacturer's standard finish color, except where specific color is indicated.
- 2.02 PULL AND JUNCTION BOXES
- A. NEMA 4 X fiberglass reinforced
    - 1. Cover: Gasketed, weatherproof, and hinged with stainless steel hardware
    - 2. Hubs: Threaded coated MEYERS type for all raceway terminations
    - 3. Manufacturers and Products, Nonhazardous Locations:
      - a. Hoffman or equal
- 2.03 PUSHBUTTONS, INDICATING LIGHTS, AND SELECTOR SWITCHES
- A. Type: Heavy-duty, oil-tight. Provide contact arrangements, colors, inscriptions, and functions as shown.
  - B. Contact Rating: NEMA ICS 2, Type A600.
  - C. Unless otherwise shown, provide the following features:
    - 1. Selector Switch Operating Lever: Standard.
    - 2. Indicating Lights: Push-to-test, transformer-type.
    - 3. Pushbutton Color:
      - a. ON or START: Black.
      - b. OFF or STOP: Red.
    - 4. Pushbuttons and selector switches lockable in OFF position where indicated.
  - D. Legend Plate:
    - 1. Material: Plastic
    - 2. Engraving: Indicating specific function, or as shown.
    - 3. Letter Height: 7/64 inch.
  - E. Manufacturers and Products:
    - 1. General Electric Co.; Type CR 104P.
    - 2. Square D Co.; Type T.
    - 3. Eaton; Type 10250T.

## 2.04 TERMINAL BLOCKS

- A. Type: UL 1059. Compression screw clamp, with current bar providing direct contact with wire and yoke, with individual rail mounted terminals. Marking system shall permit use of preprinted or field-marked tags.
- B. Yokes and Clamping Screws: Zinc-plated, hardened steel.
- C. Rating: [600V ac.]
- D. Manufacturers:
  - 1. Weidmuller, Inc.
  - 2. Ideal.

## 2.05 MAGNETIC CONTROL RELAYS

- A. NEMA ICS 2, Class A600 (600 volts, 10 amperes continuous, 7,200VA make, 720VA break), machine tool type with field convertible contacts.
- B. Manufacturer and Model:
  - 1. Eaton; Type M 600.
  - 2. General Electric; Type CR120B.

## 2.06 TIME DELAY RELAY

- A. Industrial Relay Rated: 150 volts, 5 amps continuous, (3600 VA make, 360 VA break).
- B. Solid-state electronic, field convertible ON/OFF delay.
- C. Two Form C contacts (minimum).
- D. Repeat accuracy plus or minus 2 percent.
- E. Timer Adjustment: Multiple adjustable ranges, including 1 second to 60 seconds, unless otherwise shown.
- F. Manufacturers:
  - 1. Omron.
  - 2. Eaton.
  - 3. General Electric Co.

## 2.07 SUPPORT AND FRAMING CHANNELS

- A. Fiberglass reinforced Framing Channel 1 5/8 minimum
- B. Manufacturers:
  - 1. B Line Systems, Inc.

2. Unistrut Corp.

2.08 NAMEPLATES

- A. Material: Laminated plastic.
- B. Attachment: stainless screws.
- C. Color: Black, engraved to a white core, or as shown.
- D. Engraving:
  - 1. Devices and Equipment: Name or tag shown, or as required.
  - 2. Minimum Requirement: Label metering and power distribution equipment, local control panels, junction boxes, motor controls, and transformers.
- E. Letter Height:
  - 1. Pushbuttons, Selector Switches, and Other Devices: 1/8 inch.
  - 2. Equipment and Panelboards: 1/4 inch.

2.09 CONDUIT AND FITTINGS

- A. PVC Schedule 80
  - 1. UL Listed rated for 105 C conductors water tight bell end with all factory fittings , elbows, couplings male adapters
- B. Rigid Galvanized Steel Conduit (RGS):
  - 1. Meet requirements of NEMA C80.1 and UL 6.
  - 2. Material: Hot-dip galvanized, with chromated protective layer.
- C. Material: Hot-dip galvanized, with chromated and lacquered protective layer
- D. Flexible Metal, Liquid-Tight Conduit:
  - 1. UL 360 listed for 105 degrees C insulated conductors.
  - 2. Material: Galvanized steel, with an extruded PVC jacket.
- E. Flexible Coupling, Hazardous Locations:
  - 1. Approved for use in the atmosphere involved.
  - 2. Rating: Watertight and UL listed for use in Class I, Division 1 and Division 2 areas.
  - 3. Outer bronze braid and an insulating liner.
  - 4. Conductivity equal to a similar length of rigid metal conduit.
  - 5. Manufacturers and Products:
    - a. Crouse-Hinds; Type ECGJH or ECLK.
    - b. Appleton; EXGJH or EXLK.

F. Fittings:

1. Provide bushings, grounding bushings, conduit hubs, conduit bodies, couplings, unions, conduit sealing fittings, drain seals, drain/breather fittings, expansion fittings, and cable sealing fittings, as applicable.
2. Rigid Galvanized Steel and Intermediate Metal Conduit:
  - a. Meet requirements of UL 514B.
  - b. Type: Threaded, galvanized.
  - c. e XJG.
3. Flexible Metal, Liquid-Tight Conduit:
  - a. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
  - b. Insulated throat and sealing O rings.
4. Flexible Coupling, Hazardous Locations:
  - a. Approved for use in the atmosphere involved.
  - b. Rating: Watertight and UL listed for use in Class I, Division 1 and Division 2 areas.
  - c. Outer bronze braid and an insulating liner.
  - d. Conductivity equal to a similar length of rigid metal conduit.
  - e. Manufacturers and Products:
    - 1) Crouse-Hinds; Type ECGJH or ECLK.
    - 2) Appleton; EXGJH or EXLK.

2.10 CONDUIT ACCESSORIES

A. Identification Devices:

1. Raceway Tags:
  - a. Material: Permanent, nonferrous metal
  - b. Shape: Round.

B.

2.11 CONDUCTORS AND CABLES

A. Conductors 600 Volts and Below:

1. Conform to applicable requirements of NEMA WC 71, WC 72, and WC 74.
2. Conductor Type:
  - a. Power
3. Insulation: THWN r
  - a. Conform to physical and minimum thickness requirements of NEMA WC 70.
4. Flexible Cords and Cables:
  - a. Type SOW A/50 with ethylene propylene rubber insulation in accordance with UL 62.
  - b. Conform to physical and minimum thickness requirements of NEMA WC 70.

B. 600 Volt Rated Cable:



1. General:
  - a. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 20,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
  - b. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
  - c. Suitable for installation in open air, in cable trays, or conduit.
  - d. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
  - e. Overall Outer Jacket: [PVC, flame-retardant, sunlight- and oil-resistant] [Hypalon (chlorosulfonated polyethylene)].
2. Type TSP, 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.
  - a. Outer Jacket: 45 mils nominal thickness.
  - b. Individual Pair Shield: 1.35 mils, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
  - c. Dimension: 0.31 inch nominal outside diameter.
  - d. Conductors:
    - 1) Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
    - 2) 20 AWG, seven-strand tinned copper drain wire.
    - 3) Insulation: 15 mils nominal PVC.
    - 4) Jacket: 4 mils nominal nylon.
    - 5) Color Code: Pair conductors black and red.
  - e. Manufacturers: Okonite Co.
3. CAT 5
  - a. Four Pair 24 AWG Stranded Copper PVC Jacket Cat 5 E Shielded and Unshielded Cable Belden P/N Reference (7924A, 7939A)
  - b. Quality Assurance
    - 1) Except as otherwise stated herein, the industrial Ethernet cables furnished in accordance with the specification shall comply with the latest applicable codes and standards of the American National Standards Institute (ANSI), the Telecommunications Industry Association (TIA), the International Standardization Organization (ISO), the International Electro technical Commission (IEC), the Institute of Electrical and Electronic Engineers (IEEE), the National Electrical Manufacturers Association (NEMA), the American Society for Testing and Materials (ASTM), and Underwriters Laboratory (UL).
  - c. As a minimum, the latest edition of the following individual standards shall apply:
    - 1) ANSI/TIA/EIA-568-B
    - 2) ISO/IEC 11801
    - 3) UL444, UL1666, UL1581

- 4) ASTM B-3, B-8, B-33, B-470
- 5) IEEE 802.3
- 6) NFPA 70 NEC
- 7) CSA C22.1-06 CEC

C. Accessories:

1. Tape:
  - a. General Purpose, Flame Retardant: 7 mils, vinyl plastic, Scotch Brand 33, rated for 90 degrees C minimum, meeting requirements of UL 510.
  - b. Flame Retardant, Cold and Weather Resistant: 8.5 mils, vinyl plastic, Scotch Brand 88.
  - c. Arc and Fireproofing:
    - 1) 30 mils, elastomer.
    - 2) Manufacturers and Products:
      - a) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tape binder.
      - b) Plymount; Plyarc 53, with Plyglas 77 glass cloth tape binder.
2. Identification Devices:
  - a. Sleeve-type, permanent, PVC, yellow or white, with legible machine-printed black markings.
  - b. Manufacturer and Products: Raychem; Type D SCE or ZH SCE.
3. Connectors and Terminations:
  - a. Nylon, Self-Insulated Crimp Connectors:
  - b. Manufacturers and Products:
    - 1) Thomas & Betts; Sta-Kon.
    - 2) Burndy; Insulug.
    - 3) ILSCO.
4. Self-Insulated, Freespring Wire Connector (Wire Nuts):
  - a. Plated steel, square wire springs.
  - b. UL Standard 486C.
  - c. Manufacturers and Products:
    - 1) Thomas & Betts.
    - 2) Ideal; Twister.
5. Cable Lugs:
  - a. In accordance with NEMA CC 1.
  - b. Rated 600 volts of same material as conductor metal.
  - c. Uninsulated Crimp Connectors and Terminators:
    - 1) Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
    - 2) Manufacturers and Products:
      - a) Thomas & Betts; Color-Keyed.
      - b) Burndy; Hydent.
      - c) ILSCO.
  - d. Uninsulated, Bolted, Two-Way Connectors and Terminators:
    - 1) Manufacturers and Products:
      - a) Thomas & Betts; Locktite.

- b) Burndy; Quiklug.
  - c) ILSCO.
6. Cable Ties:
    - a. Nylon, adjustable, self-locking, and reusable.
    - b. Manufacturer and Product: Thomas & Betts; TY RAP.
  7. Heat Shrinkable Insulation:
    - a. Thermally stabilized, crosslinked polyolefin.
    - b. Manufacturer and Product: Thomas & Betts; SHRINK-KON.

## 2.12 GROUNDING

- A. Ground all enclosures, interior back plates, enclosures and all metal parts to A/C ground run within each equipment room. Minimum size shall be # 6 copper stranded but shall me article 250 of the NEC. All metallic raceways installed shall contain a grounding bushing with a # 6 stranded bond wire tied to the common ground.
- B. Compression Type:
  1. Compress-deforming type; wrought copper extrusion material.
  2. Single indentation for conductors 6 AWG and smaller.
  3. Double indentation with extended barrel for conductors 4 AWG and larger.
  4. Single barrels prefilled with oxide-inhibiting compound.
  5. Manufacturers:
    - a. Burndy Corp.
    - b. Thomas and Betts Co.
    - c. ILSCO.
- C. Mechanical Type:
  1. Split-bolt, saddle, or cone screw type; copper alloy material.
  2. Manufacturers:
    - a. Burndy Corp.
    - b. Thomas and Betts Co.
  3. Company.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Install materials and equipment in accordance with manufacturer's instructions and recommendations.
- B. Work shall comply with all applicable provisions of NECA 1.
- C. Install materials and equipment in hazardous areas in a manner acceptable to regulatory authority having jurisdiction for the class, division, and group of hazardous areas shown.

- D. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

3.02 DEMOLITION

1. General Demolition:
2. Remove all existing raceways ,conductors, equipment and associated materials from existing flow signal equipment with care and turn over to the owner. Prior to any demolition obtain onsite agreement as to what equipment shall be removed and where equipment shall be stored. Move removed equipment and materials into owner storage area as instructed by owner.

3.03 PROTECTION FOLLOWING INSTALLATION

1. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation.
2. Cap conduit runs during construction with manufactured seals.
3. Close openings in boxes or equipment during construction.
4. Energize space heaters furnished with equipment.
- 5.

3.04 JUNCTION AND PULL BOXES

1. Install where necessary to terminate, tap-off, or redirect multiple conduit runs.
2. Install pull boxes where necessary in raceway system to facilitate conductor installation.
3. Mounting Hardware:
4. .
5. Outdoor or Noncorrosive Indoor Wet Areas: Stainless steel.
6. Corrosive Areas: Stainless steel.
7. Location/Type:
- 8.
9. All locations NEMA 4 X unless otherwise shown.

3.05 SUPPORT AND FRAMING CHANNELS

1. Install where required for mounting and supporting electrical equipment and raceway systems.
2. Channel Type:
3. Interior, Wet or Dry Corrosive Locations,
4. Outdoor, Corrosive Locations: reinforced fiberglass

3.06 NAMEPLATES

1. Provide identifying nameplate on all equipment .

3.07 TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS) EQUIPMENT

1. Install in accordance with manufacturer's instructions, including lead length, overcurrent protection, and grounding.

### 3.08 CONDUIT AND FITTINGS

1. General:
2. Crushed or deformed raceways not permitted.
3. Maintain raceway entirely free of obstructions and moisture.
4. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
5. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.
6. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.
7. Group raceways installed in same area.
8. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
9. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.
10. Conduit Application:
11. Galvanized Rigid steel with threaded connections outside acid room
12. Schedule 80 PVC in areas within room
- 13.

### 3.09 CONDUCTORS AND CABLES

1. Conductor storage, handling, and installation shall be in accordance with manufacturer's recommendations.
2. Do not exceed manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
3. Conduit system shall be complete prior to drawing conductors. Lubricate prior to pulling into conduit. Lubrication type shall be as approved by conductor manufacturer.
4. Terminate all conductors and cables, unless otherwise shown.
5. Do not splice conductors, unless specifically indicated or approved by Engineer.
6. Wiring within Equipment and Local Control Panels: Remove surplus wire, dress, bundle, and secure.
7. Power Conductor Color Coding:
8. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1 1/2 to 2 inches wide.
9. 8 AWG and Smaller: Provide colored conductors.
10. Colors:
11. Neutral Wire: White.
12. Live Wires, 120/240 Volt, Single-Phase System: Black, red.
13. Live Wires, 120/208 Volt, Three-Phase System: Black, red, or blue.
14. Live Wires, 277/480 Volt, Three-Phase System: Brown, orange, or yellow.
15. Ground Wire: Green.
16. Circuit Identification:

17. Identify power, instrumentation, and control conductor at each termination.
18. Method: Identify with sleeves. Taped-on markers or tags relying on adhesives not permitted.
19. Connections and Terminations:
20. All terminations shall be compression lugs for larger power conductors and crimp type connectors for control and signal conductors. All control conductors shall terminate with in terminal strips
21. Wire nuts are not permitted.
22. Install crimp connectors and compression lugs with tools approved by connector manufacturer.

### 3.10 GROUNDING

1. Grounding shall be in compliance with NFPA 70 and as shown.
2. Bond together system equipment enclosures, back plates, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and enclosure doors. Minimum bonding conductor # 6 bare stranded unless otherwise noted .Ground neutral terminal of the Mini-Power center to the plant grid as shown on the drawings.
3. Shielded Instrumentation Cables:
4. Ground shield to ground bus at power supply for analog signal.
5. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
6. Do not ground instrumentation cable shield at more than one point.
7. Equipment Grounding Conductors: Provide in all conduits containing power conductors and control circuits above 50 volts.

### 3.11 LOW VOLTAGE MOTOR CONTROL

1. Install equipment in accordance with NEMA ICS 2.3 and manufacturer's instructions and recommendations.
2. Field adjust trip settings of motor starter magnetic-trip-only circuit breakers. Adjust to approximately 11 times motor rated current.
3. Select and install overload relay heaters or adjust electronic overload protection after the actual nameplate full-load current rating of motor has been determined.

### 3.12 FIELD QUALITY CONTROL

#### A. General:

1. Test equipment shall have an operating accuracy equal to, or greater than, requirements established by NETA ATS.
2. Test instrument calibration shall be in accordance with NETA ATS.
3. Perform inspection and electrical tests after equipment has been installed.
4. Perform tests with apparatus de-energized whenever feasible.
5. Inspection and electrical tests on energized equipment are to be:
6. Scheduled with Engineer and OWNER prior to de-energization.

7. Minimized to avoid extended period of interruption to the operating plant equipment.
- B. Tests and inspection shall establish that:
1. Electrical equipment is operational within industry and manufacturer's tolerances.
  2. Installation operates properly.
  3. Equipment is suitable for energization.
  4. Installation conforms to requirements of Contract Documents and NFPA 70.
- C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.
- D. Adjust mechanisms and moving parts for free mechanical movement.
- E. Adjust adjustable relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
- F. Verify nameplate data for conformance to Contract Documents.
- G. Realign equipment not properly aligned and make sure equipment is level.
- H. Properly anchor electrical equipment found to be inadequately anchored.
- I. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations, or as otherwise specified.
- J. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- K. Provide proper lubrication of applicable moving parts.
- L. Investigate and repair or replace:
1. Electrical items that fail tests.
  2. Active components not operating in accordance with manufacturer's instructions.
  3. Damaged electrical equipment.
- M. Electrical Enclosures:
1. Remove foreign material and moisture from enclosure interior.
  2. Vacuum and wipe clean enclosure interior.
  3. Remove corrosion found on metal surfaces.
  4. Repair or replace, as determined by Engineer, door and panel sections having damaged surfaces.
  5. Replace missing or damaged hardware.
- N. Provide certified test report(s) documenting the successful completion of specified testing. Include field test measurement data.

- O. Test the following equipment and materials:
  - 1. Conductors: Insulation resistance, No. 4 and larger only meg with 1000-volt megger record values with each conductor identified as to phase location and equipment served. Submit test report to Engineer
  - 2. Mini Power Center, switches, and circuit breakers.
  - 3. Meg Ohm Motor controls.
  - 4. Meg Ohm Grounding electrodes.
  - 5. Motors.
- P. Controls:
  - 1. Test control and signal wiring for proper termination and function.
  - 2. Test local control panels and other control devices for proper terminations, configuration and settings, and functions.
  - 3. Demonstrate control, monitoring, and indication functions in presence of Owner and Engineer.
- Q. Balance electrical load between phases on panel boards and mini-power centers after installation.
- R. Voltage Testing:
  - 1. When installation is complete and facility is in operation, check voltage at point of termination of electric utility supply system to Project.
  - 2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
  - 3. If unbalance exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded conditions more than plus or minus 4 percent of nominal, make written request to electric utility to correct condition.
  - 4. If corrections are not made, obtain written statement from a responsible electric utility official that voltage variations and/or unbalance are within their normal standards.
- S. Equipment Line Current:
  - 1. Check line current in each phase for each piece of equipment.
  - 2. If electric utility makes adjustments to supply voltage magnitude or balance, make line current check after adjustments are made.

### 3.13 SUPPLEMENTS

- A. CONTRACT DRAWINGS

**END OF SECTION**



**SECTION 40 27 00**  
**PROCESS PIPING—GENERAL**

**PART 1      GENERAL**

1.01      REFERENCES

- A.    The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:
1.    Air Force: A-A-58092, Tape Antiseize, Polytetrafluorethylene.
  2.    American Society of Mechanical Engineers (ASME):
    - a.    Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels.
    - b.    Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
    - c.    B1.20.1, Pipe Threads, General Purpose (Inch).
    - d.    B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).
    - e.    B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
    - f.    B16.9, Factory-Made Wrought Buttwelding Fittings.
    - g.    B16.11, Forged Fittings, Socket-Welding and Threaded.
    - h.    B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
    - i.    B16.25, Butt Welding Ends.
    - j.    B31.3, Process Piping.
    - k.    B36.19M, Stainless Steel Pipe.
  3.    American Society for Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
  4.    American Water Works Association (AWWA):
    - a.    C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
    - b.    C606, Grooved and Shouldered Joints.
  5.    American Welding Society (AWS):
    - a.    Brazing Handbook.
    - b.    A5.8/A5.8M, Specification for Filler Metals for Brazing and Braze Welding.
    - c.    QC1, Standard for AWS Certification of Welding Inspectors.
  6.    ASTM International (ASTM):
    - a.    A135/A135M, Standard Specification for Electric-Resistance-Welded Steel Pipe.
    - b.    A139/A139M, Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).

- c. AA182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
  - d. A320/A320M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.
  - e. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
  - f. B32, Standard Specification for Solder Metal.
  - g. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
  - h. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
  - i. D2464, Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
  - j. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
  - k. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
  - l. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
  - m. D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
  - n. F436, Standard Specification for Hardened Steel Washers.
  - o. F437, Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
  - p. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
  - q. F441/F441M, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
  - r. F493, Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
  - s. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
  - t. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
7. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS): SP-43, Wrought Stainless Steel Butt-Welding Fittings.
  8. NSF International (NSF): 61 Drinking Water System Components-Health Effects.

## 1.02 DESIGN REQUIREMENTS

- A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:
  - 1. Process Piping: ASME B31.3, normal fluid service unless otherwise specified.

## 1.03 SUBMITTALS

- A. Informational Submittals:
  - 1. Manufacturer's Certification of Compliance:
    - a. Pipe and fittings.
    - b. Factory applied resins and coatings.
  - 2. Pipe coating applicator certification.

## 1.04 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Section 01 61 00, Project Requirements, and:
  - 1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
  - 2. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.
  - 3. Linings and Coatings: Prevent damage or excessive drying.
  - 4. Cold Weather Storage: Locate products to prevent coating from freezing to ground.
  - 5. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.
  - 6. No forks allowed inside pipe or fittings.
  - 7. All factory-installed thread on flanges on ductile iron pipe shall be sealed with a suitable sealant to prevent rusting.

## **PART 2 PRODUCTS**

### 2.01 PIPING

- A. As specified on Piping Data Sheet(s) and Piping Schedule located at the end of this section as Supplement.
- B. Diameters Shown:
  - 1. Standardized Products: Nominal size.
  - 2. Fabricated Steel Piping: Outside diameter, ASME B36.10M.

## 2.02 JOINTS

### A. Flanged Joints:

1. Flat-faced, carbon steel, or alloy flanges when mating with flat-faced cast or ductile iron flanges.
2. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.

### B. Threaded Joints: NPT taper pipe threads in accordance with ASME B1.20.1.

## 2.03 GASKET LUBRICANT

- ### A. Lubricant shall be supplied by pipe manufacturer and no substitute or “or-equal” will be allowed.

## 2.04 FABRICATION

### A. Mark each pipe length on outside with the following:

1. Size or diameter and class.
2. Manufacturer’s identification and pipe serial number.
3. Location number on laying drawing.
4. Date of manufacture.

### B. Code markings according to approved Shop Drawings.

- ### C. Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the Site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the manufacturer.

## 2.05 FINISHES

- ### A. Factory prepare, prime, and finish coat in accordance with Section 09 90 00.

## **PART 3 EXECUTION**

### 3.01 EXAMINATION

- ### A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.
- ### B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

### 3.02 PREPARATION

- A. See Section 09 90 00, Painting and Coating, for additional requirements.
- B. Notify Engineer at least 2 weeks prior to field fabrication of pipe or fittings.
- C. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.
- D. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

### 3.03 INSTALLATION—GENERAL

- A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.
- B. Remove foreign objects prior to assembly and installation.
- C. Flanged Joints:
  - 1. Install perpendicular to pipe centerline.
  - 2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
  - 3. Use torque-limiting wrenches and sequenced bolt tightening pattern as required by the joint manufacturer to ensure uniform bearing and proper bolt tightness.
  - 4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange. Tightened flanged joints shall not produce bending or distortion of the flanges.
  - 5. Grooved Joint Flange Adapters: Include stainless steel washer plates as required for mating to serrated faces and lined valves and equipment.
  - 6. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.
  - 7. Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.
  - 8. Flange fillers are to be avoided, but if necessary, may be used to make up for small angles up to 6 degrees and for filling gaps up to 2 inches between flanges. Stacked flange fillers shall not be used.
  - 9. Threaded flanged joints shall be shop fabricated and delivered to Site with flanges in-place and properly faced.
  - 10. Manufacturer: Same as pipe manufacturer or grooved joint flange adapter manufacturer.
- D. Threaded and Coupled Joints:
  - 1. Conform to ASME B1.20.1.

2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
3. Countersink pipe ends, ream and clean chips and burrs after threading.
4. Make connections with not more than three threads exposed.
5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

E. PVC and CPVC Piping:

1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
2. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.
3. Do not thread Schedule 40 pipe.

### 3.04 INSTALLATION—EXPOSED PIPING

A. Piping Runs:

1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

B. Supports: As specified herein.

C. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

D. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

- E. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.
- F. Piping clearance, unless otherwise shown:
  - 1. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
  - 2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
  - 3. From Adjacent Work: Minimum 2 inches from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
  - 4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
  - 5. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
  - 6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
  - 7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

### 3.05 DOUBLE WALL CONTAINMENT PIPING SYSTEM

- A. For double contained piping use a CPVC conduit with long radius 90 degree sweeps. Install a containment basin for any runs that have more than four 90 degree changes of direction.
- B. Pull through one solid piece of CHemfluor 367, scientific grade fluoropolymer tubing, by Saint-Gobain Performance Plastics. Tubing shall be one continuous piece throughout the full run between connection points.
- C. Tubing connections shall be flared. Use PVDF FlareLINK fittings from Fit-LINE.

### 3.06 BRANCH CONNECTIONS

- A. Do not install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.

B. When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including the first block valve in the line carrying the lower pressure, unless otherwise shown.

C. Threaded Pipe Tap Connections:

1. Ductile Iron Piping: Connect only with service saddle or at a tapping boss of a fitting, valve body, or equipment casting.
2. Welded Steel or Alloy Piping: Connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.

### 3.07 PIPING SUPPORT SYSTEMS

A. General

1. Design, size, and locate piping support systems throughout facility, whether shown or not.
2. Supports are shown only where specific types and locations are required. Not all pipe supports, lateral stiffeners, sway bracings, or similar are shown or detailed. Contractor shall provide all required supports and stability to all piping, whether shown or not, as part of the Work. Additional pipe supports shall be provided, as required, at no additional cost to the Owner. Meet requirements of MSS SP 58 and ASME B31.1 or as modified by this section.
3. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated.
4. Special support and hanger details may be required for cases where standard catalog supports are not applicable.
5. Materials: In accordance with Table 1 herein.

B. Wall Brackets, Supports and Guides

1. Welded Steel Wall Bracket: MSS SP 58, Type 33 (heavy-duty):
  - a. Anvil; Figure 199, 3,000-pound rating.
  - b. B-Line; Figure B3067, 3,000-pound rating.
2. Adjustable “J” hanger MSS SP 58, Type 5:
  - a. Anvil; Figure 67, sizes 1/2 inch through 8 inches.
  - b. B-Line; Figure B3690, sizes 1/2 inch through 8 inches.
3. Offset Pipe Clamp: Anvil; Figure 103, sizes 3/4 inch through 8 inches.
4. Channel Type:
  - a. Unistrut.
  - b. Anvil; Power-Strut.
  - c. B-Line; Strut System.
  - d. Aickinstrut (FRP).

C. Channel Type Support Systems



1. Channel Size: 12-gauge, 1-5/8-inch wide minimum steel, or 1-1/2-inch wide, minimum FRP.
2. Members and Connections: Design for loads using one-half of manufacturer's allowable loads.
3. Fasteners: Vinyl ester fiber, polyurethane base composite nuts and bolts, or encapsulated steel fasteners.
4. Manufacturers and Products:
  - a. B-Line; Strut System.
  - b. Unistrut.
  - c. Anvil; Power-Strut.
  - d. Aickinstrut (FRP System).
  - e. Enduro-Durostrut (FRP Systems).

#### D. FRP Support Systems

1. General:
  - a. FRP with UV additive, protective veil, and vinyl ester resins resistance to chemicals listed in Supplement at end of section.
  - b. Fire Retardant: ASTM E84.
  - c. Include hangers, rods, attachments, and fasteners.
2. Clevis Hangers:
  - a. Factor of Safety: 3 to 1.
  - b. Minimum Design Load: 200 pounds.
3. Design:
  - a. Design pipe supports spacing, hanger rod sizing based upon manufacturer's recommendations.
  - b. Identify and highlight nonFRP fasteners or components in Shop Drawing.
4. Manufacturers:
  - a. Aickinstrut.
  - b. Enduro.
  - c. Century Composite.

#### E. Pipe Clamps

- a. Riser Clamp: MSS SP 58, Type 8.
- b. Anvil; Figure 261, sizes 3/4 inch through 24 inches.
- c. B Line; Figure B3373, sizes 1/2 inch through 30 inches.

#### F. Elbow and Flange Supports

1. Elbow with Adjustable Stanchion: Sizes 2 inches through 18 inches, Anvil; Figure 62C base.
2. Elbow with Nonadjustable Stanchion: Sizes 2 1/2 inches through 42 inches, Anvil; Figure 63A or Figure 63B base.

3. Flange Support with Adjustable Base: Sizes 2 inches through 24 inches, Standon; Model S89.
- G. Pipe Anchors
1. Type: Anchor chair with U-bolt strap.
  2. Manufacturer and Product: B-Line; Figure B3147A or Figure B3147B.
- H. Anchor Bolts:
1. Size and Material: Sized by Contractor for required loads, 1/2-inch minimum diameter
  2. Bolt Length (Extension Above Top of Nut):
    - a. Minimum Length: Flush with top of nut preferred. If not flush, shall be no more than one thread recessed below top of nut.
    - b. Maximum Length: No more than a full nut depth above top of nut.
- I. Plastic Pipe Support Channel:
1. Type: Continuous support for plastic pipe and to increase support spacing.
  2. Manufacturer and Product: B-Line; Figure Series B3106V, sizes 1/2 inch through 6 inches with Figure B3106 Vee bottom hanger.
- J. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.
- K. General Installation:
1. Install support systems in accordance with MSS SP 58, unless shown otherwise.
  2. Install pipe hanger rods plumb, within 4 degrees of vertical during shut down, start up or operations.
  3. Support piping connections to equipment by pipe support and not by equipment.
  4. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
  5. Support no pipe from pipe above it.
  6. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and elsewhere required.
  7. Do not use adhesive anchors for attachment of supports to ceiling or walls.
  8. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
  9. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.

10. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
  11. Repair mounting surfaces to original condition after attachments are completed.
- L. Standard Pipe Supports:
1. Horizontal Suspended Piping:
    - a. Single Pipes: Clevis hangers or adjustable swivel split-ring.
    - b. Grouped Pipes: Trapeze hanger system.
  2. Horizontal Piping Supported from Walls:
    - a. Single Pipes: Wall brackets, or attached to wall, or to wall mounted framing with anchors.
    - b. Stacked Piping: Wall mounted framing system and “J” hangers acceptable for pipe smaller than 3-inch.
    - c. Pipe clamp that resists axial movement of pipe through support is not acceptable. Use pipe rollers supported from wall bracket.
  3. Horizontal Piping Supported from Floors:
    - a. Saddle Supports:
      - 1) Pedestal Type, elbow and flange.
      - 2) Provide minimum 1-1/2-inch grout beneath baseplate.
    - b. Floor Mounted Channel Supports:
      - 1) Use for pipe smaller than 3-inch running along floors and in trenches at pipe elevations lower than can be accommodated using pedestal pipe supports.
      - 2) Attach channel framing to floors with baseplate on minimum 1-1/2-inch nonshrink grout and with anchor bolts.
      - 3) Attach pipe to channel with clips or pipe clamps.
    - c. Concrete Cradles: Use for pipe larger than 3 inches along floor and in trenches at pipe elevations lower than can be accommodated using stanchion type.
  4. Vertical Pipe: Support with wall bracket and elbow support, or riser clamp on floor penetration.
- M. Standard Attachments:
1. Concrete Walls: Concrete inserts or brackets or clip angles with concrete anchors.
  2. Concrete Beams: Concrete inserts, or if inserts are not used attach to vertical surface similar to concrete wall. Do not drill into beam bottom.

| <b>Table 1<br/>Chemical Areas</b>  |                                    |                                    |
|--|------------------------------------|------------------------------------|
| <b>Exposure Conditions</b>   | <b>Support for Direct Exposure</b> | <b>Support for Remote Exposure</b> |
| Sulfuric Acid  | Stainless Steel or FRP             | Stainless Steel or FRP             |
| <p>Notes:</p> <ol style="list-style-type: none"> <li>1. Direct exposure includes entire area within containment area; area within 20 feet horizontal and 10 feet vertical of chemical pumps or chemical mixing stations; or as specified.</li> <li>2. Remote exposure is area beyond area defined as direct exposure, but within designated building.</li> <li>3. Stainless steel to be Type 316.</li> </ol> |                                    |                                    |

3.08 DISINFECTION

- A. See Section 01 61 00, Project Requirements.

3.09 FIELD FINISHING

- A. Notify Engineer at least 3 days prior to start of any surface preparation or coating application work.
- B. As specified in Section 09 90 00, Painting and Coating.

3.10 FIELD QUALITY CONTROL

- A. Pressure Leakage Testing: As specified in Section 01 61 00, Project Requirements .

3.11 CLEANING

- A. Following assembly and testing, and prior to disinfection and final acceptance, flush pipelines (except as stated below) with water at 2.5 fps minimum flushing velocity until foreign matter is removed.
- B. Blow clean of loose debris instrument air-lines with compressed air at 4,000 fpm; do not flush with water.

### 3.12 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are a part of this Specification:

1. Data Sheets.

| <b>Number</b> | <b>Title</b>  |
|---------------|---|
| 40 27 00.11   | Chlorinated Polyvinyl Chloride (CPVC) Pipe and Fittings |
| 40 27 00.18   | Polyvinylidene Fluoride (PVDF) Pipe and Fittings        |

**END OF SECTION**

**SECTION 40 27 00.11  
CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND  
FITTINGS**

| <b>Item</b> | <b>Size</b> | <b>Description</b>   |
|-------------|-------------|--|
| Pipe        | All         | Schedule 80 CPVC: Type IV, Grade I or Class 23447-B conforming to ASTM D1784 and ASTM F441. Pipe shall be manufactured with titanium dioxide for ultraviolet protection.<br><br>Threaded nipples shall be Schedule 80.   |
| Fittings    | All         | Schedule to Match Pipe Above: Conforming to the requirements of ASTM F439 for socket weld type and Schedule 80 ASTM F437 for threaded type. Fittings shall be manufactured with titanium dioxide for ultraviolet protection.   |
| Joints      | All         | Solvent socket weld except where connection to threaded valves and equipment may require future disassembly.   |
| Flanges     | All         | One piece, molded hub Type CPVC flat face flange in accordance with Fittings above; ASME B16.1, Class 125 drilling.  |
| Bolting     | All         | Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts, ASTM A194/A194M Grade 8M hex head nuts and ASTM F436/F436M Type 3 alloy washers at nuts and bolt heads. Achieve 40 percent to 60 percent of bolt minimum yield stress.<br><br>Raised Face Mating Flange: Carbon steel ASTM A307 Grade B square head bolts, ASTM A563 Grade A heavy hex head nuts and ASTM F436/F436M hardened steel washers at nuts and bolt heads. Achieve 40 percent to 60 percent of bolt minimum yield stress. |

**SECTION 40 27 00.11  
CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND  
FITTINGS**

| <b>Item</b>      | <b>Size</b> | <b>Description</b>   |
|------------------|-------------|--|
| Gaskets          | All         | <p>Flat Face Mating Flange: Full faced 1/8-inch-thick ethylene propylene (EPR) rubber.</p> <p>Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EPR) rubber with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.</p>  |
| Solvent Cement   | All         | <p>All socket type joints shall be made employing primer and solvent cements that meet or exceed the requirements of ASTM F493 and primers that meet or exceed the requirements of ASTM F656 and as recommended by the pipe and fitting manufacturer. Solvent cement and primer shall be listed by NSF for use with potable water.</p> |
| Thread Lubricant | All         | Teflon tape.   |

**END OF SECTION**

| SECTION 40 27 00.18<br>POLYVINYLIDENE FLUORIDE (PVDF) PIPE AND FITTINGS |      |   |
|---|------|---|
| Item  | Size | Description   |
| Pipe  | All  | PVDF: Type I of ASTM D3222, conforming to ASTM D2837. Use unpigmented PVDF resin and size according to SDR system to 230 psi for sizes 3/8 inch to 2-1/2 inches and 150 psi for 3 inches through 12 inches at 73.4°F. |
| Fittings  | All  | PVDF as specified under Pipe above. All pressure fittings shall be injection mold for butt fusion.  |
| Joints  | All  | Butt Fusion. Temperatures, times, and pressures of fusion shall be according to the manufacturer. Pipe joining equipment shall be provided by the pipe and fitting manufacturer.                                      |
| Flanges   | All  | Stub end and polypropylene coated steel backing ring with ANSI, 150-pound bolt hole pattern. Follow manufacturers torque and tightening procedures.   |
| Bolting   | All  | ASTM A193/A193M Rev A Type 316 stainless steel Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts.   |
| Gaskets   | All  | Shall be low torque, full face to ASME B16.5 dimensions and shall have two concentric, convex, molded rings between center hole and bolt hole circle in Teflon-bonded EPDM.   |

END OF SECTION



**SECTION 40 27 02**  
**PROCESS VALVES AND OPERATORS**

**PART 1 GENERAL**

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI):
  - a. B16.5 Stainless Steel Pipe Flanges and Flanged Fittings.
2. American Water Works Association (AWWA):
  - a. C540, Power Actuating Devices for Valves and Sluice Gates.
  - b. C606, Grooved and Shouldered Joints.
3. ASTM International (ASTM):
  - a. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
  - b. A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
  - c. D429, Test Methods for Rubber Property—Adhesion to Rigid Substrates.
  - d. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
4. Manufacturers Standardization Society (MSS):
  - a. SP 110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
5. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
6. NSF International (NSF):
  - a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
  - b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
7. Underwriters Laboratories (UL).

1.02 SUBMITTALS

A. Shop Drawings:

1. Product data sheets for make and model.
2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
3. Power and control wiring diagrams, including terminals and numbers.
4. Certification of NSF 61 compliance.

- B. Information Submittals:
  - 1. Tests and inspection data.
  - 2. Manufacturer's Certificate of Proper Installation.
  - 3. Operation and Maintenance Manual.

## **PART 2 PRODUCTS**

### **2.01 GENERAL**

- A. The specifications of this section indicate the minimum requirements for the Vendor. It is the responsibility of the Vendor to ensure that all valves and operators are suitable for the intended service and compatible with the proposed process systems.
- B. All internal components of valves that come in contact with water shall be manufactured using NSF 61 approved.
- C. Valve ends to suit adjacent piping.
- D. Size operator to operate valve for the full range of pressures and velocities.
- E. Valve to open by turning counter-clockwise.
- F. Field mount actuator and accessories.
- G. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
- H. Use or reuse of components and materials without a traceable certification is prohibited.

### **2.02 VALVES**

- A. Ball Valves:
  - 1. Type V333 PVDF Ball Valve 3 Inches and Smaller:
    - a. Rated 230 psi at 100 degrees F, with Type II Polyvinylidene fluoride (PVDF) body, ball and stem. Valve ends shall be butt-fused or flanges to conform to piping system. PTFE Teflon elastomer seat, Viton or Telfon O-ring stem seals. Blowout proof design.
    - b. Manufacturers and Products:

- 1) ASAHI/America; Type 21.
  - 2) Or equal
2. Type V335 CPVC Ball Valve 2 Inches and Smaller:
    - a. Rated 150 psi at 100 degrees F, 80 psi at 140 degrees, with ASTM D1784, Type IV, Grade 1 chlorinated polyvinyl chloride (CPVC) body, ball, and stem, end entry, double union design, with solvent-weld socket ends or single union ball with flanged ends drilled to ASME B16.1, replaceable Teflon seat, Viton or Teflon O-ring stem seals, to block flow in both directions. For sodium hypochlorite service, provide pressure relief hole drilled on low pressure side of ball.
    - b. Manufacturers and Products:
      - 1) Nibco; Chemtrol Tru-Bloc.
      - 2) ASAHI/America; Type 21.
      - 3) Spears; True Union.
- B. Butterfly Valves:
1. Type V520 Solid PVC Butterfly Valve 1-1/2 Inches to 14 Inches:
    - a. ANSI Class 150 lug style
    - b. Rated 150 psi at 70 degrees F CWP, solid ASTM D1784, Type 1, Grade 1, PVC body and contoured PVC or polypropylene valve disc, Type 316 SST valve stem, Viton seat, lever or gear operator.
    - c. Manufacturers and Products:
      - 1) ASAHI/America; Type 57IL.
      - 2) Spears.
- C. Diaphragm Valve:
1. Type V904 Diaphragm Valve, ½ inch to 4 inches
    - a. Weir type with PVDF body, PTFE diaphragm with PVDF gas barrier and EPDM backing cushion, flanged ends, handwheel operator, position indicator, adjustable travel stop, clear molded acrylic stem cap.
    - b. Manufacturers and Products:
      - 1) ASAHI/America. Diaphragm Valve Type 14

## 2.03 OPERATORS

### A. Manual Operator:

1. General:
  - a. For non-AWWA valves, operator force not to exceed applicable industry standard or 80 pounds, whichever is less, under operating condition, including initial breakaway. Provide gear reduction operator when force exceeds requirements.

- b. Operator self-locking type or equipped with self-locking device.
  - c. Position indicator on quarter turn valves.
  - d. Worm and gear operators one-piece design worm gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operators threaded steel reach rods with internally threaded bronze or ductile iron nut.
- B. Electric Motor Actuators, 120 Volts:
1. General:
    - a. Comply with latest version of AWWA C542.
    - b. Size to 1-1/2 times required operating torque. Motor stall torque not to exceed torque capacity of valve.
    - c. Controls integral with actuator and fully equipped as specified in AWWA C542.
    - d. Stem protection for rising stem valves.
  2. Actuator Operation—General:
    - a. Suitable for full 90-degree rotation of quarter-turn valves or for use on multiturn valves, as applicable.
    - b. Manual override handwheel.
    - c. Valve position indication.
    - d. Operate from FULL CLOSED to FULL OPEN positions or the reverse in the number of seconds given in Electric Actuated Valve Schedule.
  3. Modulating (M) Service:
    - a. Size actuators for continuous modulating duty.
    - b. Feedback potentiometer, or equivalent, and integral electronic positioner/comparator circuit to maintain valve position.
    - c. HAND-OFF-AUTO (Local-Off-Remote) Selector Switch, padlockable in each position:
      - 1) Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control valve in HAND (Local) position.
      - 2) 4 mA to 20 mA dc input signal to control valve in AUTO (Remote) position.
      - 3) Auxiliary contact that closes in AUTO (Remote) position.
    - d. OPEN and CLOSED indicating lights.
    - e. AC motor with solid state reversing starter or DC motor with solid state reversing controller, and built-in overload protection. Controller capable of 1,200 starts per hour.
    - f. Duty cycle limit timer and adjustable band width, or equivalent, to prevent actuator hunting.
    - g. Valve position output converter that generates isolated 4 mA to 20 mA DC signal in proportion to valve position and is capable of driving into loads of up to 500 ohms at 24 volts DC.
  4. Limit Switch:
    - a. Single-pole, double-throw (SPDT) type, field adjustable, with contacts rated for 5 amps at 120 volts ac.

- b. Each valve actuator to have a minimum of two auxiliary transfer contacts at end position, one for valve FULL OPEN and one for valve FULL CLOSED.
- c. Housed in actuator control enclosure.
- 5. Control Features: Electric motor actuators with features as noted above, and as modified/supplemented in Electric Actuated Valve Schedule.
- 6. Manufacturers and Products:
  - a. Rotork Controls; IQ.
  - b. Flowsolve Limitorque; QX-2.

#### 2.04 ACCESSORIES

- A. Tagging: 1-1/2-inch diameter stainless steel tag attached with No. 16 stainless steel jack chain for each valve operator.
- B. Position/Limit Switch:
  - 1. Factory installed position/limit switch by valve manufacturer.
  - 2. SPST, rated at 5 amps, 120V ac.
  - 3. Manufacturers:
    - a. Asco.
    - b. Westlock.

### **PART 3 EXECUTION**

#### 3.01 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. PVC and CPVC Valves: Install using solvents approved for valve service conditions.
- C. Valve Installation and Orientation:
  - 1. General:
    - a. Install valves so handles operate from fully open to fully closed without encountering obstructions.
    - b. Install valves in location for easy access for routine operation and maintenance.
    - c. Install valves per manufacturer's recommendations.
  - 2. Ball Valves:
    - a. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.

- b. Install operating stem horizontal in horizontal runs of pipe having centerline elevations greater than 4 feet 6 inches above finish floor, unless otherwise shown.
3. Check Valves:
- a. Install valve in accordance with manufacturer's instructions and provide required distance from immediate upstream fitting.

**END OF SECTION**

**SECTION 49 90 01**  
**INSTRUMENTATION AND CONTROL**

**PART 1      GENERAL**

1.01      ABBREVIATIONS

1.    DI – Digital Input
2.    DO – Digital Output
3.    HMI – Human Machine Interface
4.    I/O – Input/Output
5.    mA - Milliamps
6.    MSDS – Material Safety Data Sheet
7.    NFPA – National Fire Protection Association
8.    OSHA – Occupational Safety and Health Administration
9.    PAT – Performance Acceptance Test
10.   PICS – Plant Instrumentation and Control System
11.   PLC – Programmable Logic Controller
12.   PPE – Personal Protective Equipment
13.   SCADA – Supervisory Control and Data Acquisition
14.   SDS – Safety Data Sheet
15.   UL – Underwriter Laboratories
16.   VAC – Voltage, Alternating Current
17.   VDC – Voltage, Direct Current
18.   W – Watts

1.02      SUMMARY

- A.    The following section specifies the minimum requirements for selection, installation, and testing of the instrumentation and controls related to the sulfuric acid bulk tank valves in this project. The major items in the scope of work includes:
1.    Modify existing sulfuric acid control panel to interface Programmable Logic Controller Input/Output (PLC I/O) signals with new valve actuators for Bulk Tank 1 and Bulk Tank 2.
  2.    Modify existing Day Tank 1 and Day Tank 2 valve control panels beside the PLC-6 enclosure to include new control hand switches for the Bulk Tank 1 and Bulk Tank 2 valves.
  3.    Provide Human Machine Interface (HMI) graphics for monitoring and remote manual control of the new Bulk Tank 1 and Bulk Tank 2 actuators from the Supervisory Control and Data Acquisition (SCADA) System.

## **PART 2      PRODUCTS**

### **2.01      MODIFICATIONS TO EXISTING SULFURIC ACID CONTROL PANEL AND PLC-6**

- A. Each valve actuator shall include the following I/O signals relative to the Sulfuric Acid System PLC:
  - 1. Three Digital Inputs (DI)
    - a. Valve In Remote Status
    - b. Valve Open Limit Switch
    - c. Valve Closed Limit Switch
  - 2. Two Digital Outputs (DO)
    - a. Valve Open Command
    - b. Valve Close Command
  - 3. Total New I/O Count: 6 DI, 4 DO
  
- B. In reference to the 10/3/2013 PLC-6 panel drawings, PLC-6 currently contains three spare DI points and 12 spare DO points available. PLC-6 shall be modified as follows:
  - 1. Insert a new 16-channel DI card in the PLC rack to accept additional DI points. Wire six of the DI points to accept the DI signals from each bulk tank valve actuator.
    - a. DI Card Specification:
      - 1) Power Supply: 24 VDC
      - 2) Sink/Source Input Compatible
      - 3) Number of Inputs/Channels: 16 Minimum
      - 4) Max Current Draw: 110 mA at 5 VDC
      - 5) Max In-Rush Current: 250mA
      - 6) Heat Dissipation: 3.55 W Total
      - 7) Isolation:
        - a) Two Input Group Isolation
        - b) Input Group to Input Group Isolation:
          - (1) Verified 1200 VAC for 1 s or 1697 VDC for 1s.
          - (2) 75 VDC working voltage.
      - 8) Manufacturer and Products:
        - a) Allen-Bradley; Model 1769-IQ16F
        - b) Only equivalent models within the same product series may be considered for Engineer approval. No other manufacturers or product series will be considered.
  - 2. Rewire four spare DO channels at the embedded DO slot of the CPU to accept the valve open and close command signals for each bulk tank valve actuator. Terminate field signals at existing TB4.
  - 3. For each newly assigned DI circuit, provide and install a 0.5A circuit breaker. Manufacturer and model to match existing panel circuit breakers.



4. Install new terminal block and terminal bases for each new DI signal from the field and label in panel as Terminal Block 8 (TB8) inside the panel. Manufacturer and model to match existing panel terminal assemblies.
5. Install new control relays for each new DO signal to field equipment. Manufacturer and model to match existing panel control relays.
6. Provide redline markups to the existing 10/3/2013 panel drawings to show all modifications to the control panel, including I/O pinout, panel layout, and all circuit components. Provide date and description of the markups on each page.
7. Program modified hardware configuration to accept the new I/O card above and map PLC I/O points to the new valve actuator signals.

## 2.02 MODIFICATIONS TO EXISTING DAY TANKS 1 AND 2 VALVE CONTROL PANELS

### A. Day Tank 1 Control Panel

1. Affix permanent label centered above the existing Day Tank 1 valve hand switches to read “Day Tank 1 Valve”
2. Provide two new panel cutouts on the panel for two new selector switches. Affix permanent label centered above the cutouts to read “Bulk Tank 1 Valve”.
3. Provide two selector switches to insert into the new cutouts. Each selector switch shall be a two-position switch. Affix permanent label over the left selector switch to read “Local/Remote” and indicate “Local” and “Remote” positions for the switch. Affix permanent label over the right selector switch to read “Open/Close” and indicate “Open” and “Close” positions for the switch.

### B. Day Tank 2 Control Panel

1. Affix permanent label centered above the existing Day Tank 2 valve hand switches to read “Day Tank 2 Valve”
2. Provide two new panel cutouts on the panel for two new selector switches. Affix permanent label centered above the cutouts to read “Bulk Tank 2 Valve”.
3. Provide two selector switches to insert into the new cutouts. Each selector switch shall be a two-position switch. Affix permanent label over the left selector switch to read “Local/Remote” and indicate “Local” and “Remote” positions for the switch. Affix permanent label over the right selector switch to read “Open/Close” and indicate “Open” and “Close” positions for the switch.

### C. Refer to Drawings for the modified valve control panel layouts and new control diagram.

### D. Operation Summary of the Valve Control Panel:

1. Local Operation from the Actuator: Operator shall turn the selector switch to “Local” at the valve actuator inside the room. The valve is then operated using the onboard control switches at the valve actuator. WARNING: This control method is intended for maintenance or troubleshooting methods only and is not intended for regular operations. Potential exposure to sulfuric acid is present during operations inside the chemical room. Refer to Plant Safety Procedures at the end of this document.
2. Local Operation from the Valve Control Panel: Operator shall turn the selector switch to “Remote” at the valve actuator and “Local” at the valve control panel outside the acid room. The valve is then operated using the Open/Close selector switch located on the valve control panel.
3. Remote Manual Operation from the SCADA System HMI: Operator shall turn the selector switch to “Remote” at both the valve actuator and the valve control panel outside the acid room. Once the PLC receives the In-Remote signal from the valve control panel, the valve is then operated using the Open and Close pushbuttons on the SCADA System HMI screen.
4. During regular operations, the selector switch at the valve actuator is intended to remain in the “Remote” position, with Local and Remote toggling solely performed at the valve control panel. This method allows for operators to safely open and close the bulk tank valves either from the control room or in the field looking into the acid room without having to physically enter the acid room.

## 2.03 INTEGRATION OF BULK TANK VALVES WITH EXISTING SCADA SYSTEM

- A. Program modifications to the existing SCADA system HMI to implement the following:
  1. Display the Bulk Tank 1 and Bulk Tank 2 valves as graphic objects on the Sulfuric Acid HMI screen. Provide a typical Open/Close Valve faceplate that pops up when the valve is selected.
  2. At a minimum, provide the following functionality on the HMI screen for each valve.
    - a. Provide Open and Close pushbuttons for remote operation of the valve. Disable the pushbuttons if the valve is placed in Local.
    - b. Provide status indication (both color and description) of the valve in the Open, Closed, and In-Transition states based on inputs from the valve limit switches.
    - c. Provide Local/Remote status of the valve based on the In-Remote input from the valve control panel.
    - d. Provide fault indication and alarm stack entries for fail-to-open and fail-to-close alarms based on discrepancies between the valve limit switch input and the valve position command signal. Provide an adjustable time delay for each alarm.

## **PART 3 EXECUTION**

### **3.01 TEST PROCEDURES**

- A. After all new components are installed, PICS Contractor shall perform a witnessed Performance Acceptance Test for the two new bulk tank valves. The PAT shall be divided into two parts:
1. Part 1 – Verification of Local Operation
    - a. Begin with both the valve actuator selector switch and the valve control panel selector switch in the Local position. Verify that the HMI shows the valve in Local.
    - b. Cycle the valve open and closed using the selector switches on the valve actuator. Confirm the valve physically opens and closes fully. Verify that the limit switches activate corresponding to each position and that the proper graphic is shown on the HMI screen.
    - c. Stop the valve in mid-travel and confirm the valve holds position. Verify that neither limit switch is made during mid-travel and that the HMI shows the valve in a transition state.
    - d. Switch the valve actuator position to Remote while leaving the valve control panel selector switch in Local. Verify that the HMI still shows the valve in Local.
    - e. Repeat step 2 using the selector switch at the valve control panel instead.
  2. Part 2 – Verification of Remote Operation
    - a. After completing Part 1 above, turn the selector switch at the valve control panel to Remote. Verify on the HMI that the valve graphic has changed to “Remote” and the control buttons are active.
    - b. Cycle the valve open and closed using the pushbuttons on the HMI faceplate. Verify the valve is physically moving to a fully open and fully closed position based on command signals from the PLC. Verify that the valve graphic correctly corresponds to the physical position in the field.
    - c. Simulate a valve fail-to-open alarm by disconnecting the open input or physically stopping the valve in between limits. Verify the valve goes into alarm at the HMI after the time delay and that an alarm is identified in the HMI alarm stack. Restore the valve position and confirm the fault clears.
    - d. Repeat step 3 simulating a valve fail-to-close alarm instead.
  3. Document pass/fail for all field connected I/O and operation of the devices in Local and Remote. Spares are not required to be checked during this test.
  4. All test documents are to be signed by the PICS Contractor in addition to the Owner and/or Owner’s representative after successful completion of the test.

### 3.02 PLANT SAFETY PROCEDURES

- A. The following safety precautions apply to all installation, commissioning, and troubleshooting activities to be performed under the project scope described above.
- B. In addition to the safety precautions described below, Contractor personnel shall adhere to the Owner's facility safety procedures and current OSHA requirements.
- C. Potential exposure to sulfuric acid is present for any tasks performed inside the sulfuric acid room. Contractor shall obtain a copy of the SDS/MSDS from the Owner prior to performing any work inside the acid room. Additionally, Contractor shall coordinate with Owner to determine safety shower locations closest to the work area in the event of chemical exposure. Contractor is responsible for reviewing the chemical hazards present in the work area.
- D. Contractor personnel are required to wear appropriate PPE at all times, including, but not limited to: safety shoes, protective goggles, hardhat, high visibility safety vest, chemically resistant work gloves, and ear protection. Contractor is responsible for providing personnel PPE for all work activities.
- E. Contractor shall maintain and distribute to personnel a list of emergency contacts that are readily available during any work activities performed at the Owner's facility. An on-site safety representative is required to be present during work hours and shall coordinate with Owner's staff describing all work activities to be performed each day.

**END OF SECTION**