SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module.

1.4 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

1.6 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven days' advance notice.

C. Training Location and Reference Material: Conduct field demonstrations and training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017900

SECTION 018829 - SEISMIC PERFORMANCE REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Architectural, fire suppression, plumbing, mechanical, and electrical building components and systems and non-building structures that are designed and constructed for seismic demands, unless specifically exempted in ASCE 7.

    a. Architectural, mechanical and electrical components are exempt in Seismic Design Category B.

B. Related Requirements:

1. Architectural Components: Refer to various Sections in Division 02 through Division 14.
2. Plumbing Components: Refer to various Sections in Division 22.
3. HVAC Components: Refer to various Sections in Division 23.
4. Electrical Components: Refer to various Sections in Division 26 through Division 28.

1.3 DEFINITIONS AND ABBREVIATIONS

A. Anchorage: Connection to structure typically through the use of welding, bolts, screws, anchor bolts, post-installed anchors or other fasteners selected to meet the Building Code.

B. Authority Having Jurisdiction (AHJ): The governmental agency or subagency that regulates the construction process. This may be a local building department, state agency, federal entity or other body or bodies having statutory authority.

C. Code or Building Code: Building Code currently in effect where the Project is located.

D. Designated Seismic System: Those architectural, electrical and mechanical systems and their components that require seismic design or qualification in accordance with ASCE 7 and for which the component importance factor, Ip, is 1.5 according to ASCE 7.

E. International Accreditation Service, Inc. (IAS).

F. International Building Code (IBC).

G. International Code Council Evaluation Service (ICC-ES).

H. Inspection Agency: Organization or individual accredited to ISO 17020 and regularly engaged in factory inspection services for seismic restraint or qualification of non-structural components and equipment.

I. Nonstructural Component: A part or element of an architectural, electrical or mechanical system permanently attached to a structure including its supports and attachments.

J. Restraint/Bracing: Bracing or anchorage used to limit movement under seismic forces. Cables or rigid elements, i.e., strut, pipe, and angles, used to resist forces by uniaxial tension or compression. Term "bracing" may also be used to describe design to resist lateral forces through the use of wall or frame elements.

K. Seismic Deformations: Drifts, deflections and relative displacements determined in accordance with the applicable seismic requirements of the Building Code.

L. Seismic Demand: Forces and deformations caused by a Code seismic event that must be resisted or accommodated by a structure, component, or system.

M. Seismic Forces: Forces acting in any direction due to the action of an earthquake as defined in the Building Code.

N. Special Inspector: An IAS accredited IBC Special Inspection Agency or qualified Professional Engineer who demonstrates competence, to the satisfaction of the building official (or Authority Having Jurisdiction AHJ), for inspection of the Designated Seismic System. The Owner or the Engineer in responsible charge acting as the owner's agent shall employ one or more Special Inspectors to provide periodic inspections during installation of Designated Seismic Systems.

O. Support: Elements used to support the weight (gravity load) of an item. Where the support is located at a seismic brace, the element may also resist tension/compression reactions from the restraint system.

P. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

1.4 QUALITY ASSURANCE

A. Comply with the International Building Code (IBC) latest adopted Edition by the jurisdiction where the Project is located and applicable local and statewide adopted amendments.

PART 2 - PRODUCTS

2.1 PROJECT SEISMIC DESIGN CRITERIA

A. Seismic Design Category – B.

B. Seismic Design Force: Base calculation of seismic design force on requirements of ASCE 7 including Chapter 11 through Chapter 15 with the following seismic design parameters:

1. $S_S = 0.09$: Mapped Short Period Spectral Response Acceleration Parameter.
2. $S_1 = 0.055$: Mapped 1 s. Spectral Response Acceleration Parameter.

3. S_{DS} = 0.097: Design Short Period Spectral Response Acceleration Parameter.
4. S_{D1} = 0.088: Design 1 s. Spectral Response Acceleration Parameter.
5. I_e = 1.25: Building or Structure Importance Factor.

PART 3 - EXECUTION

3.1 COORDINATION

A. Do not fabricate or install seismic restraints or non-building structures until submittals have been approved by the Engineer.

B. Verify that multiple systems installed in the same vicinity can be installed without conflict.

C. Verify tolerances between installed items to confirm that unbraced components will not come into contact with restrained equipment or structural members during an earthquake. When contact is possible, provide seismic restraint or provide justification to Engineer's satisfaction that contact will not cause unacceptable damage to the components in contact, their supports, finishes or other elements that are contacted.

3.2 DESIGN AND GENERAL CONSTRUCTION

A. Attach or anchor components and their supports, non-building structures, and Designated Seismic Systems to the structure. Provide a continuous load path of sufficient strength and stiffness between the component and the supporting structure.

B. Design equipment support and bracing to resist seismic design force in any direction.

C. Provide supports, braces, connections, hardware, and anchoring devices to withstand code-required seismic forces and seismic deformations without shifting or overturning.

D. For components with Ip = 1.5, in addition to providing for code-required seismic forces and deformations, construct installations capable of providing post-earthquake functionality.

E. Bolt, weld, or otherwise positively fastened component attachments in accordance with ASCE 7 Chapter 13 without consideration of frictional resistance produced by the effects of gravity.

F. Where equipment is mounted on vibration isolators and restraints, use isolators and restraints designed for amplified code forces per ASCE 7 and with demonstrated ability to resist required forces including gravity, operational, and seismic forces.

G. As an alternate to project-specific design of seismic bracing, use of proprietary restraint systems with a Certificate of Compliance verified and listed by an accredited Inspection Agency is acceptable. Use of a certified product does not preclude the requirement for Shop Drawings.

H. Design piping, piping risers, ducts, and duct risers to accommodate interstory drift.

I. Provide flexible connections:

1. Between floor-mounted equipment and suspended piping.

2. Between unbraced piping and restrained suspended items.
3. As required for thermal movement.
4. At building separations and seismic joints.
5. Wherever relative differential movements could damage piping in an earthquake.

J. Where piping is explicitly exempt from seismic bracing requirements, provide flexible connections between piping and connected equipment, including in-line devices such as VAV boxes and reheat coils.

K. Where piping is explicitly exempt from seismic bracing requirements, install piping such that swinging of the pipes will not cause damaging impact with adjacent components, finishes or structural framing. This will be considered satisfied if there is horizontal clear distance of at least 2/3 the hanger length between subject components. If swinging of exempted piping can cause damaging contact with adjacent components, finishes or structural framing, add swing restraints as required to eliminate contact.

L. Ductwork:

1. Provide independent support for in-line devices weighing more than 20 pounds.
2. Provide independent support and bracing for in-line devices weighing more than 75 pounds.

M. Provide unbraced piping attached to braced in-line equipment with adequate flexibility to accommodate differential displacements.

N. Tanks:

1. Design tank to resist seismic design forces.
2. Design tank anchorage to resist seismic design forces.
3. Design tank legs or supporting structure to resist seismic design forces.
4. Provide flexible connections between tank and interconnected piping.

O. Conduit, cable tray, bus duct, raceways, bundled cabling:

1. Provide gravity support for conduit/cable tray/bus duct/raceway/bundled cabling that is independent of suspended ceiling framing.
2. Provide seismic bracing of conduit/cable tray/bus duct/raceway/bundled cabling to resist gravity and seismic design forces.
3. Design conduit/cable tray/bus duct/raceway/bundled cabling to accommodate interstory drift.
4. Provide flexible connections wherever relative differential movement could damage conduit/cable tray/bus duct/raceway/bundled cabling in an earthquake.

END OF SECTION 018829

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Owner's Project Requirements and Basis-of-Design Document are included by reference for information only.

1.2 SUMMARY

A. Section Includes:

1. General requirements for coordinating and scheduling commissioning activities.
2. Commissioning meetings.
3. Commissioning reports.
4. Use of commissioning process test equipment, instrumentation, and tools.
5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
6. Commissioning tests and commissioning test demonstration.
7. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:

1. Section 011000 "Summary" for Commissioning Authority responsibilities.
2. Section 013300 "Submittal Procedures" for submittal procedure requirements for commissioning process.
3. Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
4. Section 017823 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal requirements.

1.3 DEFINITIONS

A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

B. Basis-of-Design Document: A document prepared by Engineer that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.

C. Commissioning Authority: An entity engaged by Owner, and identified in Section 011000 "Summary," to evaluate Commissioning-Process Work.

D. Commissioning Plan: A document, prepared by Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation of commissioning requirements.

E. Commissioning: A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities. The scope of the commissioning process is defined in Section 011000 "Summary."

F. Construction-Phase Commissioning-Process Completion: The stage of completion and acceptance of commissioning process when resolution of deficient conditions and issues discovered during commissioning process and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date construction-phase commissioning-process completion is achieved. See Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.

1. Commissioning process is complete when the Work specified of this Section and related Sections has been completed and accepted, including, but not limited to, the following:

a. Completion of tests and acceptance of test results.
b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
c. Comply with requirements in Section 017900 "Demonstration and Training."
d. Completion and acceptance of submittals and reports.

G. Owner's Project Requirements: A document that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This document is prepared either by the Owner or for the Owner by the Engineer or Commissioning Authority.

H. Owner's Witness: Commissioning Authority, Owner's Project Manager, or Engineer-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.

I. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

J. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

K. Sampling Procedures and Tables for Inspection by Attributes: As defined in ASQ Z1.4.

1.4 COMPENSATION

A. If Engineer, Commissioning Authority, other Owner's witness, or Owner's staff perform additional services or incur additional expenses due to actions of Contractor listed below, compensate Owner for such additional services and expenses.

1. Failure to provide timely notice of commissioning activities schedule changes.

2. Failure to meet acceptance criteria for test demonstrations.

1.5 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

1. Commissioning Coordinator: A person or entity employed by Contractor to manage, schedule, and coordinate commissioning process.
2. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning process.
3. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning process.
4. Appointed team members shall have the authority to act on behalf of the entity they represent.

B. Members Appointed by Owner:

1. Commissioning Authority, plus consultants that Commissioning Authority may deem appropriate for a particular portion of the commissioning process.
2. Owner representative(s), facility operations and maintenance personnel, plus other employees, separate contractors, and consultants that Owner may deem appropriate for a particular portion of the commissioning process.
3. Engineer, plus employees and consultants that Engineer may deem appropriate for a particular portion of the commissioning process.

1.6 INFORMATIONAL SUBMITTALS

A. Comply with requirements in Section 013300 "Submittal Procedures" for submittal procedure general requirements for commissioning process.

B. Commissioning Plan Information:

1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors performing the various commissioning requirements.
2. Schedule of commissioning activities, integrated with the Construction Schedule. Comply with requirements in Section 013200 "Construction Progress Documentation" for the Construction Schedule general requirements for commissioning process.
3. Contractor personnel and subcontractors participating in each test.
4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.

C. Commissioning schedule.

D. Two-week look-ahead schedules.

E. Commissioning Coordinator Letter of Authority:

1. Within 10 days after approval of Commissioning Coordinator qualifications, submit a letter of authority for Commissioning Coordinator, signed by a principal of Contractor's firm. Letter shall authorize Commissioning Coordinator to do the following:

    a. Make inspections required for commissioning process.
    b. Coordinate, schedule, and manage commissioning process of Contractor, subcontractors, and suppliers.
    c. Obtain documentation required for commissioning process from Contractor, subcontractors, and suppliers.
    d. Report issues, delayed resolution of issues, schedule conflicts, and lack of cooperation or expertise on the part of members of the commissioning team.

F. Commissioning Coordinator Qualification Data: For entity coordinating Contractor's commissioning activities to demonstrate their capabilities and experience.

1. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

G. List test instrumentation, equipment, and monitoring devices. Include the following information:

1. Make, model, serial number, and application for each instrument, equipment, and monitoring device.
2. Brief description of intended use.
3. Calibration record showing the following:

    a. Calibration agency, including name and contact information.
    b. Last date of calibration.
    c. Range of values for which calibration is valid.
    d. Certification of accuracy.
    e. Certification for calibration equipment traceable to NIST.
    f. Due date of the next calibration.

H. Test Reports:

1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed construction checklists.
2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
3. Commissioning Issue Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
5. Data Trend Logs: Submit data trend logs at the end of the trend log period.
6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit printout of log of alarms that occurred since the last log was printed.

I. Construction Checklists:

1. Material checks.
2. Installation checks.
3. Startup procedures, where required.

1.7 CLOSEOUT SUBMITTALS

A. Commissioning Report:

1. At Construction-Phase Commissioning Completion, include the following:

a. Pre-startup reports.
b. Approved test procedures.
c. Test data forms completed and signed.
d. Progress reports.
e. Commissioning issue report log.
f. Commissioning issue reports showing resolution of issues.
g. Correspondence or other documents related to resolution of issues.
h. Other reports required by commissioning process.
i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction-Phase Commissioning Completion.
j. Report shall include commissioning work of Contractor.

B. Request for Certificate of Construction-Phase Commissioning Process Completion.

C. Operation and Maintenance Data: For proprietary test equipment, instrumentation, and tools to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Commissioning Coordinator Qualifications:

1. Documented experience commissioning systems of similar complexity to those contained in these documents on at least three projects of similar scope and complexity.
2. Certification of commissioning-process expertise. The following certifications are acceptable. Owner reserves the right to accept or reject certifications as evidence of qualification.

a. Certified Commissioning Authority, by AABC Commissioning Group (ACG).
b. Commissioning-Process Management Professional, by American Society of Heating, Refrigerating and Air-Conditioning Engineers.
c. Certified Commissioning Professional, by Building Commissioning Association.
d. Accredited Commissioning-Process Authority Professional, by University of Wisconsin.
e. Accredited Commissioning-Process Manager, by University of Wisconsin.
f. Accredited Green Commissioning-Process Provider, by University of Wisconsin.

B. Calibration Agency Qualifications: Certified by The American Association for Laboratory Accreditation that the calibration agency complies with minimum requirements of ISO/IEC 17025.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Test equipment and instrumentation required to perform the commissioning process shall remain the property of Contractor unless otherwise indicated.

B. Test equipment and instrumentation required to perform commissioning process shall comply with the following criteria:

1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.
2. Calibrated and certified.
    a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags shall be permanently affixed.
    b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.
3. Maintain test equipment and instrumentation.
4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

2.2 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate, or perform work on its equipment.

1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.
2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Substantial Completion.

2.3 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:

1. Bind report in three-ring binders.
2. Label the front cover and spine of each binder with the report title, volume number, project name, Contractor's name, and date of report.
3. Record report on compact disk.
4. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report:

1. Include a table of contents and an index to each test.
2. Include major tabs for each Specification Section.
3. Include minor tabs for each test.
4. Within each minor tab, include the following:

a. Test specification.
b. Pre-startup reports.
c. Approved test procedures.
d. Test data forms completed and signed.
e. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

PART 3 - EXECUTION

3.1 PREPARATION

A. Review preliminary construction checklists and preliminary test procedures and data forms.

3.2 CONSTRUCTION CHECKLISTS

A. Construction checklists cannot modify or conflict with the Contract Documents.

B. Create construction checklists based on actual systems and equipment to be included in Project.

C. Material Checks: Compare specified characteristics and approved submittals with materials as received. Include factory tests and other evaluations, adjustments, and tests performed prior to shipment if applicable.

1. Service connection requirements, including configuration, size, location, and other pertinent characteristics.
2. Included optional features.

3. Delivery Receipt Check: Inspect and record physical condition of materials and equipment on delivery to Project site, including agreement with approved submittals, cleanliness, and lack of damage.
4. Installation Checks:

    a. Location according to Drawings and approved Shop Drawings.
    b. Configuration.
    c. Compliance with manufacturers' written installation instructions.
    d. Attachment to structure.
    e. Access clearance to allow for maintenance, service, repair, removal, and replacement without the need to disassemble or remove other equipment or building elements. Access coordinated with other building elements and equipment, including, but not limited to, ceiling and wall access panels, in a manner consistent with OSHA fall-protection regulations and safe work practices.
    f. Utility connections are of the correct characteristics, as applicable.
    g. Correct labeling and identification.
    h. Startup Checks: Verify readiness of equipment to be energized. Include manufacturer's standard startup procedures and forms.

D. Startup: Perform and document initial operation of equipment to prove that it is installed properly and operates as intended according to manufacturer's standard startup procedures, at minimum.

E. Performance Tests:

1. Static Tests: As specified elsewhere, including, but not limited to, duct and pipe leakage tests, insulation-resistance tests, and water-penetration tests.
2. Component Performance Tests: Tests evaluate the performance of an input or output of components under a full range of operating conditions.
3. Equipment and Assembly Performance Tests: Test and evaluate performance of equipment and assemblies under a full range of operating conditions and loads.
4. System Performance Tests: Test and evaluate performance of systems under a full range of operating conditions and loads.
5. Intersystem Performance Tests: Test and evaluate the interface of different systems under a full range of operating conditions and loads.

F. Deferred Construction Checklists: Obtain Owner approval of proposed deferral of construction checklists, including proposed schedule of completion of each deferred construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, deferred construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify deferred construction checklists by number and title.
2. Provide a target schedule for completion of deferred construction checklists.
3. Written approval of proposed deferred construction checklists, including approved schedule of completion of each deferred construction checklist.

G. Delayed Construction Checklists: Obtain Owner approval of proposed delayed construction checklists, including proposed schedule of completion of each delayed construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process

Completion. When approved, delayed construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify delayed construction checklist by construction checklist number and title.
2. Provide a target schedule for completion of delayed construction checklists.
3. Written approval of proposed delayed construction checklists, including approved schedule of completion of each delayed construction checklist.

3.3 GENERAL EXECUTION REQUIREMENTS

A. Schedule and coordinate commissioning process with the Construction Schedule.

B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.

C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies. In some instances, demonstration of a random sample of other than 100 percent of the results of a test is specified.

1. Where sampling is specified, the sampling plan and procedure for the test demonstration shall be determined using ASQ Z1.4.

    a. General Inspection: Level I.
    b. Acceptance Quality Limit (AQL) of 1.5.

2. The "lot size" in ASQ Z1.4 is the sum of the number of items to which the test demonstration applies, as described in the scope subparagraph of each test.
3. On determination of the sample size, the samples shall be selected randomly by Owner's witness at the time of the test demonstration.
4. Include in the Commissioning Plan a detailed list of the test demonstrations with lot and sample quantities for each test.

D. Report test data and commissioning issue resolutions.

E. Schedule personnel to participate in and perform Commissioning-Process Work.

F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:

1. Operating the equipment and systems they install during tests.
2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

3.4 COMMISSIONING COORDINATOR RESPONSIBILITIES

A. Management and Coordination: Manage, schedule, and coordinate commissioning process, including, but not limited to, the following:

1. Coordinate with subcontractors on their commissioning responsibilities and activities.

2. Obtain, assemble, and submit commissioning documentation.
3. Attend periodic on-site commissioning meetings. Comply with requirements in Section 013100 "Project Management and Coordination."
4. Develop and maintain the commissioning schedule. Integrate commissioning schedule into the Construction Schedule. Update Construction Schedule at specified intervals.
5. Review and comment on preliminary test procedures and data forms.
6. Report inconsistencies and issues in system operations.
7. Verify that tests have been completed and results comply with acceptance criteria, and that equipment and systems are ready before scheduling test demonstrations.
8. Direct and coordinate test demonstrations.
9. Coordinate witnessing of test demonstrations by Owner's witness.
10. Coordinate and manage training. Be present during training sessions to direct video recording, present training, and direct the training presentations of others. Comply with requirements in Section 017900 "Demonstration and Training."
11. Prepare and submit specified commissioning reports.
12. Track commissioning issues until resolution and retesting is successfully completed.
13. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide Owner's representative access to these records on request.
14. Assemble and submit commissioning report.

3.5 COMMISSIONING TESTING

A. Quality Control: Construction checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.

B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published Commissioning Schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning process.

C. Construction Checklists:

1. Complete construction checklists as Work is completed.
2. Distribute construction checklists to installing contractors before they start work.
3. Installers:

    a. Verify installation using approved construction checklists as Work proceeds.
    b. Complete and sign construction checklists weekly for work performed during the preceding week.

4. Provide Commissioning Authority access to construction checklists.

D. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with construction checklists. Record installation compliance issues on the construction checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.

E. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.

F. Test Procedures and Test Data Forms:

1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
3. Completed test data forms are the official records of the test results.
4. Commissioning Authority will provide to Contractor preliminary test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.
5. Review preliminary test procedures and test data forms and provide comments within 14 days of receipt from Commissioning Authority. Review shall address the following:

    a. Equipment protection and warranty issues, including, but not limited to, manufacturers' installation and startup recommendations, and operation and maintenance instructions.
    b. Applicability of the procedure to the specific software, equipment, and systems approved for installation.

6. After Contractor has reviewed and commented on the preliminary test procedures and test data forms, Commissioning Authority will revise and reissue the approved revised test procedures and test data forms marked "Approved for Testing."
7. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.

G. Performance of Tests:

1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.
2. Perform and complete each step of the approved test procedures in the order listed.
3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.

H. Performance of Test Demonstration:

1. Perform test demonstrations on a sample of tests after test data submittals are approved. The sampling rate for test demonstrations shall be 100 percent unless otherwise indicated in the individual test specification.

2. Notify Owner's witness at least three days in advance of each test demonstration.
3. Perform and complete each step of the approved test procedures in the order listed.
4. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.
5. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration, sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.
6. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.

    a. Exception for Failure of Owner's Witness to Attend: Failure of Owner's witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for Contractor and for Owner's witness and shall note the absence of Owner's witness at the scheduled time and place.

7. False load test requirements are specified in related sections.

    a. Where false load testing is specified, provide temporary equipment, power, controls, wiring, piping, valves, and other necessary equipment and connections required to apply the specified load to the system. False load system shall be capable of steady-state operation and modulation at the level of load specified. Equipment and systems permanently installed in this work shall not be used to create the false load without Engineer's written approval.

I. Deferred Tests:

1. Deferred Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed deferred tests or other tests approved for deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction-Phase Commissioning Completion. Identify proposed deferred tests in the request for Certificate of Construction-Phase Commissioning Process Completion as follows:

    a. Identify deferred tests by number and title.
    b. Provide a target schedule for completion of deferred tests.

2. Schedule and coordinate deferred tests. Schedule deferred tests when specified conditions are available. Notify Engineer and Commissioning Authority at least three working days (minimum) in advance of tests.
3. Where deferred tests are specified, coordinate participation of necessary personnel and of Engineer, Commissioning Authority, and Owner's witness. Schedule deferred tests to minimize occupant and facility impact. Obtain Engineer's approval of the proposed schedule.

J. Delayed Tests:

1. Delayed Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. Include the following in the request for Certificate of Construction-Phase Commissioning Process Completion:

    a. Identify delayed tests by test number and title.
    b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.

2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Engineer and Commissioning Authority at least three working days (minimum) in advance of tests.
3. Where delayed tests are approved, coordinate participation of necessary personnel and of Engineer, Commissioning Authority, and Owner's witness. Schedule delayed tests to minimize occupant and facility impact. Obtain Engineer's approval of the proposed schedule.

K. Commissioning Compliance Issues:

1. Test results that are not within the range of acceptable results are commissioning compliance issues.
2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.
3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.
4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:

    a. Complete a commissioning compliance issue report form promptly on discovery of test results that do not comply with acceptance criteria.
    b. Submit commissioning compliance issue report form within 24 hours of the test.
    c. Determine the cause of the failure.
    d. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.

5. Commissioning Compliance Issue Report: Provide a commissioning compliance issue report for each issue. Do not report multiple issues on the same commissioning compliance issue report.

    a. Exception: If an entire class of devices is determined to exhibit the identical issue, they may be reported on a single commissioning compliance issue report. (For example, if all return-air damper actuators that are specified to fail to the open position are found to fail to the closed position, they may be reported on a single commissioning issue report. If a single commissioning issue report is used for

multiple commissioning compliance issues, each device shall be identified in the report, and the total number of devices at issue shall be identified.

b. Complete and submit Part 1 of the commissioning compliance issue report immediately when the condition is observed.
c. Record the commissioning compliance issue report number and describe the deficient condition on the data form.
d. Resolve commissioning compliance issues promptly. Complete and submit Part 2 of the commissioning compliance issue report when issues are resolved.

6. Diagnose and correct failed test demonstrations as follows:

a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.
b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.
c. Record the results of each step of the diagnostic procedure.
d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.
e. Determine and record corrective measures.
f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report.

7. Retest:

a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.
b. For each repeated test demonstration, submit a new test data form, marked "Retest."

8. Do not correct commissioning compliance issues during test demonstrations.

a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than five minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data form, marked "Retest," shall be initiated after the resolution has been completed.

3.6 COMMISSIONING MEETINGS

A. Schedule and conduct commissioning meetings. Comply with requirements in Section 013100 "Project Management and Coordination."

3.7 SEQUENCING

A. Sequencing of Commissioning Verification Activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:

1. Construction Checklists:

   a. Material checks.
   b. Installation checks.
   c. Startup, as appropriate. Some startups may depend on component performance. Such startup may follow component performance tests on which the startup depends.
   d. Performance Tests:

      1) Static tests, as appropriate.
      2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.
      3) Equipment and assembly performance tests.
      4) System performance tests.
      5) Intersystem performance tests.

2. Commissioning tests.

B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to construction checklists.

C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Engineer if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.

D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

3.8 SCHEDULING

A. Commence commissioning process as early in the construction period as possible.

B. Commissioning Schedule: Integrate commissioning activities into Construction Schedule. See Section 013200 "Construction Progress Documentation."

1. Include detailed commissioning activities in monthly updated Construction Schedule and short-interval schedule submittals.
2. Schedule the start date and duration for the following commissioning activities:

   a. Submittals.

b. Preliminary operation and maintenance manual submittals.
c. Installation checks.
d. Startup, where required.
e. Performance tests.
f. Performance test demonstrations.
g. Commissioning tests.
h. Commissioning test demonstrations.

3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.
4. Determine milestones and prerequisites for commissioning process. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short-interval schedule submittals.

C. Two-Week Look-Ahead Commissioning Schedule:

1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning process.
2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.
3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.

D. Owner's Witness Coordination:

1. Coordinate Owner's witness participation via Engineer.
2. Notify Engineer of commissioning schedule changes at least two workdays in advance for activities requiring the participation of Owner's witness.

3.9 COMMISSIONING REPORTS

A. Test Reports:

1. Pre-startup reports include observations of the conditions of installation, organized into the following sections:

a. Equipment Model Verification: Compare contract requirements, approved submittals, and provided equipment. Note inconsistencies.
b. Preinstallation Physical Condition Checks: Observe physical condition of equipment prior to installation. Note conditions including, but not limited to, physical damage, corrosion, water damage, or other contamination or dirt.
c. Preinstallation Component Verification Checks: Verify components supplied with the equipment, preinstalled or field installed, are correctly installed and functional. Verify external components required for proper operation of equipment correctly installed and functional. Note missing, improperly configured, improperly installed, or nonfunctional components.
d. Summary of Installation Compliance Issues and Corrective Actions: Identify installation compliance issues and the corrective actions for each. Verify that issues noted have been corrected.

e. Evaluation of System Readiness for Startup: For each item of equipment for each system for which startup is anticipated, document in summary form acceptable to Owner completion of equipment model verification, preinstallation physical condition checks, preinstallation component verification checks, and completion of corrective actions for installation compliance issues.

2. Test data reports include the following:

   a. "As-tested" system configuration. Complete record of conditions under which the test was performed, including, but not limited to, the status of equipment, systems, and assemblies; temporary adjustments and settings; and ambient conditions.
   b. Data and observations, including, but not limited to, data trend logs, recorded during the tests.
   c. Signatures of individuals performing and witnessing tests.
   d. Data trend logs accumulated overnight from the previous day of testing.

3. Commissioning Compliance Issue Reports: Report as commissioning compliance issues results of tests and test demonstrations that do not comply with acceptance criteria. Report only one issue per commissioning compliance issue report. Use sequentially numbered facsimiles of commissioning compliance issue report form included in this Section, or other form approved by Owner. Distribute commissioning compliance issue reports to parties responsible for taking corrective action. Identify the following:

   a. Commissioning compliance issue report number. Assign unique, sequential numbers to individual commissioning compliance issue reports when they are created, to be used for tracking.
   b. Action distribution list.
   c. Report date.
   d. Test number and description.
   e. Equipment identification and location.
   f. Briefly describe observations about the performance associated with failure to achieve acceptable results. Identify the cause of failure if apparent.
   g. Diagnostic procedure or plan to determine the cause (include in initial submittal)
   h. Diagnosis of fundamental cause of issues as specified below (include in resubmittal).
   i. Fundamental cause of unacceptable performance as determined by diagnostic tests and activities.
   j. When issues have been resolved, update and resubmit the commissioning issue report forms by completing Part 2. Identify resolution taken and the dates and initials of the persons making the entries.
   k. Schedule for retesting.

4. Weekly progress reports include information for tests conducted since the preceding report and the following:

   a. Completed data forms.
   b. Equipment or system tested, including test number, system or equipment tag number and location, and notation about the apparent acceptability of results.
   c. Activities scheduled but not conducted per schedule.
   d. Commissioning compliance issue report log.
   e. Schedule changes for remaining Commissioning-Process Work, if any.

5. Data trend logs shall be initiated and running prior to the time scheduled for the test demonstration.

    a. Trend log data format shall be multiple data series graphs. Where multiple data series are trend logged concurrently, present the data on a common horizontal time axis. Individual data series may be presented on a segmented vertical axis to avoid interference of one data series with another, and to accommodate different axis scale values. Graphs shall be sufficiently clear to interpret data within the accuracy required by the acceptance criteria.
    b. Attach to the data form printed trend log data collected during the test or test demonstration.
    c. Record, print out, and attach to the data form operator activity during the time the trend log is running. During the time the trend log is running, operator intervention not directed by the test procedure invalidates the test results.

6. System Alarm Logs: Record and print out a log of alarms that occurred since the last log was printed. Evaluate alarms to determine if the previous day's work resulted in any conditions that are not considered "normal operation."

    a. Conditions that are not considered "normal operation" shall be reported on a commissioning issue report attached to the alarm log. Resolve as necessary. The intent of this requirement is to discover control system points or sequences left in manual or disabled conditions, equipment left disconnected, set points left with abnormal values, or similar conditions that may have resulted from failure to fully restore systems to normal, automatic control after test completion.

3.10 CERTIFICATE OF CONSTRUCTION-PHASE COMMISSIONING PROCESS COMPLETION

A. When Contractor considers that construction-phase commissioning process, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Owner and Commissioning Authority through Engineer a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to compete commissioning process.

B. On receipt of Contractor's list, Commissioning Authority will make an inspection to determine whether the construction-phase commissioning process or designated portion thereof is complete. If Commissioning Authority's inspection discloses items, whether included on Contractor's list, which is not sufficiently complete as defined in "Construction-Phase Commissioning Process Completion" Paragraph in the "Definitions" Article, Contractor shall, before issuance of the Certificate of Construction-Phase Commissioning Process Completion, complete or correct such items on notification by Commissioning Authority. In such case, Contractor shall then submit a request for another inspection by Commissioning Authority to determine construction-phase commissioning process completion.

C. Contractor shall promptly correct deficient conditions and issues discovered during commissioning process. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Engineer's and Commissioning Authority's services and expenses made necessary thereby, shall be at Contractor's expense.

D. When construction-phase commissioning process or designated portion is complete, Commissioning Authority will prepare a Certificate of Construction-Phase Commissioning Process Completion that shall establish the date of completion of construction-phase commissioning process. Certificate of Construction-Phase Commissioning Process Completion shall be submitted prior to requesting inspection for determining date of Substantial Completion.

END OF SECTION 019113

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SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove Hazardous Materials: Isolate and remove hazardous materials from existing construction and properly dispose as required by existing regulations.

C. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.

D. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

E. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

D. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Notify warrantor on completion of selective demolition and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.

6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.8 SELECTIVE DEMOLITION SCHEDULE

A. Remove: Existing Polymer Feed System and associated piping, control panel and fittings, portion of 6 inch Sludge Feed piping and fittings (as indicated on demolition sheets), existing BFP Control Panel, existing BFP concrete containment area, existing 1 ½ inch Plant Service Water piping.

B. Remove and Salvage: Existing Belt Filter Press (BFP-906) and existing control panel.

C. Remove and Reinstall: Existing screw conveyor.

D. Existing to Remain: Portion of the BFP containment area (refer to demolition sheets), portion of 6 inch Sludge Feed piping (as indicated), existing 8 inch BFP Drainpipe, polymer piping from feed system to injection point, Gravity Belt Thickener and Belt Filter Press (BFP-907).

END OF SECTION 024119

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SECTION 030130.71 - MODIFICATIONS TO EXISTING CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Cutting, removing, or modifying parts of existing concrete structures or appurtenances.
2. Addressing existing steel reinforcing bars encountered.
3. Bonding new concrete or grout to existing concrete.

B. Related Requirements:

1. Section 024119 “Selective Demolition” for selective demolition and modification procedures.
2. Section 033010 “Miscellaneous Cast-In-Place Concrete” for concrete materials, and related work.
3. Section 036000 “Grouting” for grout and related accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Submit manufacturer's technical literature and installation instructions that include:

a. Current printed recommendations and product data sheets for products including performance criteria, product life, working time after mixing, surface preparation and application requirements and procedures, curing, volatile organic compound data, and safety requirements.
b. Storage requirements including temperature, humidity, and ventilation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Documentation of the qualifications for Contractor qualifications, Manufacturer's qualifications, and Contractor's supervisor as specified in Part 1 “Quality Assurance” Article.

B. Material Certificates: For each material provided.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Have a minimum of ten years' experience within last 10 years in manufacture and use of specified products and have an ongoing program of training, certifying, and technically supporting Contractor's personnel.

B. Contractor Qualifications: Complete a program of instruction in application of approved manufacturer's material and provide certification from manufacturer attesting to their training and status as an approved applicator.

C. Contractor's Supervisor: Have attended a training program sponsored by manufacturer supplying materials approved for this project.

D. Manufacturer's Representative: A representative of product manufacturer who will visit the site for first three days of installation to give instructions to installation crew. Make periodic site visits to ensure products being installed are in accordance with published instructions.

E. Be solely responsible for workmanship and quality of modification work. Inspections by the manufacturer, the Engineer, or others do not limit Contractor's responsibility for work quality.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials in original, new and unopened packages and containers clearly labeled with the following information:

1. Manufacturer's name.
2. Name or title of material, and other product identification.
3. Manufacturer's stock number and batch number.
4. Date of manufacture.
5. Instructions.
6. Expiration date.

B. Storage: Store products in accordance with manufacturers' published recommendations and the following supplementary requirements:

1. Store only approved materials on site and in locations as directed.
2. Keep area clean and accessible.
3. Comply with health and fire regulations including those of the Occupational Safety and Health Administration (OSHA).

C. Handling: Handle products carefully and in accordance with manufacturers' published recommendations and the following supplementary requirements:

1. Prevent inclusion of foreign materials.
2. Do not open containers or mix components until necessary preparatory work has been completed and application work will start immediately.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with this Section and applicable state and local regulations.

B. Epoxy Bonding Agent:

1. Product: Two-component, solvent-free, asbestos-free moisture insensitive epoxy resin material used to bind plastic concrete to hardened concrete and complying with requirements of ASTM C 881, Type V, Grade 2, Class C.

C. Epoxy Paste Adhesive:

1. Product: Two-component, solvent-free, moisture insensitive epoxy resin material used as an adhesive for mating surfaces where the glue line is 1/8 inch or less and to bond fresh, plastic concrete to clean, sound hardened concrete and complying with requirements of ASTM C 881, Type IV, Grade 3, Class C.

D. Repair Mortar (Polymer-Modified Portland Cement Mortar):

1. Horizontal Surfaces:

a. Product: Two-component polymer-modified, portland cement based mortar used to repair horizontal surfaces with a migrating corrosion inhibitor and having a minimum compressive strength of 7,000 psi at 28 days tested in accordance with ASTM C 881 or ASTM C 109 .

2. Vertical and Overhead Surfaces:

a. Product: Two-component polymer-modified, portland cement based, fast setting, non-sag mortar used to repair vertical and overhead surfaces with a migrating corrosion inhibitor and having a minimum compressive strength of 5,000 psi at 28 days tested in accordance with ASTM C 881 or ASTM C 109 .

2.2 ADHESIVE ANCHORING SYSTEM

A. Fastening to Concrete Substrate: Manufactured system consisting of post installed threaded rods, nuts, washers, other anchoring hardware, and chemical dispenser for installation in hammer drilled holes.

1. Anchors: Meet ICC ES AC308 cracked concrete qualifications.
2. Injection Adhesive: Two-component epoxy system consisting of a hardener and a resin, furnished in pre-measured side-by-side cartridges which keep both components separate.
3. Adhesive Cartridge: Side-by-side design to accept a static mixing nozzle which thoroughly blends both components and allows injection directly into a drilled hole.
4. Reinforcing Bar Dowels: Reinforcing bar, per Section 033010.

a. Basis-of-Design:

1) Anchorage designs indicated are based on Hilti HIT- RE 500 V3, unless otherwise noted.

2) Acceptable Manufacturers: Hilti HIT- RE 500 V3; Simpson Strong Tie Set-3G; or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which modification work is to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting performance of the Work.

3.2 INSTALLATION - GENERAL

A. Do not shift, cut, remove, or otherwise alter existing structure or concrete until authorization is given by the Engineer.

B. When removing materials from or making openings in existing structures, take precautions and erect necessary barriers, shoring and bracing, and other protective devices. Prevent damage to structures beyond limits necessary for new work, protect personnel, control dust, and to prevent damage to structures or contents by falling or flying debris.

C. Unless otherwise permitted, shown, or specified, cut existing concrete by line drilling.

D. Construction Tolerances: Comply with requirements specified elsewhere in Division 03, except as modified herein, and elsewhere in Contract Documents.

E. Make locations and phases of the work available for access by the Engineer or other personnel designated by the Engineer. Provide ventilation and safe access to the work.

F. Cut, remove, or otherwise modify parts of existing structures or appurtenances as indicated, specified, or as necessary to complete the work. Finishes, joints, reinforcements, sealants, and similar materials are specified in their respective Sections. Install work complying with requirements of this Section and as indicated.

G. Locations, details, and limits of modifications are indicated on Drawings. Comply with requirements of this Section and as indicated on Drawings.

H. Examine areas and conditions under which modification work is to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

I. Store, mix, apply, and cure materials in strict compliance with manufacturer's instructions.

J. Where concrete is to be modified near an expansion joint or control joint, preserve isolation between components on either side of the joint.

K. When drilling holes for dowels and bolts or when coring holes for slab or wall penetrations, stop drilling if reinforcing is encountered. Do not cut reinforcing without prior approval by the Engineer. Relocate hole to avoid reinforcing as approved by the Engineer.

1. Identify reinforcing locations prior to drilling using reinforcing bar locators so that drill hole locations may be adjusted to avoid reinforcing interference.

L. Saw-cut edges for modification areas vertically and horizontally straight. Make intersecting cuts perpendicular to each other.

M. Stop saw cutting if reinforcing is encountered. Do not cut reinforcing without prior approval by the Engineer. Identify reinforcing locations within 1 foot of saw cut locations in any direction prior to saw cutting using reinforcing bar locators.

N. Clean concrete surfaces of efflorescence, deteriorated concrete, dirt, laitance, and existing repair materials such as liners, adhesives, and epoxies. Remove foreign matter and deleterious films by sandblasting, oil-free air-blasting, scarifying, or other mechanical means to sound original concrete.

O. Consolidate modification materials, completely filling portions of the area to be filled.

P. Bring finished surfaces into alignment with adjacent existing surfaces to provide a uniform, flush, and even surface. Match repair surfaces to adjacent existing surfaces in texture including any coatings or surface treatments that had been provided for the existing structure.

Q. Repair or replace concrete indicated or specified to be left in place that is damaged because of the work by approved means without additional compensation.

3.3 CONCRETE REMOVAL

A. When removing materials from or making openings in existing structures, take precautions and erect necessary barriers, shoring and bracing, and other protective devices. Prevent damage to structures beyond limits necessary for new work, protect personnel, control dust, and to prevent damage to structures or contents by falling or flying debris.

B. Concrete designated to be removed to specific limits indicated or directed by the Engineer, perform saw cutting 1 inch deep at limits of removal followed by line drilling and chipping, sandblasting, or oil-free air blasting, as appropriate in the areas where concrete is to be taken out. Remove concrete such that surrounding concrete and existing reinforcing to be left in place and existing in place equipment are not damaged.

1. Perform full thickness saw-cutting at limits of concrete to be removed only if indicated, herein specified, or after obtaining written approval from the Engineer.

C. Where existing reinforcing is exposed due to saw cutting or line drilling and no new material is to be placed on cut surface, apply a 1/4 inch thick surface treatment of epoxy paste to entire cut surface.

D. Where joint between new concrete or grout and existing concrete will be exposed in finished work, remove concrete edge by making a 1 inch deep saw cut on each exposed surface of existing concrete or as indicated.

3.4 CONNECTION SURFACE PREPARATION

A. Concrete areas requiring patching, repairs, or modifications, prepare connection surfaces as specified, as indicated, or as directed by the Engineer.

B. Remove loose and deteriorated materials, efflorescence, existing repair materials, dirt, oil, grease, and other bond inhibiting materials from concrete surface by dry mechanical means such as sandblasting, chipping, wire brushing, or other mechanical means as approved by the Engineer.

1. Uniformly roughen concrete surface to approximately 1/4 inch amplitude with pointed chipping tools. Thoroughly clean surface of loose or weakened material by sandblasting or air-blasting.
2. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into parent concrete.

C. If reinforcing steel is exposed, mechanically clean to remove loose material, contaminants, and rust as approved by the Engineer. If half of reinforcing steel diameter is exposed, chip out behind the steel. Chip distance behind the steel to a minimum of 1 inch. Do not damage reinforcing to be incorporated in new concrete or repair mortar during removal operation.

D. Clean reinforcing from existing removed or deteriorated concrete that is shown to be incorporated in new concrete or repair mortar by mechanical means to remove loose material and products of corrosion before proceeding. Cut, bend, or lap to new reinforcing as indicated and provide with 1 inch minimum clear cover.

E. Use following specific concrete surface preparation Methods where indicated, specified, or as directed by the Engineer:

1. Method A:

    a. Roughen and clean existing concrete surface at connection.
    b. Thoroughly saturate surfaces with water; prevent standing water during application.
    c. Scrub cement paste (cement and water mixed to consistency of a thick paste) into substrate filling concrete pores and voids.
    d. Place new concrete against scrub coat of cement paste while cement paste is still plastic.

2. Method B:

    a. Roughen and clean existing concrete surface at connection.
    b. Apply epoxy bonding agent at connection surfaces.
    c. Place new concrete or grout mixture to limits indicated within time constraints recommended by manufacturer to ensure bond.

3. Method C:

    a. Use adhesive anchoring system, as specified in drawings, for installation of reinforcing steel dowels into existing concrete where indicated.
    b. Perform installation complying strictly with manufacturer's recommendations, including drill bit diameter, surface preparation, injection, and installation of dowels.
    c. Drill concrete to embedded deformed bars to indicated depths.
    d. Use oil-free compressed air to blast out loose particles and dust from drilled holes. Clean dowels to be free of dirt, oil, grease, ice, or other deleterious material that would reduce bond.
    e. Concrete in existing structures is considered to have a strength of 3,000 psi.

4. Method D:

    a. Combination of Method B & Method C.

3.5 GROUTING

A. Grout: As specified in Section 036000 “Grouting.”

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect completed installations.

1. Perform inspection with Contractor, material installer, and the Engineer present. Give minimum of 72 hours’ notice prior to time of inspection.
2. Repair modifications not in conformance with Contract Documents in accordance with manufacturer's instructions at no additional cost to Owner.
3. At completion of non-conforming repairs, Contractor, material installer, and the Engineer shall reinspect the repaired problem areas.
4. Prepare inspection reports, identifying acceptable work, type and locations of unacceptable work, and actions taken to correct unacceptable work.
5. Complete field quality control work without additional compensation.

END OF SECTION 030130.71

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SECTION 033010 – MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 036000 “Grouting” for grouting.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with fly ash or ground granulated blast furnace slag; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Concrete Design Mixtures: Design Mixtures: For each formulation of concrete proposed for use, submit constituent quantities per cubic yard (cubic meter), water cementitious ratio, air content, concrete slump, type and manufacturer of cement and type and manufacturer of fly ash or ground granulated blast furnace slag. Provide either:

1. Standard deviation data for each proposed concrete mix based on statistical records.
2. Water cementitious ratio curve for concrete mixes based on laboratory tests.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, spacing, lengths, material, grade, bar schedules, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, and supports for concrete reinforcement. Reference bars to be the same identification marks shown on the bar bending details.

D. Construction Joint Layout: As shown on the Drawings.

E. Material Certificates: For each of the following:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Curing compounds.
6. Bonding agents.

F. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates**:** Conformance to ASTM standards, including sieve analysis, mechanical properties, and deleterious substance content.
2. Mill Test Reports: Conformance to ASTM standards, including chemical analysis and physical tests.

   a. Cementitious materials.
   b. Steel Reinforcing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For independent testing agency responsible for concrete design mixtures.

B. Certifications:

1. Certify that admixtures used in the same concrete mix are compatible with each other and the aggregates.
2. Certificate of conformance for concrete production facilities from the NRMCA.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Provide reinforcement free from mill scale, rust, mud, dirt, grease, oil, ice, or other foreign matter that will reduce or destroy bond. Deliver, store, and handle steel reinforcement to prevent bending and damage. Store reinforcement off the ground, protect from moisture, and keep out of standing water, and free from rust, mud, dirt, grease, oil, ice, or other contaminants and deleterious matter that will reduce or destroy bond.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions. Limit total storage time from date of manufacture to date of installation to six months or the manufacturer’s recommended storage time, whichever is less.

D. Remove immediately from the site material which becomes damp, contains lumps, or is hardened and replace with acceptable material.

E. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location.
2. Provide additional protection according to manufacturer instructions.

1.8 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average of the highest and lowest temperature from midnight to midnight is expected to fall below 40 degrees F for three successive days, maintain delivered concrete temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature below 90 degrees F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301.
2. ACI 117.

2.2 FORM-FACING MATERIALS

A. Surface Finish 2.0 Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

C. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Form-release agent to comply with Federal, State and local VOC limitations.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

D. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete, heavy high frequency vibration of the concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to retaining walls.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, new deformed bars.

2.4 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete of greater compressive strength than the specified concrete strength, according to CRSI's "Manual of Standard Practice," and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar support contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

B. Tie wires for reinforcement: 16 gauge or heavier black annealed wire to tie uncoated reinforcing.

C. Concrete Reinforcing Fibers:

1. Synthetic Micro-Fiber:

a. Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches long.
b. Add synthetic reinforcing fibers to the concrete grout mix at the rate of 1.5 lbs (approximated) of fibers per cubic yard of grout.
c. Fiber length and quantity for the concrete grout mix shall be in strict accordance with the manufacturer's recommendations as approved by the Engineer.
d. Add fibers from the manufacturer's pre-measured bags and according to the manufacturer's recommendations to ensure complete dispersion of the fiber bundles as single monofilaments within the concrete grout.
e. Provide services of a manufacturer's representative, with at least 2 years' experience in the use of the synthetic reinforcing fibers for a preconstruction meeting and assistance during the first placement of the material.
f. Synthetic reinforcing fibers for concrete grout shall be 100 percent polypropylene collated, fibrillated fibers,
g. Fibermesh 300 as manufactured by Propex Concrete Systems Corp, Chattanooga, TN, or equal.
h. Description: High-strength industrial-grade fibers specifically engineered for secondary reinforcement of concrete.
i. Comply with ASTM C1116.
j. Tensile Strength: 130
k. Toughness: 15 ksi.
l. Fiber Length: As listed above.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type II.
2. Blended Cement: ASTM C595, Type IL (MS).
3. Fly Ash: ASTM C618, Class F.
4. Ground Granulated Blast Furnace Slag: ASTM C989/C989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: As indicated by concrete mixtures specified herein.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

F. Water: ASTM C94/C94M and potable.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1-D, Class B, dissipating.

2.7 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: limit percentage, by weight, of cementitious materials (Portland cement alone or in combination with fly ash or Ground Granulated Blast Furnace Slag) in concrete as follows:

1. Fly Ash: 20-25 percent.
2. Ground Granulated Blast Furnace Slag: 25-45 percent.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete, for placement and workability.
2. High-range water-reducing admixture in concrete, may be used, for placement and workability.

2.8 CONCRETE MIXTURES

A. Structural Concrete 10-in or greater in thickness:

1. Minimum Compressive Strength: 4000 psi at 28 days.

2. Maximum W/C Ratio: 0.42.
3. Slump Limit: 4 inches or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. Air Content: 4 percent, plus or minus 1.5 percent at point of placement.
5. Coarse Aggregate: ASTM C33, size 57.

B. Structural Concrete 10-inch or less in thickness:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum W/C Ratio: 0.42.
3. Slump Limit: 4 inches or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
5. Air Content: 4 percent, plus or minus 1.5 percent at point of placement.
6. Coarse Aggregate: ASTM C33, size 67.

2.9 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M and furnish batch ticket information.

1. When air temperature is between 85 and 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Erect, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Use form-facing materials as required to meet the surface finishes (SF) requirements of ACI 301, unless otherwise specified provide as-cast form finishes per ACI 301 as follows.

1. Surface Finish (SF-2.0)

D. Construct forms tight to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where necessary. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, ice, snow and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations must be maintained.

1. Leave formwork for structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing materials are not acceptable for exposed surfaces. Re-apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose mill scale, rust, mud, dirt, grease, oil, ice, and other foreign materials that reduce or destroy the bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum clear concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Splicing:

1. Lengths and locations of splices as indicated on the Drawings.
2. If not indicated on Drawings, locate reinforcement splices at point of minimum stress.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
2. Locate joints for foundations in the middle third of spans.
3. Locate horizontal joints in walls and at the top of footings.
4. Space vertical joints in walls as indicated on the Drawings.
5. At construction joints and at concrete joints indicated on Drawings to be "roughened", uniformly roughen the surface of concrete to a full amplitude (distance between high and low points and side to side) of 1/4 inch with chipping tools to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by waterblasting or sandblasting and prepare for bonding. At least two hours before and again shortly before the new concrete is deposited, saturate joints with water. After glistening water disappears, coat joints with neat cement slurry mixed to consistency of very heavy paste. Coat surfaces to a depth of at least 1/8 inch thick, scrubbed-in by means of stiff bristle brushes. Deposit new concrete before the neat cement dries.

6. Do not use keyways in construction joints unless specifically shown on the Drawings or approved by the Engineer.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid “cold” joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
4. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

D. Slabs and equipment foundations:

1. Maintain reinforcement in position on chairs during concrete placement.
2. Screed surfaces with a straightedge and strike off to correct elevations.
3. Slope surfaces uniformly to drains where required.
4. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING SURFACES

A. Finish concrete surfaces according to ACI 301 and ACI 318.

B. Float Finish: Apply float finish per ACI 301 prior to broom finish or trowel finish.

C. Broom Finish: After concrete has received a float finish, apply to smooth-formed-finished as-cast concrete surfaces subject to pedestrian traffic. Provide broom finish perpendicular to direction of pedestrian traffic.

D. Trowel Finish: After concrete has received a float finish, apply to smooth-formed-finished horizontal interior as-cast concrete surfaces.

E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and chamfers.

C. Equipment Pads:

1. Coordinate sizes and locations of concrete pads with actual equipment provided.
2. Install reinforcing dowels; to connect concrete pad to concrete floor, unless otherwise indicated.
3. For supported equipment, install anchor bolts that extend through concrete pad and anchor into structural concrete substrate.
4. Prior to placing concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Cast anchor-bolt insert into pads. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.

B. Formed Surfaces: Cure formed concrete surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.

b. Continuous water-fog spray.
c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.10 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repair surfaces containing defects. Surface defects include color and texture irregularities, voids, cracks, spalls, air bubbles, bug holes, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

D. Limit sawcut at the perimeter of the area to a depth of 3/4 inch. Make edges of cuts perpendicular to concrete surface. Prepare surfaces per patching mortar manufacturer’s recommendations.

E. Repairing Formed Surfaces:

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects using patching mortar. On surfaces exposed to view repair by blending white Portland cement and standard Portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

F. Repairing Unformed Surfaces:

1. Inspect unformed surfaces, such as tops of foundations or equipment pads, for finish and verify surface tolerances specified for each surface.
2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Limit sawcut at the perimeter of the area to a depth of 3/4 inch. Finish repaired areas to blend into adjacent concrete.
4. Repair defective areas, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Mix patching mortar per manufacturer's recommendations, including coarse aggregate when required. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
5. Correct crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

G. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

H. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.11 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing and inspection agency to perform field tests and inspections and prepare test reports.

B. Notify the Owner when the reinforcing is complete and ready for inspection, at least six working hours prior to the proposed concrete placement. Do not cover reinforcing steel with concrete until the installation of the reinforcement, including the size, spacing and position of the reinforcement has been inspected by the Owner's inspection agency and the Owner's inspection agency release to proceed with the concreting has been obtained. Keep forms open until the Owner's inspection agency has completed inspection of the reinforcement.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements by the Owner's testing agency:

1. Testing Frequency: One composite sample for each day's placement of each concrete mixture exceeding 5 cubic yards., but less than 25 cubic yards, plus one set for each additional 50 cubic yards or fraction thereof.
2. Testing Frequency: One composite sample for each 100 cubic yards or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C143/C143M; one test at point of discharge for each composite sample, but not less than one test for each day's placement of each concrete mixture. Additional tests will be performed when concrete consistency appears to change.

4. Air Content: ASTM C231/C231M, pressure method, for concrete; one test for each composite sample at the point of placement, but not less than one test for each day's placement of each concrete mixture.
5. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 degrees F and below or 80 degrees F and above, and one test for each composite sample.
6. Compression Test Specimens: ASTM C31/C31M.

    a. Cast and cure one set of five 6 inch x 12 inch long standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at 7 days, test one specimen at 14 days, test two specimens at 28 days. The fifth may be used to verify strength after 28 days if the 28-day test results are low.
8. Strength of each concrete mixture will be satisfactory if every average of any three-consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break.
10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Engineer.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033010

SECTION 036000 - GROUTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Concrete grout.
2. Nonshrink cementitious grout.

B. Related Requirements:

1. Section 024119 “Selective Demolition”: Demolition and removals.
2. Section 033010 “Miscellaneous Cast-in-Place Concrete.”

1.3 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information regarding grout and surface preparation, mixing and installation.

1. Commercially Manufactured Nonshrink Cementitious Grout: Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, and conformity to specified ASTM standards.
2. Concrete grout. Include data as required for concrete and for fiber reinforcement as delineated in Section 033010 “Miscellaneous Cast-in-Place Concrete.”

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Manufacturer Instructions: Submit instructions for mixing, handling, surface preparation, and placing nonshrink grouts.

C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

D. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience in production and use of provided grouts.

B. Pre-installation Meeting: At least ten working days before grouting, hold a pre-installation meeting to review the requirements for surface preparation, mixing, placing, and curing procedures for each product proposed for use. Notify all parties involved with grouting, including Engineer, of the meeting at least ten working days prior to its scheduled date.

C. Services of Manufacturer's Representative: Provide services of a field technician of nonshrink grout manufacturer epoxy grout manufacturer who has performed at least five projects of similar size and complexity during last five years, to attend pre-installation meeting, to be present for initial installation of each type of nonshrink and epoxy grout, and to correct installation problems.

D. Field testing of concrete grout will be as specified for concrete in Section 033010 “Miscellaneous Cast-in-Place Concrete.”.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions. Limit total storage time from date of manufacture to date of installation to six months or manufacturer’s recommended storage time, whichever is less.

C. Remove immediately from the site material which becomes damp, contains lumps, or is hardened and replace with acceptable material.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location.
2. Provide additional protection according to manufacturer instructions.

1.7 AMBIENT CONDITIONS

A. Maximum Conditions: Do not perform grouting if temperatures exceed 90 degrees F.

B. Minimum Conditions: Do not perform grouting if the minimum temperature of base plates, supporting concrete and grout are less than 40 degrees F. Maintain minimum temperature of 40 degrees F before, during, and after grouting, until grout has set.

PART 2 - PRODUCTS

2.1 CONCRETE GROUT

A. Description: Conform to the requirements of Section 033010 “Miscellaneous Cast-in-Place Concrete.” except as follows. Proportion with Type II cement, coarse and fine aggregates, water, water reducing admixture, and air entraining agent to produce specified mix performance:

1. Average Strength (ASTM C579): 3,500 psi.
2. Maximum Coarse Aggregate Size: 3/8-inch .
3. Minimum Cement Content: 540 lbs per cubic yard .
4. Maximum Water to Cement Ratio: 0.45.
5. Maximum Slump: 5 inches.

B. Add synthetic reinforcing fibers as specified in Section 033010 “Miscellaneous Cast-in-Place Concrete.” to the concrete grout mix at the rate of 1.5 lbs of fibers per cubic yard of grout. Add fibers from manufacturer's pre-measured bags and according to manufacturer's recommendations to ensure complete dispersion of fiber bundles as single monofilaments within the concrete grout.

2.2 NONSHRINK CEMENTITIOUS GROUT

A. Description:

1. Pre-mixed and ready-for-use formulation requiring only addition of water.
2. Nonshrink, non-corrosive, nonmetallic, non-gas forming, not containing expansive cement and no chlorides.
3. No shrinkage when tested in conformity with ASTM C827/C827M.
4. For placements 3 inches and thicker, extend nonshrink cementitious grout with 3/8 inch aggregate in accordance with manufacturer’s recommendations.

B. Performance and Design Criteria:

1. Certified to maintain initial placement volume or expand after set, and to meet following minimum properties when tested according to ASTM C1107/C1107M for Grades B, C, D and CRD-C621 nonshrink grout:

    a. Setting Time:

        1) Initial: Approximately two hours.
        2) Final: Approximately three hours.
        3) Comply with ASTM C191.

    b. Maximum Expansion: 0.10 to 0.40 percent.
    c. Minimum Compressive Strength:

        1) One-Day: 4,000 psi.
        2) Seven-Day: 7,000 psi.

3) 28-Day: 10,000 to 10,800 psi.
4) Comply with CRD-C621.

2.3 FORMWORK

A. As specified in this Section and in Section 033010 “Miscellaneous Cast-in-Place Concrete”. Provide forms that are liquid-tight, anchored in place, and shored to resist the forces imposed by the grout and its placement.

B. Provide form release agent as recommended by the grout manufacturer. For concrete grouts, provide water-based form release agents .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify areas to receive grout.

3.2 PREPARATION

A. Place grout where indicated or specified over existing concrete and cured concrete which has attained its specified design strength unless otherwise approved by Engineer.

B. Remove defective concrete, ice, laitance, dirt, oil, grease, form release agents, paints, and other foreign material from concrete surfaces, which may affect the bond or performance of the grout by brushing, hammering, chipping, sand blasting or other similar dry mechanical means until sound and clean concrete surface is achieved. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.

1. Air compressors used to clean surfaces in contact with grout shall be the oil-less type or equipped with an oil trap in the airline to prevent oil from being blown onto the surface.

C. Roughen concrete lightly, but not to interfere with placement of grout.

D. Remove foreign materials from metal surfaces in contact with grout.

E. Align, level, and maintain final positioning of components to be grouted.

F. Wash concrete surfaces clean and then keep moist for at least 24 hours prior to the placement of nonshrink cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, or flooding the surface or other method acceptable to Engineer. Upon completion of the 24 hour period, remove visible water from the surface prior to grouting.

G. Support equipment during alignment and installation of grout by shims, wedges, blocks, or other approved means. Prevent bond of shims, wedges and blocking devices by bond breaking

coatings and remove after grouting unless otherwise approved by Engineer. Grout voids created by the removal of shims, wedges, and blocks.

H. Formwork:

1. Construct leakproof forms anchored and shored to withstand grout pressures.
2. Install formwork with clearances to permit proper placement of grout.

3.3 INSTALLATION – GENERAL

A. Mix, apply and cure products in strict compliance with the manufacturer's recommendations and these Specifications.

B. Provide staffing and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.

C. Maintain temperatures of base plate, supporting concrete, and grout between 40 and 90 degrees F during grouting and for at least 24 hours after placement, until grout compressive strength reaches 1,000 psi or as recommended by grout manufacturer, whichever is longer. Do not allow differential heating or cooling of baseplates and grout during the curing period.

D. Take special precautions for hot weather or cold weather grouting as recommended by manufacturer when ambient temperatures and/or temperature of materials in contact with the grout are outside of 40 to 90 degrees F range.

E. Install grout to preserve the isolation between elements on either side of the joint where grout is placed in the vicinity of an expansion or partial contraction joint.

F. Reflect all existing underlying expansion, partial contraction and construction joints through the grout.

3.4 INSTALLATION - CONCRETE GROUT

A. Inspect slabs finished under Section 033010 “Miscellaneous Cast-In-Place Concrete” and scheduled to receive concrete grout. ICRI CSP 6 (medium scarification). Protect and keep the surface clean until placement of concrete grout.

B. Mix concrete grout with mechanical mixers only.

C. Remove debris and clean surface by sweeping and vacuuming of dirt and other foreign materials. Pressure-wash the surface. Do not flush debris into tank drain lines.

D. Saturate concrete surface for at least 24 hours prior to placement of concrete grout by use of saturated burlap bags, soaker hoses or ponding. Remove excess water just prior to placement of concrete grout. Place a cement slurry immediately ahead of concrete grout so that the slurry is moist when grout is placed. Work slurry over the surface with a broom until it is coated with approximately 1/16 to 1/8-in thick cement paste.

E. Place concrete grout to final grade using scrapers of installed mechanical equipment as a guide for surface elevation and to eliminate high and low spots. Unless specifically approved by

equipment manufacturer, do not use mechanical scraper mechanisms powered by their motors as a finishing machine or screed to push grout.

F. Steel trowel finish. Cure concrete grout a minimum of 7 days.

3.5 INSTALLATION – NONSHRINK CEMENTITIOUS GROUTS

A. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel or admixtures without prior approval by Engineer.

B. Mix in a mortar mixer with moving blades. Pre-wet mixer and empty excess water. Add pre-measured amount of water for mixing, followed by the grout. Begin with minimum amount of water recommended by manufacturer and then add minimum additional water required to obtain workability. Do not exceed manufacturer's maximum recommended water content. Do not mix by hand.

C. Provide forms as specified in “Preparation” Article. Place grout into the designated areas and prevent segregation and entrapment of air. Do not vibrate grout to release air or to consolidate the material. Fill all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes and vent holes as necessary.

D. Place grout rapidly and continuously to avoid cold joints. Do not place grout in layers. Do not add additional water to the mix (retemper) after initial stiffening.

E. Just before grout reaches its final set, cut back grout to the substrate at a 45 degree angle from lower edge of bearing plate unless otherwise ordered and approved by Engineer. Finish this surface with a wood float or brush finish.

F. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement, until grout compressive strength reaches 1,000 psi or as recommended by manufacturer, whichever is longer. Saturate grout surface by use of saturated burlap bags, soaker hoses or ponding. Provide sunshades. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

3.6 SCHEDULE

A. Use particular types of grout as follows:

1. Concrete Grout:

    a. Use for overlaying the base concrete as indicated.

2. General Purpose Nonshrink Cementitious Grout (CRD-C621 Grade D): Use at locations where nonshrink grout is indicated, except for base plates greater in area than 3-feet wide by 3-feet long .

3. Flowable (precision) Nonshrink Cementitious Grout (CRD-C621 Grade B or C): Use under base plates greater in area than 3-feet wide by 3-feet long . Use at locations indicated to receive flowable (precision) nonshrink grout. Flowable (precision), nonshrink, cementitious grout may be substituted for general purpose nonshrink cementitious grout.

END OF SECTION 036000

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SECTION 260510 – LIMITED ELECTRICAL FOR SMALL PROJECTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper power and control wire rated 600V or less.
2. Low-voltage instrumentation cable.
3. Industrial Ethernet cable.
4. Connectors, splices, and terminations.
5. Grounding and bonding components.
6. Support systems for raceways, boxes, and electrical equipment.
7. Metal conduits and fittings.
8. Nonmetallic conduit and fittings.
9. Boxes, enclosures, and cabinets.
10. Handholes and boxes for exterior underground cabling.
11. Identification requirements.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit. See also RAC.

B. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.

C. Duct: A single duct or multiple ducts. Duct may be installed singly or as a component of a duct bank.

D. Duct Bank:

1. Two or more ducts installed in parallel, with or without additional casing materials.
2. Multiple duct banks.

E. EMI: Electromagnetic interference.

F. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50V or for remote-control and signaling power-limited circuits.

G. RAC: Rigid aluminum conduit. See also ARC.

H. RoHS: Restriction of Hazardous Substances.

I. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

J. National Electrical Code (NEC) / NFPA conduit types:

1. RMC – rigid metal conduit
2. FMC – flexible metal conduit
3. LFMC – liquidtight flexible metal conduit
4. PVC – rigid polyvinyl chloride conduit
5. LFNC – liquidtight flexible nonmetallic conduit
6. RNC – rigid nonmetallic conduit

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product used on this project.

B. Shop Drawings:

1. Precast Handholes: Include plans, elevations, sections, and details.

C. Installation Working Drawings: For underground conduit routing.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 ELECTRICAL MATERIALS

A. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with associated UL Standards as applicable and listed in this specification.

2.2 WIRE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Alpha Wire Company.
2. Encore Wire Corporations.
3. General Cable Technologies Corporation.
4. Okonite Company (The).
5. Service Wire Co.
6. Southwire Company.

B. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V.

C. Standards:

1. RoHS compliant.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Size: Minimum No. 12 AWG for power circuits, minimum No. 14 AWG for control circuits.

F. Stranding: Refer to Part 3 “Conductor Applications” Article.

G. Conductor Insulation: Refer to Part 3 “Conductor Applications” Article.

1. Type RHW-2: Comply with UL 44.
2. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
3. Type THHN and Type THWN-2: Comply with UL 83.
4. Type XHHW-2: Comply with UL 44.

2.3 INSTRUMENTATION CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Belden.
2. Rockbestos.

B. Single of Multiple Paired Cable: NEC type ITC (Instrumentation Tray Cable), UL Type TC for 4-20mA process instrumentation signals and use under NEC Article 72.

1. One or Multi-pair, twisted, shielded, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. XLPE insulation, 600V.
3. Shield: 100 percent aluminum/polyester foil with drain wire. Pairs individually shielded.
4. PVC jacket with manufacturer’s identification.
5. Standards: UL 1277 Type TC, UL 1581

2.4 INDUSTRIAL ETHERNET CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Rockwell Automation Bulletin 1585.

B. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz *Ethernet/IP* compliant.

C. Standard: UL, UL PLTC, UL AWM 2570 80C 600V, TIA 568B.

D. Conductors: 100-ohm, No. 22 AWG solid copper.

E. Shielding/Screening: Overall foil shield.

F. Cable Rating: 600V.

G. Jacket: PVC.

2.5 CONNECTORS, SPLICES, AND TERMINATIONS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. 3M Electrical Products.
2. Ideal Industries, Inc.
3. TE Connectivity Ltd.
4. Thomas & Betts Corporation; A Member of the ABB Group.

B. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Tin-plated copper.
2. Type:

a. Locking spade with insulated sleeve for No. 10 AWG and smaller.
b. One hole with long barrels for No. 8 AWG to No. 4/0 AWG.
c. Two holes with long barrels for 250 kcmil and larger.

3. Termination: Compression for No. 8 AWG and larger.

D. Connectors:

1. Solderless pressure type (wirenuts) for No. 10 AWG and smaller.
2. Pre-filled with silicone-based sealant for exterior, wet, or corrosive locations.
3. Split bolt type for No. 8 AWG and larger splices.

E. Motor Terminations: Mechanical compression ring type, secured with bolt, nut, and spring washer. Insulated with Raychem type RVC, roll-on stub insulator or equal.

F. Industrial Ethernet Cable Terminations: Match conductor count, RJ45 type, intended for shielded cable. Rockwell Automation Bulletin 1585J or equal.

2.6 GROUNDING AND BONDING MATERIALS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ERICO; a brand of nVent.
2. Hubbell Incorporated (Construction and Energy Group).
3. O-Z/Gedney; a brand of Emerson Industrial Automation.
4. Thomas & Betts Corporation; A Member of the ABB Group.

B. Standard: Comply with UL 467 for grounding and bonding materials and equipment.

C. Grounding Conductors:

1. Insulated conductors to match corresponding 600V phase conductor insulation requirements.
2. Bare copper conductors: tin-plated.

D. Ground rods: Copper-clad steel, sectional type; 3/4-inch diameter by 10-foot; minimum copper thickness 0.25 mm (10 mil).

E. Grounding conduit hubs: Malleable iron type, mechanical type, terminal with threaded hub, sized for the associated conduit.

F. Waterpipe ground clamps: cast bronze saddle type, sized for the associated water pipe.

G. Exothermic weld: CADWELD process, or equal. Molds and powder furnished by same manufacturer and selected for specific combination of conductors and connected items. Use low emission type, CADWELD EXOLON or equal for welds used indoors in occupied buildings or confined spaces.

2.7 SUPPORT SYSTEMS

A. Aluminum Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Channel Material: 6063-T5 aluminum alloy.
3. Fittings and Accessories Material: 5052-H32 aluminum alloy.

B. Stainless Steel Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Stainless steel, Type 316.

C. Hot-dipped Galvanized Steel Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Hot-dipped galvanized steel.

D. Nonmetallic Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Channel Material: Ultraviolet resistant FRP.
3. Fittings and Accessories Material: Stainless steel, Type 316 or compatible non-metallic.

E. Accessories: conduit clamps, straps, hangers, rods, backplates, anchors, nuts, washers, etc. shall match channel material as listed in the SUPPORT MATERIALS APPLICATION Article. Use of galvanized steel components is only allowed with galvanized steel channel.

F. Threaded rod: 3/8-inch minimum diameter.

G. Expansion anchors: 3/8-inch minimum diameter.

2.8 METAL CONDUITS AND FITTINGS

A. Rigid Aluminum Conduit: Comply with ANSI C80.5 and UL 6A.

B. LFMC: Sealtite®, Type UA, continuously interlocked flexible steel conduit with sunlight and chemical resistant PVC jacket and complying with UL 360.

C. FMC: Comply with UL 1; zinc-coated steel.

D. Metallic Fittings: Comply with NEMA FB 1 and UL 514B.

1. Use cast aluminum fittings with RAC.
2. Use malleable iron, three-piece screw in type with LMFC.
3. Use Myers Electric Products, Inc. or equal, grounding type for conduit hubs.
4. Use die cast compression type fittings with EMT, no set-screw type.

2.9 NONMETALLIC CONDUIT AND FITTINGS

A. RNC: Schedule 40 or Schedule 80 PVC based on application; comply with NEMA TC 2 and UL 651.

B. LFNC-B: Comply with UL 1660, Type B.

C. Nonmetallic Fittings:

1. RNC: Comply with NEMA TC 3; match conduit type and material.
2. LFNC: Comply with UL 514B; dust-tight, liquid-tight, chemical resistant thermoplastic/nylon construction with tapered thread hub and neoprene O-ring gasket. Push-on fittings are prohibited.

D. Solvents and Adhesives: As recommended by conduit manufacturer.

2.10 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: Pressed steel. Comply with NEMA OS 1 and UL 514A.

B. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

C. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

D. NEMA 1 and NEMA 12 Pull and Junction Boxes:

1. Material: Sheet steel, minimum 14 gauge, without knockouts.
2. Construction: flanged box, galvanized with continuous weld seams that are ground smooth.
3. Cover: Gasketed, hanged, fastened with quick connect door clamp.

E. NEMA 4X Pull and Junction Boxes:

1. Material: Type 316 stainless steel, minimum 14 gauge, without knockouts.
2. Construction: flanged box, continuous weld seams that are ground smooth.
3. Cover: Gasketed, hanged, fastened with quick connect door clamp.

F. NEMA 4X Chemical Area Pull and Junction Boxes: When Drawings classify the area as CORROSIVE, ultraviolet resistant fiberglass reinforced plastic (FRP) with 316 stainless steel hardware and gasketed covers.

G. NEMA 7/4 Pull and Junction Boxes: When Drawings classify the area for Class 1, Division 1, Group D hazardous area, cast aluminum with stainless steel bolts; Type EJB-N4 as manufactured by Crouse Hinds or equal.

H. Handholes and Boxes for Exterior Underground Cabling: Comply with details as indicated on the Drawings.

2.11 IDENTIFICATION

A. Factory applied insulation color for No. 8 AWG conductors and smaller. Factory applied insulation color or field applied colored electrical tape for No. 6 AWG conductors and larger:

1. Color for 208/120V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
d. Neutral: White.

2. Color for 240/120V Circuits (Single Phase):

a. Phase A: Black.
b. Phase B: Red.
c. Neutral: White.

3. Color for 240Δ/120V Circuits (Three Phase, Four Wire, high leg, center tap):

a. Phase A: Black.
b. Phase B: Orange (high leg).

c. Phase C: Blue.
d. Neutral: White.

4. Color for 480/277V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.
d. Neutral: Gray.

5. Color for Equipment Grounds: Green.
6. Color of Individual Control Conductors:

a. AC: Red.
b. DC: Blue.

B. Nameplates and Labels:

1. Equipment Identification and Source Nameplates:

a. Black letters on a white field.
b. Engraved, laminated plastic, 3/16-inch-high lettering.
c. Provide for all electrical equipment. Match Drawing designation.
d. Include power source information, i.e., “FED FROM MCC-2” or provide separate nameplate.

2. Device Identification Labels:

a. Black letters on a white field.
b. Machine generated, self-adhesive, 1/4-inch-high lettering.
c. Provide for all receptacles, wall switching, lighting fixtures, photocells, exit lights, instruments, etc.
d. Include power source and branch circuit information, i.e., “LP-2/15” indicates panelboard LP-2, branch circuit 15.

3. Wire and Cable Labels:

a. Black letters on a white field.
b. Wraparound or sleeve type.

C. Detectable Underground-Line Warning Tape:

1. Foil-backed, detectable buried utility tape with black lettering on a bright background.
2. Width: 6 inches.
3. Overall Thickness: 5 mils.
4. Background Color / Description:

a. Red / Electric: electrical power, control, or instrumentation.
b. Orange / Fiber: fiber optic cables.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the applicable National Electrical Contractors Association (NECA) documents for installation requirements except where requirement on Drawings or in this specification are stricter.

1. NECA 1: Standard for Good Workmanship in Electrical Construction.
2. NECA 101: Standard for Installing Steel Conduits.
3. NECA 102: Standard for Installing Aluminum Rigid Metal Conduit.
4. NECA 111: Standard for Installing Nonmetallic Raceways.
5. NECA 331: Standard for Installing Building and Service Entrance Grounding and Bonding.
6. NECA / NEMA 605: Recommended Practice for Installing Underground Nonmetallic Utility Duct.

3.2 CONDUCTOR APPLICATIONS

A. Wires and Cables: Copper, stranded, except for lighting and receptacle wiring which may be solid.

B. Wire for lighting, receptacles, and other circuits not exceeding 150 volts to ground shall be NEC type XHHW-2. Below grade and underground the wire shall be type XHHW-2.

C. Wire for power circuits over 150 volts to ground shall be NEC type XHHW-2 for sizes No. 4/0 AWG and smaller and shall be NEC type RHW-2 for sizes 250 kcmil and larger.

D. Equipment grounding conductors shall be the same NEC type as the phase conductors described previously, green and sized per NEC Table 250.122.

E. Bare copper ground wire shall be stranded, tinned soft drawn annealed copper wire.

F. Ground grid conductors shall be uninsulated unless shown otherwise on the Drawings.

G. Wire for control, status, and alarm shall be NEC type XHHW-2.

H. Multi-conductor control cable shall be NEC type TC (tray cable), stranded, No. 14 AWG, XHHW-2 600V insulated color coded conductors, bare stranded ground wire, with overall PVC cable jacket.

3.3 CONDUCTOR INSTALLATION

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway. Use of steel fish tapes and/or steel pulling cables in PVC conduit or raceways that terminate into energized enclosures is prohibited.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Adequately support cables.

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

H. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors. Do not splice service or feeder cables without prior written approval of Engineer. Instrumentation and Ethernet cables may not be spliced and shall be continuous from terminal to terminal.

I. Wiring at Outlets:

1. Install conductor at each outlet, with at least 6 inches of slack.
2. Form solid wire into loop to fit around device terminal screw. Do not overlap wire.

J. Identify and color-code conductors and cables.

K. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

L. Identify circuit number associated with lights, receptacles, and other miscellaneous loads to panelboards. Identify phase and neutral conductors with circuit number.

M. Install instrumentation and Ethernet cabling in separate raceway from control or power wiring.

N. Separation from EMI Sources:

1. Separation between open instrumentation cables or cables in non-metallic or non-ferrous raceways and unshielded power conductors and electrical equipment shall be as follows:

a. Equipment or circuits rated less than 2 kVA: Minimum 5 inches.
b. Equipment or circuits rated between 2 and 5 kVA: Minimum 12 inches.
c. Equipment or circuits rated more than 5 kVA: Minimum 24 inches.

3.4 GROUNDING

A. Comply with NEC Article 250.

B. Install insulated green equipment grounding conductor in all power and control raceways.

C. For instrumentation wiring, ground shield at one end only as recommended by instrument manufacturer and in accordance with Owner's standard.

D. Install grounding conductors in conduit or sleeves when passing through floor slabs.

E. Use exothermic welding process for all underground connections, connections to structural steel, connections to ground rods, or other connections which will become inaccessible at project completion.

3.5 SUPPORT MATERIALS APPLICATON

A. Dry, indoor, conditioned, non-process space: Hot-dipped galvanized steel.

B. Outdoor, process areas, or areas shown on the drawings as "DUST", "DAMP", or "WET": Aluminum and/or stainless-steel channel, depending upon load requirements.

C. Areas shown on the drawings as "CORROSIVE": Nonmetallic.

3.6 RACEWAY APPLICATIONS

A. Refer to Appendix Table 260510-1 for specific raceway application requirements.

B. Minimum Raceway Size: 3/4-inch trade size.

3.7 BOX APPLICATIONS

A. All boxes shall be metallic unless specified herein or indicated on the Drawings.

B. Use cast malleable iron for boxes and condulet fittings for exposed switch, receptacle, and lighting outlets.

C. Use pressed steel boxes for concealed switch, receptacles, and lighting outlets.

D. Pull boxes, junction boxes, cabinets, etc. shall be suitable for the location and conform to the NEMA enclosure rating and material descriptions as indicated on the Drawings.

E. Where no size is indicated for junction boxes, pull boxes, or terminal cabinets, size in accordance with NEC Article 314.

3.8 RACEWAY INSTALLATIONS

A. Complete raceway installation before starting conductor installation.

B. Tightly plug ends of conduits during construction to exclude dust and moisture.

C. Arrange stub-ups so curved portions of bends are not visible above finished slab.

D. Arrange conduit system to allow liquids such as water, condensation, etc. will drain away from equipment served. If conduit drainage is not possible, plug conduits using conduit seals.

E. Install no more than the equivalent of three 90-degree bends in any conduit run. Support within 12 inches of changes in direction.

F. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

G. Support conduit within 12 inches of enclosures to which attached.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

J. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits. Install Meyers grounding type hubs when conduits terminate at gasketed enclosures.

K. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

M. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

O. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

P. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways using “Duxseal” or seal fitting at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.

4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

Q. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

R. Install expansion joint fittings where necessary to compensate for thermal expansion and contraction.

S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission or movement; and for transformers and motors.

T. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

U. A maximum continuous run of conduit shall not exceed 300 feet and shall be reduced by 75 feet for each 90-degree elbow.

V. Provide a 4-inch concrete housekeeping pad at all slab and grade penetrations. Provide a 45 degree, 3/4-inch chamfer at all exposed edges.

W. Protect metallic finish conduit installed in contact with concrete or below grade with two coats of bitumastic paint, heat shrink tubing, or approved equivalent. Extend protection on riser conduits from 12 inches below slab to 6 inches above slab.

X. In hazardous locations, seal conduits terminating at boxes enclosing circuit opening equipment at the entrance to the enclosure with approved compound filled sealing fittings to prevent passage of explosive or combustible gases through the conduits. Similarly seal all conduits leading from or entering hazardous locations at points of exit or entrance. Seal exposed conduits passing through hazardous locations at both the entrance to and the exit from the hazardous locations.

Y. Install conduit sealing and drain fittings in all hazardous (classified) areas designated Class 1, Division 1, and Class 1, Division 2.

3.9 UNDERGROUND SYSTEM INSTALLATION

A. Coordinate final arrangement with other underground utilities, site grading, and surface features.

B. Comply with specifications for earthwork, excavation, trenching, backfill, and compaction.

C. Raceway Drainage:

1. Drain away from buildings.
2. Drain towards manholes or handholes.
3. Slope raceway not less than 3-inches per 100-feet.

D. Restoration: Restore surface features and re-establish grade, paving, and vegetation to original unless otherwise indicated.

E. Separate underground copper signal conduits (instrumentation and telecommunication) from power conduits by a minimum of 12 inches unless noted otherwise. Keep crossing of these conduits to a minimum; cross at 90-degree angles.

F. Transition to Metal Conduit:

1. Use fittings manufactured for RNC to metal conduit transition.
2. Make transition from underground duct to metal conduit at least 10 feet outside the building wall, without reducing duct line slope away from building and without forming a trap in the line.

G. Minimum Cover and Additional Detail: As indicated per details on Drawings.

H. Where Drawings call for concrete encased duct bank, color concrete red.

3.10 ELECTRICAL PENETRATIONS

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc.

B. Locate all slots and concealed conduits and stub-ups for electrical work and place and form as required before concrete is poured.

C. Make weathertight and restore finishes on exterior penetrations.

D. Use conduit wall seals where underground conduits penetrate walls or at other locations indicated on the Drawings.

E. Seal openings where conduits pass through walls or floors to prevent passage of flame and smoke. Maintain fire rating of walls.

F. Patch and paint interior wall penetrations to match original.

3.11 IDENTIFICATION INSTALLATION

A. Self-Adhesive Identification Products: Before applying identification product, prepare and clean attachment surface with manufacturer recommended product to allow for effective bond.

B. Verify and coordinate identification names and other features.

C. Nameplate Attachment:

1. Screw mounted for NEMA 1 enclosures.
2. Epoxy or similar waterproof adhesive for all other enclosure types.

D. Install identification and power source nameplates for electrical equipment. Refer to Part 2 “Identification” Article for requirements.

E. Install circuit identification labels for cables and conductors at each termination location and within pull boxes and handholes. Refer to PART 2 “Identification” Article for color code and additional requirements.

F. Install device identification labels for receptacles, light switches, etc. Refer to Part 2 “Identification” Article for requirements.

G. Install underground warning tape during backfilling of trenches for underground conduits and duct banks in accordance with details on the Drawings.

H. Panelboard Identification

1. Provide equipment and power source nameplates as previously described.
2. Label branch circuit phase and neutral wires with associated pole number.
3. Install typed as built circuit directory giving location and nature of load served.

3.12 FIELD QUALITY CONTROL

A. Perform the following tests and inspections for conductors and cables.

1. Visually inspect for correct installation.
2. Perform continuity test.
3. Perform insulation-resistance test for power and control conductors in accordance with NETA standards.
4. Verify uniform resistance of parallel conductors.

B. Cable will be considered defective if it does not pass tests and inspections.

C. Conduct fall-of-potential grounding electrode system test in accordance with IEEE 81.

D. Prepare test and inspection reports.

3.13 CLEANING / PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration. Repair damage as recommended by manufacturer.

B. Remove all rubbish and construction debris from inside electrical equipment and enclosures.

3.14 APPENDICES

A. Table 260510-1: Raceway Application Guidelines

Table 260510-1 Raceway Application Guidelines	
Raceway Type	Location / Application
Aluminum Rigid Conduit (ARC)	All indoor and outdoor applications, except where other types are listed. All exposed, non-corrosive areas. All concealed, non-corrosive areas. Under slabs in slab on grade construction. Stub-ups through slabs. Use LFMC for flexible connections. When installed underground or in contact with concrete, paint with two coats of bitumastic paint.
PVC Schedule 40	Concrete encased duct banks. Embedded in concrete slabs or structures. Use ARC elbows.
PVC Schedule 80	Direct buried. Corrosive areas. Protection of grounding electrode conductors. Protection of lightning conductors. Where exposed, use LFNC for flexible connections. Use ARC elbows for underground applications.

END OF SECTION 260510

SECTION 400506 - COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe penetrations
2. Pipe sleeves
3. Wall castings
4. Sealing materials
5. Miscellaneous materials
6. Restrained joints.
7. Flexible connections
8. Service clamps
9. Sleeve-type couplings.
10. Flange adapter.
11. Dismantling joint.
12. Finishes

B. Related Requirements:

1. Section 078400 “Firestopping”: Penetrations through fire-rated materials
2. Section 079000 “Joint Protection”: Sleeve sealant for pipe penetrations
3. Section 330519 “Pressure Piping Tied Joint Restraint System”: Pipe restraints.
4. Section 400507 “Hangers and Supports for Process Piping: Hangers, anchors, sleeves, and sealing of piping to adjacent structures.
5. Section 400519 “Ductile Iron Process Pipe”: Ductile-iron piping materials and appurtenances
6. Section 400531 “Thermoplastic Process Pipe”: Plastic piping materials and appurtenances
7. Section 400551 “Common Requirements for Process Valves”: Common product requirements for valves for placement by this Section
8. Section 404213 “Process Piping Insulation”: Piping insulation as required by this Section.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): The sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire-rated construction.

B. FM: Factory Mutual Insurance Company; FM Global is the communicative name of the company.

C. WH: Warnock Hersey; indicates compliance to relevant building codes, association criteria, and product safety and performance standards.

1.4 COORDINATION

A. Coordinate Work of this Section with installation of piping, valves and equipment connections specified in other Sections and indicated on Drawings.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Submit manufacturer catalog information for each specified product, including installation instructions.
2. Firestopping: Submit data on product characteristics, performance, and limitation criteria.
3. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
4. Expansion Joints: Indicate maximum temperature, pressure rating, and expansion compensation.

B. Shop Drawings:

1. Identification:

   a. Submit list of wording, symbols, letter size, and color coding for pipe identification.
   b. Comply with ASME A13.1.

2. Indicate restrained joint details and materials.
3. Submit layout drawings showing piece numbers and location, indicating restrained joint locations.
4. Indicate layout of piping systems, including flexible connectors, expansion joints and compensators, loops, offsets, and swing joints.

C. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings for maintenance of fire-resistance rating of adjacent assembly.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.

C. Manufacturer Instructions: Submit special procedures and setting dimensions.

D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.
3. Welders: Qualify procedures and personnel according to AWS D1.1/D1.1M.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping appurtenances.

B. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.

B. Perform Work according to ASME B31.9 for installation of piping systems and according to AWS D1.1/D1.1M for welding materials and procedures.

C. Perform Work according to applicable code for installation of piping systems.

D. Through-Penetration Firestopping of Fire-Rated Assemblies:

1. Comply with ASTM E814.
2. Minimum Positive Pressure Differential: 0.1-inch wg to achieve fire F-ratings and temperature T-ratings as indicated on Drawings, but not less than one hour.
3. Wall Penetrations: Fire F-ratings as indicated on Drawings, but not less than one hour.
4. Floor and Roof Penetrations:

    a. Fire F-ratings and Temperature T-ratings: As indicated on Drawings, but not less than one hour.
    b. Floor Penetrations within Wall Cavities: T-rating is not required.

E. Through-Penetration Firestopping of Non-fire-rated Floor and Roof Assemblies:

1. Materials to resist free passage of flame and products of combustion.
2. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
3. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

F. Fire-Resistive Joints in Fire-Rated Floor, Roof, and Wall Assemblies:

1. Comply with ASTM E1966 orUL 2079.

2. Rating: As indicated on Drawings for assembly in which joint is installed.

G. Fire-Resistive Joints between Floor Slabs and Exterior Walls:

1. Comply with ASTM E119.
2. Minimum Positive Pressure Differential: 0.1-inch wg to achieve fire-resistance rating as indicated on Drawings for floor assembly.

H. Surface-Burning Characteristics: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.

I. Maintain One copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.

C. Welders: AWS qualified within previous 12 months for employed weld types.

D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed at Project location in State of Georgia.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

A. Furnish five-year manufacturer's warranty..

PART 2 - PRODUCTS

2.1 PIPE PENETRATIONS

A. Performance and Design Criteria:

1. Firestopping Materials: As specified in Section 078400 “Firestopping”.
2. Firestop interruptions to fire-rated assemblies, materials, and components.
3. Firestopping: Provide certificate of compliance from authority having jurisdiction, indicating approval of materials used.

2.2 PIPE SLEEVES

A. All construction except new concrete walls:

1. Material: Schedule 40 galvanized steel conforming to ASTM A53.
2. 2-inch minimum circumference water stop welded to exterior sleeve at midpoint
3. Ends cut and ground to be:

a. Flush with ground
b. Flush with ceiling
c. 2 inches above finished floors
d. Sealed with caulking.
e. Sized as required.

B. New concrete walls with pipes up to 20 inches in diameter:

1. Material: non-metallic High-Density Polyethylene Sleeves (HDPE)
2. Integral hollow molded water stops.

a. 4 inches larger than the outside diameter of the sleeve.

3. End caps for forming and reinforcing ribs.
4. Domestically manufactured by:

a. Century-Line as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or equal.

C. New concrete with pipes 20 to 60 inches in diameter:

1. Material: molded HDPE modular interlocking discs to make the width of the wall

a. Corrugated
b. Cell-Cast as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or equal.

D. External wall penetrations:

1. 36 -inches diameter and less may be made by means of a ductile iron sleeve capable of being bolted directly to the formwork:
2. Seal of the annular space between the carrier pipe and the sleeve made by means of a confined rubber gasket and be capable of withstanding 350 psi.:
3. Sleeve to have an integrally cast waterstop of 1/2-in minimum thickness, 2-1/2-inch minimum height.
4. Manufacturers: Omni-Sleeve, Malden, MA or equal.

2.3 WALL CASTINGS

A. Ductile iron conforming to ANSI/AWWA A21.51/C151, thickness Class 53.

B. Diameter as required.

C. Flanges and/or mechanical joint bells drilled and tapped for studs where flush with the wall.

D. Castings provided with a 2-in minimum circumferential flange/waterstop integrally cast with or welded to the casting.

E. Located as follows:

1. For castings set flush with walls: located at the center of the overall length of the casting,
2. For castings which extend through wall: located within the middle third of the wall.

2.4 SEALING MATERIALS

A. Mechanical seals:

1. Of rubber links shaped to continuously fill the annular space between the pipe and the wall opening or sleeve.
2. Link pressure plates molded of glass reinforced nylon:

    a. colored throughout elastomer,
    b. permanent identification of the size and manufacturer's name molded into the pressure plate and sealing element.

3. Hardware:

    a. Mild steel with a 60,000 psi minimum tensile strength
    b. 2-part Zinc Dichromate coating per ASTM B-633
    c. Organic Coating, tested in accordance with ASTM B-117 to pass a 1,500-hour salt spray test.
    d. Use Type 316 Stainless Steel hardware:

        1) in chemical areas
        2) for submerged service
        3) for penetrations in tanks containing sludge or wastewater.

4. Completed sealing system:

    a. Duty pressure rated for 20 psig differential pressure.
    b. EPDM for all services except fire rated assemblies

        1) fire rated seals use silicone link material.

    c. Manufacturers:

        1) PSI-Thunderline/ Link-Seal as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or pre-approved equal.
        2) Advance Products & Systems, Inc.
        3) Fernco Inc.
        4) Flexicraft Industries.
        5) GPT; an EnPro Industries company.

B. Sealant:

1. A two-part foamed silicone elastomer manufactured by:

    a. Dow Corning Co., Product No. 3-6548 silicone R.T.V.
    b. 3M brand fire barrier products caulk C.P. 25 and 3M brand moldable putty MP+;
    c. Flame-Safe fire stop systems FS-900 by Rectorseal.

2. Sealant bead configuration, depth and width in accordance with manufacturer's recommendations.

2.5 MISCELLANEOUS MATERIALS

A. Bonding compound:

1. Sikadur Hi-Mod epoxy by Sika Corp.
2. Euco 452 by Euclid Chemical Corp.; Master Builders Company
3. or equal.

B. Non-shrink grout:

1. Masterflow 713 by Master Builders Co.
2. Euco NS by Euclid Chemical Co.
3. Five Star Grout by U.S. Grout Corp.
4. or equal.

2.6 RESTRAINED JOINTS

2.7 FLEXIBLE CONNECTIONS

A. Manufacturers:

1. For pressure pipe applications and applications with steel and copper piping:

2. Flexicraft Industries, Chicago, IL.
3. Hyspan Precision Products, Inc.
4. Metraflex Company, Chicago, IL; Victaulic Company, Easton, PA or equal.
5. Flex-Weld, Inc.
6. For non-pressurized applications involving plastic, clay, asbestos cement, or cast iron applications: Fernco or equal.

2.8 SERVICE CLAMPS

A. Manufacturers:

1. GE Oil & Gas (Dresser Industries)
2. Xylem (Smith-Blair)
3. Mueller. or equal.

B. Service clamps on ductile iron piping systems with outlets up to 2-inches as shown on the Drawings to have malleable or ductile iron bodies that extend at least 160 degrees around the circumference of the pipe and have EPDM gasket cemented to the saddle body. Bodies to be tapped for IPS. Clamps to have double straps.

2.9 SLEEVE-TYPE COUPLINGS

A. Manufacturers:

1. GE Oil & Gas (Dresser).
2. Xylem (Smith-Blair).

B. Description: Provide products by one of the following or equal.

1. Description: To connect two plain end pipes.
2. Comply with AWWA C213, C219.
3. Working Pressure Rating: 200 psi.
4. Middle Ring: ASTM A-536, Grade 65-45-12, ductile iron.
5. Followers: ASTM A-536, Grade 65-45-12, ductile iron.
6. Gaskets:

    a. Material: Butyl rated for a maximum temperature of 250 deg F and compatible with service conditions.
    b. Comply with ASTM D2000.

7. Bolts: ASTM A307 galvanized steel.

C. Finishes:

1. Factory fusion bonded epoxy coated.

2.10 FLANGE ADAPTER:

A. Manufacturers:

1. GE Oil & Gas (Dresser), Style 128-W.
2. Xylem (Smith-Blair), Type 913.
3. Romac Industries.

B. Description:

1. To connect a plain end pipe to a pipe flange.
2. Max. Pressure Rating: 150 psi.
3. Complies with AWWA.
4. Body & Flange: Ductile iron.
5. Follower: Ductile iron coupling with AISI C1012 or ASME SA36.
6. Wedge Gasket: Buna N.
7. Bolts & Nuts: High strength, low alloy steel.
8. Finish: Factory bonded epoxy coated.

2.11 DISMANTLING JOINT:

A. Manufacturers:

1. GE Oil & Gas (Dresser), Style 131.
2. Xylem (Smith-Blair), Type. 975
3. Romac Industries, Model DJ400.

B. Description:

1. Double ended flanged adapter that allows for longitudinal adjustment between flanges and quick removal.
2. Max. Pressure Rating: 150 psi.
3. Complies with AWWA.
4. Body & Flange: Ductile iron A536 or A36 steel.
5. Follower: Ductile iron A536 or A36 steel coupling with AISI C1012.
6. Wedge Gasket: Buna N or S.
7. Bolts & Nuts: High strength, low alloy steel.
8. Tie-Rods: Required.
9. Finish: Factory bonded epoxy coated.”

2.12 FINISHES

A. Prepare piping appurtenances for field finishes as specified in Manufacturer’s standard.

2.13 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assemblies.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flanges mate properly.

C. Verify that openings are ready to receive sleeves and firestopping.

D. Verify that pipe plain ends to receive sleeve-type couplings are smooth and round for 12 inches from pipe ends.

E. Verify that pipe outside diameter conforms to sleeve manufacturer's requirements.

3.2 PREPARATION

A. Cleaning: Thoroughly clean end connections before installation.

B. Close pipe and equipment openings with caps or plugs during installation.

C. Surface Preparation: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

A. According to ASME B31.3.

B. Coating: Finish piping appurtenances as specified in Manufacturer’s standard for service conditions.

C. Pipe Penetrations:

1. Flashing:

a. Provide flexible flashing and metal counterflashing where piping penetrates weatherproofed or waterproofed walls, floors, and roofs.
b. Flash floor drains with topping over finished areas with lead, 10 inches clear on sides, with minimum 36-by-36-inchsheet size.
c. Fasten flashing to drain clamp device.

2. Sleeves:

   a. Exterior Watertight Entries: Seal with mechanical sleeve seals.
   b. Set sleeves in position in forms and provide reinforcement around sleeves.
   c. Size sleeves large enough to allow for movement due to expansion and contraction and provide for continuous insulation wrapping.
   d. Extend sleeves through floors 1 inch above finished floor level and calk sleeves.
   e. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent Work with stuffing insulation and calk airtight.
   f. Provide close-fitting metal collar or escutcheon covers at both sides of penetration.

D. Flexible Connections: Install flexible couplings at connections to equipment and where indicated on Shop Drawings.

E. Expansion Joints:

1. Install flexible couplings and expansion joints at connections to equipment and where indicated on Shop Drawings.
2. If expansion joint is supplied with internal sleeve, indicate flow direction on outside of joint.

F. Air Release and Vacuum Breakers: Provide vacuum breakers on all tanks and process equipment.

G. Backflow Preventers:

1. Install with nameplate and test cock accessible.
2. Install according to local code requirements.
3. Do not install in vertical position.

H. Insulation: As indicated on Drawings.

3.4 FIELD QUALITY CONTROL

A. After installation, inspect for proper supports and interferences.

B. Repair damaged coatings with material equal to original coating.

3.5 CLEANING

A. Keep equipment interior clean as installation progresses.

END OF SECTION 400506

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SECTION 400507 - HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Hangers and supports for piping.
2. Delegated design.

B. Related Requirements:

1. Section 033010 “Miscellaneous Cast-in-Place Concrete” for placement of concrete housekeeping pads required by this Section.
2. Section 400506 “Couplings, Adapters, and Specials for Process Piping”.
3. Section 400519 “Ductile Iron Process Pipe”.

1.3 DEFINITIONS

A. Ferrous Metal: Iron, steel, stainless steel, and alloys with iron as principal component.

B. Wetted or submerged: Submerged, less than 1-foot above liquid surface, below top of channel or tank wall, under cover or slab of channel or tank, or in other damp locations.

C. “Pipe” or “Piping”: Piping, piping system(s), hose, tube, fittings, joints, valves, and similar appurtenances.

D. Supports: Wherever the word “supports” or “pipe supports” are used, pipe supports, hangers, structural connections, concrete inserts (if allowed), anchors, guides, bolts, expansion units, restraints and all restraint, hanging, supporting, allowing controlled expansion, or other means of attaching piping along with the necessary appurtenances.

1.4 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.5 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's catalog data including load capacity.

1.6 DELEGATED DESIGN SUBMITTALS

A. Delegated-Design Submittal: For hangers and supports for piping and housekeeping pads for pipe supports; Section 014000 “Quality Requirements” for additional delegated design requirements.

1. Where the Drawings show support types and/or locations, analyze them for adequacy to support loads and stresses, modify if required, install generally where shown, and integrate with the pipe support system design.
2. Engage the services of an independent registered professional engineer licensed in the State of Georgia ordinarily engaged in the business of pipe support systems analysis and design, to analyze system piping and service conditions, and to develop a detailed support system design, specific to the piping material, pipe joints, valves, and piping appurtenances proposed for use.

    a. Support system engineering groups include the following:

        1) SAC Incorporated https://www.sacincorporated.com/contact-us/
        2) Fenny Engineering http://www.fennyengineering.com/contact/
        3) Piping Solutions and Energy Associates https://www.pseassoc.com/request-for-service/
        4) Newman Associates https://newmanassoc.com/

3. The support system design shall include:

    a. Criteria by piping system.
    b. Summary of Contractor-selected related components including joints, class, valves, appurtenances, etc., and commercial supports and especially including pipe materials.
    c. Dead weight and dynamic analysis, including system thermal effects and pressure thrusts. Computer-based software system equivalent to Bentley Systems AutoPIPE or SST Systems CAEPIPE.

        1) Present each system in an isometric graphic and show the resolved and resultant force and moment systems, as well as all recommended hangers, supports, anchors, restraints, and expansion/flexible joints.

    d. Submit support system design to the Engineer for review. The submittal needs to be stamped by a professional engineer registered in Georgia.
    e. All aspects of the analysis and design to comply with the provisions of ANSI B31.3 and the referenced standards.

4. Coordinate support arrangements to eliminate interference with similar systems to be installed under HVAC, Plumbing, and Electrical, to account for structural expansion joints and to maintain access for both personnel and for the removal of equipment.

B. Manufacturers' Instructions: Submit special procedures and assembly of components.

C. Qualifications Statement: Submit qualifications for licensed professional.

1.7 INFORMATIONAL SUBMITTALS

A. Manufacturer’s Certificate: Certify that products meet or exceed specified requirements.

B. Qualifications Statements:

1. Submit qualifications for manufacturer, fabricator, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

1.8 DELIVERY, STORAGE AND HANDLING

A. All supports and hangers shall be crated, delivered and uncrated so as to protect against any damage.

B. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.

C. Finished metal surfaces not galvanized, that are not of stainless-steel construction, or that are not coated, shall be grease coated, to prevent rust and corrosion.

1.9 QUALITY ASSURANCE

A. Perform Work according to City of Valdosta standards.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum ten years' experience.

B. Fabricator: Company specializing in fabricating products specified in this Section with minimum ten years' experience.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on-Site in original factory packaging, labeled with manufacturer's identification.

B. Protect products from weather and construction traffic, dirt, water, chemical, and damage by storing in original packaging.

1.12 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.13 WARRANTY

A. Furnish five-year manufacturer's warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.1 GENERAL

A. Support pipe and appurtenances connected to equipment to prevent any strain being imposed on the equipment. Comply with manufacturer’s requirements regarding piping loads being or not being transmitted to their equipment. Submit certification stating that such requirements have been met.

B. Support and secure all pipe and tubing in the intended position and alignment to prevent significant stresses in the pipe or tubing material, valves, fittings, and other pipe appurtenances. Design all supports to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact. Contractor may propose minor adjustments to the piping arrangements in order to simplify the supports, or in order to resolve minor conflicts in the work. Such an adjustment might involve minor change to a pipe centerline elevation so that a single trapeze support may be used.

C. Where flexible sleeve, split ring, vibration, or other couplings are required at equipment, tanks, etc., the end opposite to the piece of equipment, tank, etc., shall be rigidly supported to prevent transfer of force systems to the equipment. Do not install fixed or restraining supports between a flexible coupling and the piece of equipment.

D. Pipe Supports:

1. Shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.
2. Provide supports at changes in direction and elsewhere as shown in the Drawings or as specified herein.
3. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless specifically directed or authorized by the Engineer.
4. Provide pipe supports to minimize lateral forces through valves, both sides of flexible split ring type couplings and sleeve type couplings, and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.
5. Effects of thermal expansion and contraction of the pipe to be accounted for in the pipe support selection and installation.

E. Insofar as is possible, floor supports shall be given preference. Where specifically indicated, concrete supports, as shown on the Drawings, may be used. Base elbow and base tees shall be supported on concrete pedestals.

F. Restraints, flexible connections, expansion items, and related items as included in other specifications (especially Section 400506 SFL “Couplings, Adapters, and Specials for Process Piping” and other individual pipe sections) and shown on the Drawings.

2.2 PERFORMANCE REQUIREMENTS/DESIGN CRITERIA

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hangers and supports for piping.

B. All supports and appurtenances shall be standard products from approved manufacturers wherever possible and shall be adequate to maintain the supported load in proper position under all operating conditions. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary. Note that different materials required, as specified in Part 2 MATERIALS, may require different figures or model numbers than those shown.

1. The minimum working factor of safety for all items, with the exception of springs, shall be five times the ultimate tensile strength of the material, assuming 10 feet of water-filled pipe being supported and normal test pressures.
2. Design for all loads using a safety factor of 5.

C. Piping schedule is included in the contract drawings.

D. All items shall be designed with strength and stiffness to support, restrain, and allow expansion of the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement and pressure forces, thermal expansion and contraction, vibrations, and all probable externally applied forces.

E. Support spacing shall be per ASME B31.3.

F. Complete design details of the pipe system components shall be submitted for review and approval as specified in Part 1. No support shall be installed without approved support system Drawings.

G. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure is designed.

2.3 MATERIALS

A. Metallic Pipe Support:

1. Submerged, buried, or within outdoor structures (vaults, etc.): Type 316 stainless steel (SS).
2. Within chemical areas: Vinyl ester fiberglass reinforced plastic (FRP) for pipe size up to 2 inch, epoxy coated steel for 2-1/2 inches size and larger.

3. Other locations: steel with galvanizing where noted, or if not otherwise noted, coating as required in Division 09 Finished Painting.
4. Additional requirements (including dielectric insulation) in ACCESSORIES Article.

B. Non-Metallic Pipe Support:

1. Submerged, buried, or within vaults: Type 316 stainless steel or FRP.
2. Within chemical areas: vinyl ester FRP.
3. Other locations: steel with galvanizing where noted, or if not otherwise noted, coating as required in Division 09 Finished Painting; all with local stress protection shields.
4. Additional requirements (including stress protection shields) in ACCESSORIES Article.

C. Wherever stainless steel is noted, it shall be Type 316 unless noted otherwise.

2.4 SUPPORT AND RESTRAINT SYSTEMS

A. Steel or Ductile Iron Piping:

1. Cast iron and ductile iron, steel, and stainless-steel piping shall be supported at a maximum support spacing of 10 feet with a minimum of one support per pipe section at the joints.
2. Support spacing for ductile iron, steel, and stainless-steel piping 2-inch and smaller diameter shall not exceed 5 feet.

B. Non-Metallic Piping:

1. All uninsulated non-metallic piping such as PVC, CPVC, HDPE, PVDF, etc., shall be protected from local stress concentrations at each support point. Protection shall be provided by non-metallic protection shields or other method as approved by the Engineer.

    a. Where pipes are bottom supported 180 degrees, arc shields shall be furnished. Where 360-degree arc support is required, such as U-bolts, protection shields shall be provided for the entire pipe circumference. All U-bolts or clamps for non-metallic pipes shall be plastic coated.
    b. Protection shields shall have an 18-gauge minimum thickness, not be less than 12 inches in length and be securely fastened to pipe with Type 316 stainless steel straps not less than 1/2 inch wide.

2. Individually supported PVC pipes shall be supported as recommended by the pipe manufacturer except that support-spacing shall be manufacturers recommendation minus 2-feet. down to 5 feet spacing recommendation, then spacing shall be 3 feet.
3. Supports for horizontal multiple PVC plastic piping:

    a. Shall be continuous wherever possible.
    b. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays such as: Husky Ladder Flange Out by MPHusky; or equal.
    c. Rung spacing shall be 12 inches. Tray width shall be approximately 6 inches for single runs and 12 inches for double runs.

d. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc., required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners similar to: Globe, Series 600; Unistrut Pipe/Conduit Clamps and Hangers; or equal.

e. Spacing between clamps shall not exceed 9 feet. The cable trays shall provide continuous support along the length of the pipe. Individual clamps, hangers, and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

C. Framing Support System:

1. See Part 2 MATERIALS for materials of construction.
2. Beams: Size such that beam stress does not exceed 25,000 psi and maximum deflection does not exceed 1/240 of span.
3. Column Members: Size in accordance with manufacturer's recommended method.
4. Support Loads: Calculate using weight of pipes filled with water.
5. Maximum Spans:

a. Steel and ductile iron pipe 3 inch diameter and larger: 10 feet centers, unless otherwise shown.
b. Other pipelines and special situations: Same as noted in previous paragraphs. Supplementary hangers and supports may be required.

D. All vertical pipes shall be supported at each floor or at intervals of not more than 12 feet by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to ensure rigid construction. All vertical pipes passing through pipe sleeves shall be secured using a pipe collar.

2.5 ANCHOR BOLTS/SYSTEMS

A. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear, and pullout loads imposed by loading and spacing on each particular support. DO NOTE USE ADHESIVE ANCHOR BOLTS ON ANY PIPE SUPPORT HUNG FROM A ROOF OR CEILING, unless specifically noted otherwise.

B. All post-installed anchors in concrete shall have current published ICC-ES Evaluation Report indicating the anchor is approved for installation in cracked concrete.

C. The latest edition of the following specification and recommended practices shall become part of this specification as if written herein. Wherever requirements conflict, the more stringent shall govern.

1. ACI 318, Appendix D.
2. ACI 355.2, Mechanical Anchors “Qualification of Post-Installed Mechanical Anchors in Concrete”
3. Anchor manufacturer’s published installation requirements.

D. Expansion Anchors:

1. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1 inch behind the steel reinforcement.
2. Manufacturers:

a. Power-Stud+ SD4 and Power-Stud+ SD6 by Powers Fasteners, Brewster, NY.
b. Kwik Bolt as manufactured by Hilti USA, Tulsa, Oklahoma.
c. Wej-it by Wej-it Expansion Products, Inc., Broomfield, Colorado.

E. Unless otherwise noted: use Type 304 stainless steel anchoring parts/bolts and hardware for non-submerged supports, Type 316 stainless steel for submerged anchors.

F. Size of anchor bolts as designed by manufacturer, 1/2 inch minimum diameter, or as shown on the Drawings.

G. Anchors to concrete in chemical areas shall be epoxy secured vinyl ester FRP all thread, insertion depth and size as required by the manufacturer for the design loads. Nuts, bolts and hardware shall all be vinyl ester FRP construction.

2.6 HANGER RODS

A. Where use of steel is allowed, hanger rods shall be hot-rolled steel, machine-threaded, and, except for stainless steel, galvanized after fabrication. The strength of the rod shall be based on its root diameter.

1. Hanger rods shall be attached to concrete structures using single or continuous concrete inserts by the named support manufacturers above. Where use of steel is allowed, inserts shall be malleable iron or steel with galvanized finish.
2. Beam-clamps, C-clamps, or welded-beam attachments shall be used for attaching hanger rods to structural steel members.

B. Minimum rod size for metallic rod hangers: (* For pipe diameters less than 14 inch, if using pipe roller, use 2 hanger rods with minimum diameter noted below for pipe's diameter).

	Nominal Pipe / Tube Diameter	Minimum Hanger Rod Diameter
1	Less than 2-1/2 inch	1/4 inch*
2	3 to 8 inches	1/2 inch
3	10 to 14 inches	3/4 inch*
4	16 to 20 inches	2 at 1 inch
5	24 inches	2 at 1-1/4 inch
6	30 inches	2 at 1-1/2 inch

2.7 SINGLE PIPE HANGERS

A. Unless otherwise indicated, pipe hangers and supports shall be standard catalogued components, conforming to the requirements of MSS-41, 58, or 69 and shall be of the following type:

1. Anvil International.
2. Equal models by: Carpenter & Patterson, Inc., Wobum, MA.
3. Cooper B-Line.
4. Gulf State Manufacturing.
5. Unistrut Northeast, Cambridge, Massachusetts.
6. CADDY; nVent.
7. Carpenter & Paterson, Inc.
8. Empire Industries, Inc.
9. Globe Pipe Hanger Products Incorporated.
10. Haydon Corporation.
11. Hilti, Inc.
12. NIBCO INC.
13. PHD Manufacturing, Inc.
14. PHS Industries, Inc.
15. Unitron Product, Inc. / US-Strut.

B. Single pipes shall be supported by hangers suspended by hanger rods from structural steel members, concrete ceilings, bottom of trapeze hangers, and wall-mounted steel angle brackets.

C. Where pipes are near walls, beams, columns, etc., and located an excessive distance from ceilings or underside of beams, welded steel wall brackets similar to Carpenter and Patterson, Figure Nos. 68, 79, 84, or 139 shall be used for hanging pipe. Where single pipes rest on top of bracket pipe supports, attachments shall meet requirements as specified under multiple pipe hangers.

2.8 MULTIPLE PIPE HANGERS

A. Suspended multiple pipes, running parallel in the same horizontal plane that are adjacent to each other, shall be suspended by trapeze type hangers or wall brackets. Where use of steel is allowed, trapeze hangers shall consist of galvanized structural steel channel supported from galvanized threaded rod or attached to concrete walls, columns, or structural steel support members. See previous paragraphs about multiple PVC pipe supports.

B. Except as otherwise specified herein, pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets shall be anchor or pipe chairs similar to:

1. Anvil Fig. 175.
2. Cooper B-Line B3147A or B3147B.
3. Where use of steel is allowed, material of construction shall be galvanized steel. Chair U bolts shall be tightened to allow freedom of movement for normal expansion and contraction except where pipe must be anchored to control direction of movement or act as a thrust anchor.

2.9 SINGLE PIPE SUPPORTS FROM BELOW

A. Single pipes located in a horizontal plane close to the floor shall be Pedestal type: Schedule 40 pipe stanchion, saddle, and anchoring flange.

1. Nonadjustable Saddle: MSS SP 58, Type 37 with U-Bolt.

    a. Anvil, Figure 259.
    b. Cooper B-Line, Figure B3090.

2. Adjustable Saddle: MSS SP 58, Type 38 without clamp.

    a. Anvil, Figure 264.
    b. Cooper B-Line, Figure B3093.

B. Pipes less than 3 inch in diameter:

1. Hold in position by supports fabricated from steel C channel, welded post base similar to Unistrut, Figure P2072A, where use of steel is allowed; and pipe clamps similar to Unistrut, Figures P1109 through 26.
2. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected by horizontal member of sufficient load capacity to support pipe.
3. Fasten supports to nearby walls or other structural member to provide horizontal rigidity.
4. More than one pipe may be supported from a common fabricated support.

C. Pipes 3 inch in diameter and larger:

1. Support by adjustable stanchions.
2. Provide at least 4 inch adjustment.
3. Flange mount to floor.

D. Use yoked saddles for piping whose centerline elevation is 18 inch or greater above the floor and for all exterior installations.

E. Pipe roller type supports shall be used where required to accommodate thermal movement in conjunction with axial supports.

2.10 BASE ANCHOR SUPPORT

A. Bend Support: Where pipes change direction from horizontal to vertical via a bend, install a welded or cast base bend support to carry the load. Fasten to the floor, pipe stanchion, or concrete pedestal using expansion anchors or other method as approved by the Engineer.

B. Concrete Supports: Where indicated, securely fasten pipe bends to concrete supports with suitable metal bands as required and approved by the Engineer. Isolate piping from poured concrete with a neoprene insert.

2.11 VERTICAL PIPE SUPPORTS

A. Where vertical pipes are not supported by a Unistrut type system as specified, they shall be supported in one of the following methods.

1. For pipes 1/4 to 2 inch in diameter:

a. Provide extension hanger ring with an extension rod and hanger flange.
b. The rod diameter shall be as recommended by the manufacturer for the type of pipe to be supported.
c. Where use of steel is allowed, the hanger ring shall be steel- or PVC-clad depending on the supported pipe material of construction. The hanger ring shall be equal to Carpenter & Patterson, Figure Nos. 81.
d. Where use of steel is allowed, the anchor flange shall be galvanized malleable iron similar to Carpenter and Patterson, Figure No. 85.

2. For pipes equal to or greater than 2 inch in diameter:

a. Extended pipe clamps similar to Carpenter & Patterson, Figure No. 267 may be used.
b. Attach hanger to concrete structures using double expansion shields,
c. Attach hanger to metal support members using welding lugs similar to Carpenter & Patterson, Figure No. 114.

B. Pipe supports shall be provided for closely spaced vertical piping systems required to provide a rigid installation. The interval of vertical support spacing shall be as specified, but in no case shall vertical interval exceed 12 feet. The support system shall consist of a framework suitably anchored to floors, ceilings, or roofs.

C. Unless otherwise specified, shown, or specifically approved by the Engineer, vertical runs exceeding 12 feet shall be supported by base elbows/tees, clamps, brackets, wall rests, and pipe collars, all located as required to ensure a rigid installation.

D. Pipe riser clamps, per MSS SP58, shall be used to support all vertical pipes extending through floor slabs. Where use of steel is allowed, riser clamps shall be galvanized steel manufactured by:

1. Carpenter & Patterson, Figure No. 128.
2. Anvil, Figure 261.
3. Cooper B-Line, Figure B3373.
4. Or equal.

2.12 SPECIAL SUPPORTS

A. Framework Supports:

1. Vertical and horizontal supporting members shall be U-shaped channels similar to Unistrut, Series P1000. Vertical piping shall be secured to the horizontal members by pipe clamps or pipe straps. See pipe clamp and strap requirements.

2. For piping 3 inch and smaller, framework shall be as manufactured by:

    a. Unistrut Corporation.
    b. Power-Strut (or Ackinstrut where fiberglass systems are specified).
    c. Multi-Strut by Carpenter-Paterson.
    d. Or equal.

3. For piping larger than 3 inches, the support frame shall be fabricated from structural stainless steel or steel shapes, depending upon the support location, and secured through the use of drop in, adhesive or expansion anchors.
4. The assemblies shall be furnished complete with all nuts, bolts, and fittings required for a complete assembly including end caps for all Unistrut members.
5. Electrical Conduit Support: Under Division 26.
6. The design of each individual framing system shall be the responsibility of the Contractor. Submit shop drawings, and show all details of the installation, including dimensions and types of supports. In all instances the completed frame shall be adequately braced to provide a complete rigid structure when all the piping has been attached. See also Article SUPPORT AND RESTRAINT.

B. Supports not otherwise described in this Section shall be fabricated or constructed from standard structural stainless steel or steel shapes in accordance with Unistrut-type frame; have anchor hardware similar to items previously specified herein; shall meet the minimum requirements listed below; and be subject to the approval of the Engineer.

C. Additional Pipe Support Situations:

1. Supporting Multiple Chemical and Related Piping:

    a. Location: indicated on Drawings or otherwise required, especially adjacent to chemical pumps.
    b. Use: framework support.
    c. Materials: FRP, with proper local stress protection.

2.13 ACCESSORIES

A. Insulation Shield: Install on insulated non-steel piping. Oversize the rollers and supports, as required. Manufacturers:

1. Anvil, Figure 167.
2. Cooper B-Line, Series B3151.

B. Welding Insulation Saddle: Install on insulated metal pipe. Oversize the rollers and supports, as required. Manufacturers:

1. Anvil, Figure 160.
2. Cooper B-Line, Series B3160.

C. Vibration Isolation Pad: Install under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration.

1. Isolation pads to be neoprene, waffle type.
2. Manufacturers:

a. Mason Industries, Type W.
b. Korfund.

D. Dielectric Barrier:

1. Install between carbon steel members and copper or stainless-steel pipe.
2. Install between stainless steel supports and non-stainless steel ferrous metal piping.
3. All stainless-steel piping shall be isolated from all ferrous materials, including galvanized steel by use of neoprene sheet material and protection shields.

E. Electrical Isolation: Install 1/4 by 3 inch neoprene rubber wrap between submerged metal pipe and oversized clamps.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field dimensions as indicated on Shop Drawings.

3.2 INSTALLATION

A. Obtain permission from Engineer before using powder-actuated anchors.

B. Obtain permission from Engineer before drilling or cutting structural members.

C. Inserts:

1. Install inserts for placement in concrete forms. Before setting inserts, all drawings and figures shall be checked that have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 in and larger.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

D. Pipe Hangers and Supports:

1. Install according to: ASME B31.3.
2. Support horizontal piping as indicated on Drawings, depending upon pipe size.
3. Install hangers with minimum 1/2 in space between finished covering and adjacent Work.

4. Place hangers within 12 in of each horizontal elbow.
5. Use hangers with 1-1/2 in minimum vertical adjustment.
6. Support horizontal cast iron pipe adjacent to each hub, with 5 ft maximum spacing between hangers.
7. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
8. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
9. Support riser piping independently of connected horizontal piping.
10. Design hangers for pipe movement without disengagement of supported pipe.
11. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
12. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
13. Provide welded steel brackets where piping is to be run adjacent to building walls or columns.
14. Use beam clamps where piping is to be suspended from building steel.
15. Insulated Piping: Provide two bolted clamps designed to accommodate insulated piping.
16. Use offset clamps where pipes are indicated as offset from wall surfaces.
17. Proceed with installation of piping and supports only after any building structural work has been completed and new concrete has reached its 28-day compressive strength.
18. The installation of pipe support systems shall not interfere with the operation of any overhead bridge cranes, monorails, access hatches, etc. No piping shall be supported from stairs, other pipes, ladders, and walkways unless authorized by the Engineer.
19. Repair mounting surfaces to original condition after attachments are made.
20. Brace horizontal pipe movements by both longitudinal and lateral sway bracing.
21. Where supports are required in areas to receive chemical resistant seamless flooring, install supports prior to application of flooring system.

E. Equipment Bases and Supports:

1. Provide housekeeping pads as detailed on Drawings.
2. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.
3. Provide rigid anchors for pipes after vibration isolation components are installed. Comply with Section 400513 “Common Work Results for Process Piping”.

F. Prime Coat:

1. Prime coat exposed steel hangers and supports according to Manufacturer’s Standard.
2. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.3 FIELD QUALITY CONTROL

A. All pipe support systems shall be tested after installation in conjunction with the respective piping pressure tests. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired, augmented or replaced to the satisfaction of the Engineer.

B. After the work is installed, but before it is filled for start-up and testing, the Support System Design Engineer shall inspect the work and shall certify its complete adequacy. Each system shall be inspected and certified in the same way.

C. Submit a report, including all field modifications and including all certificates.

1. Insert state where project is located.
2. The report shall bear the stamp of a professional engineer registered in Georgia and shall be subject to the review of the Engineer.

END OF SECTION 400507

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SECTION 400519 - DUCTILE IRON PROCESS PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Ductile-iron pipe.
2. Ductile-iron, malleable-iron, and cast-iron fittings.
3. Accessories.
4. Delegated design.

B. Related Requirements:

1. Section 400506 “Couplings, Adapters, and Specials for Process Piping” for piping appurtenances.
2. Section 400507 “Hangers and Supports for Process Piping” for hangers, anchors, sleeves, and sealing of piping to adjacent structures.
3. Section 400551 “Common Requirements for Process Valves” for common product requirements for valves for placement by this Section.

1.3 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information regarding pipe and fittings.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Indicate layout of piping systems, including equipment, critical dimensions, sizes, and materials lists.
2. Include plans, elevations, sections, and mounting attachment details.

3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Include diagrams for power, signal, and control wiring.

1.5 DELEGATED-DESIGN SUBMITTALS

A. Delegated Design Submittal: For Ductile Iron Pipe; Section 014000 “Quality Requirements” for additional delegated design requirements.

B. Submit signed and sealed Shop Drawings with design calculations and assumptions for pipe sizing methods and calculations used.

C. Qualifications Statement: Submit qualifications for licensed professional.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe manufacturer stating that the pipe fittings, gaskets, linings and exterior coating for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.

B. Source Quality-Control Submittals: Indicate results of shop tests and inspections.

C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

D. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

A. Materials (including linings) in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

B. Hydrostatically test each length of ductile iron pipe at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Furnish certified test results in duplicate to the Engineer prior to time of shipment.

C. Inspect and test by Manufacturer the ductile-iron pipe and fittings at the foundry as required by the AWWA C600, Hydrostatic Testing. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.

D. Pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the Owner, at the Owner's expense.

E. Engineer will inspect the pipe and fittings after delivery. Products are subject to rejection at any time on account of failure to meet any of the specified requirements, even though accepted as satisfactory at the place of manufacture. Immediately mark pipe rejected after delivery and remove from the job site.

F. Permanently mark pipe and fittings with the following information:

1. Manufacturer name and trademark
2. Manufacturing date.
3. Size, type, class, or wall thickness.
4. Production Standard (AWWA, ASTM, etc.).

G. Perform Work according to City of Valdosta standards.

H. Maintain One copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.

C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Georgia.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage. Photograph and provide written documentation of damaged materials.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Coverall openings to prevent entrance of dirt, water, and debris.
3. Protect piping and appurtenances by storing off ground.
4. Limit stacking height to manufacturers specified maximum.
5. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

A. Piping:

1. Comply with AWWA C150.
2. Thickness Class 53
3. Ductile Iron pipe as manufactured by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; all divisions of the McWane Company or an approved equal who is a member of the Ductile Iron Pipe Research Association (DIPRA).

B. Fittings:

1. Material: ASTM A48/A48M, gray iron.
2. Class: Same as that of connected piping.
3. Mechanical Joints:

a. Comply with AWWA C110 and AWWA C111.
b. Glands: Ductile iron with asphaltic coating.
c. Push-on Joints: Comply with AWWA C111.

4. Restrained Joints: Comply with AWWA C111.
5. Flanged Fittings: Comply with ASME B16.5.

a. Assembly bolts: square headed carbon steel machine bolts with hexagon nuts per ANSI B18.2. Threads conform to ANSI B1.1. Bolt length: 1/8 inch to 5/8 inch protrusion from nut after torquing.

6. Grooved joints: Comply with AWWA C606:

a. Rigid couplings: Style 31 couplings as manufactured by Victaulic, Anvil International, or approved equal.
b. For direct connection of ductile pipe to steel pipe of IPS sizes: Victaulic Style 307 transition coupling with offsetting, angle-pattern, bolt pads.
c. Grooved end fittings for AWWA ductile iron pipe: Conform to ANSI A21.10/AWWA C110 for center-to-end dimensions and ANSI A21.10/AWWA C110 or AWWA C153 for wall thickness, with AWWA C606 grooved ends.

7. Sleeve type couplings: Dresser Style 38 or 138 as manufactured by Dresser Industries, or equivalent products of Smith-Blair, Romac Industries, Ford Meter Box Co or approved equal.

8. Flanged coupling adaptors: Smith-Blair Type 913, or equivalent products of Klamflex Pipe Couplings (PTY) LTD, Robar Industries LTD or approved equal.

C. Special Linings

1. Glass Lining:

a. Glass Lining: Consists of vitreous and inorganic lining materials applied to the internal surfaces. The internal surface shall be prepared in strict accordance with ASTM B1000, Sections 3 and 4.
b. Apply lining in a minimum of two coats, separately applied and separately fired to a maturing temperature of 1350 degree F. Finished dry film thickness: 10 mils minimum.
c. Finished glass lining Acceptance Criteria:

1) Free of visible pin holes or holidays, crazing or fish scales.
2) Surface hardness greater than 6 on the MOHS scale.
3) Able to withstand a strain of 0.001 inch/inch of the base metal without damage to the glass.
4) Inspected and tested in accordance with ASTM B1000 – 21. Certified inspection and test report to be furnished with each product shipment.

d. Applicator Qualifications: minimum of 5 years successful experience in the application of high temperature glass/porcelain coatings to the interior of ductile pipe and fittings. Certify complete compliance with all qualification, final inspection and quality guidelines included in Sections 5 and 6 of ASTM B1000 – 15.

D. Exterior Coating:

1. Exposed Service: As specified in Manufacturer’s standard .
2. If required, coatings "holdbacks" to be provided at pipe and fitting ends for satisfactory installation for joint connections in the field.
3. Provide all necessary coating materials to perform field coating applications at joints compatible with or equal to the shop applied material.
4. Field repair of pipe with damaged coating shall receive prior approval of the Engineer. If, in the opinion of the Engineer coating damage is beyond repair, pipe to be replaced at the expense of the Contractor.
5. All flange bearing surfaces shall be uncoated.
6. Mechanically clean or brush blast all surfaces to have exterior coating applied to ductile iron surfaces. Chemical cleaning or wiping with solvent is not acceptable.

2.2 ACCESSORIES

A. Thermal Insulation:

1. As indicated on the Drawings**.**

B. Gaskets:

1. Full face type per AWWA C111 to provide positive sealing for the flanged ductile iron joints.
2. Thickness: 1/8-inch.
3. NSF61 certified for potable water applications.

2.3 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Owner Inspection:

1. Make completed piping components available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and test at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Thoroughly clean pipe and fittings before installation.

B. Surface Preparation:

1. Clean surfaces to remove loose rust, mill scale, and other foreign substances by power wire brushing.
2. Touch up shop-primed surfaces with primer as specified in Section Manufacturer’s standard .
3. Solvent-clean surfaces that are not shop primed.

3.3 INSTALLATION

A. Exposed Service Piping:

1. According to ASME B31.3.
2. In compliance with manufacturer's instructions.
3. Run piping straight along alignment as indicated on Shop Drawings, with minimum number of joints.
4. Clean each length prior to installation.
5. Support per Section 400507 "Hangers and Supports for Process Piping".
6. Do not use equipment flanges for support, support pipe separately.

B. Fittings:

1. According to manufacturer instructions.
2. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
3. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer instructions.
4. Flanged joints to be made using gaskets, bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts to conform to the same ANSI Standard as the flanges.
5. Provide required upstream and downstream clearances from devices as indicated on Drawings.

C. Make taps to ductile iron piping only with service saddle, tapping boss of a fitting or valve body, or equipment casting.

D. Install piping with sufficient slopes for venting or draining liquids and condensate to low points.

E. Support exposed piping as specified in Section 400507 "Hangers and Supports for Process Piping".

F. Provide expansion joints as specified in Section 400506 "Couplings, Adapters, and Specials for Process Piping", and pipe guides as specified in Section 400507 "Hangers and Supports for Process Piping", to compensate for pipe expansion due to temperature differences.

G. Dielectric Fittings: Provide between dissimilar metals.

H. Field Cuts: According to pipe manufacturer instructions. Cutting by abrasive saw only, leaving a smooth cut at right angles to the axis of the pipe. Damage to the lining repaired to the satisfaction of the Engineer. Seal Field cut ends approved epoxy coating in accordance with manufacturer's instructions.

I. Finish primed surfaces according to Section Manufacturer's standard .

3.4 TOLERANCES

A. Laying Tolerance: As specified in Section 331116 "Site Water Utility Distribution Piping."

B. Deflection at joints not to exceed that recommended by the pipe manufacturer.

C. Supply and install fittings, in addition to those shown on Drawings, in areas where conflict exists with existing facilities.

3.5 FIELD QUALITY CONTROL

A. Inspection:

1. Inspect for damage to pipe lining or coating and for other defects that may be detrimental as determined by Engineer.
2. Repair damaged piping or provide new, undamaged pipe at no additional cost to the project.
3. After installation, inspect for proper supports and interferences.
4. Inspect and field test the glass lined piping and fittings to verify the delivered products meeting the criteria specified. Submit field test reports for spark testing [and straightness testing] showing compliance with the following criteria.

    a. Perform glass lining inspection and testing of pipe and fitting prior to installation.
    b. Visually inspect pipe in storage on site for damage and defects.
    c. The Engineer will select 10 percent of the pipe and fittings delivered to the site for field testing.
    d. Perform a spark test on the selected glass lined pipe pieces using testing firm/team acceptable to the manufacturer of the pipe and fittings. Perform the tests in accordance with ASTM B1000.
    e. The field spark test results not to exceed 15 percent variation in the number of pinholes detected during the factory test. If the field test results show greater than 15 percent variation in the number of pinholes detected when compared to the factory spark test, perform the field testing on the entire load of the glass lined pipe and fittings delivered to the site.
    f. Perform field test for straightness on 10 percent of 4 inch to 8 inch pipes. If the test results reveal deviation exceeds the maximum limits specified in ASTM B1000, perform the test on all the 4 inch to 8 inch pipes.
    g. All pieces which fail the field test specified herein or do not meet the maximum allowable pinhole requirement specified in ASTM B1000 to be replaced at no additional cost to the Owner.

B. Pressure Testing:

1. Test Pressure: Not less than 200 psig or 50 psi in excess of maximum static pressure, whichever is greater 150 percent of maximum operating design pressure.
2. Conduct hydrostatic test for minimum two hours.
3. Filling:

    a. Fill section to be tested with water slowly and expel air from piping at high points.
    b. Install corporation cocks at high points.
    c. Close air vents and corporation cocks after air is expelled.
    d. Raise pressure to specified test pressure.

4. Observe joints, fittings, and valves under test.
5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.

6. Leakage:

   a. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
   b. Maintain pressure within plus or minus 5 psi of test pressure.
   c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
   d. Compute maximum allowable leakage by following formula:

      1) L = SD x sqrt(P)/C.
      2) L = testing allowance in gph.
      3) S = length of pipe tested in feet.
      4) D = nominal diameter of pipe in inches.
      5) P = average test pressure during hydrostatic test in psig.
      6) C = 148,000.
      7) If pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

   e. If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.
   f. Correct visible leaks regardless of quantity of leakage.

3.6 CLEANING

A. Keep pipe interior clean as installation progresses.

B. After installation, clean pipe interior of soil, grit, and other debris.

END OF SECTION 400519
(*references follow*)

EXHIBIT A
Use as a reference:

LININGS AVAILABLE FOR DUCTILE PIPE

Description:	Maximum Service Temp. (Degree F): [1]	Common Use:	Thickness:
CEMENT MORTAR	With Sealcoat - 150 Degrees Without Sealcoat - 212 Degrees	Drinking Water Salt Water Non-Septic Gravity Sewers Sanitary Sewer Force Mains	
GLASS		Scum	10 Mil (Min)
PETROLEUM ASPHALT COATING	150 Degrees	Air	1 Mil
PROTECTO 401 (ceramic-filled amine-cured epoxy)	120 to 150 Degrees [2]	Septic Sewer Acids [3] Alkali Waste Pickling Brine	40 Mil (nominal)
EPOXY SUITABLE FOR DRINKING WATER [4]	120 to 150 Degrees [2]	Drinking Water Food Processing	24 Mil (Min)
POLYETHYLENE	120 to 150 Degrees [5]	Septic Sewer Acids [3] Alkali Waste Pickling Brine	40 Mil (nominal)

[1] Maximum service temperatures listed are intended as general guidelines. For higher service temperatures, consult manufacturer for specific recommendations.

[2] Maximum service temperature for epoxies depends on service conditions and specific formulation. Consult manufacturer for recommendations for elevated temperature service.

[3] Consult manufacturer for specific acid service use.

[4] All epoxies are not suitable for conveying drinking water. Consult manufacturer for recommendations.

[5] Maximum service temperature for polyethylene for acids and alkali waste depends on the specific acid or alkali waste and service condition(s). Consult manufacturer for recommendations for elevated temperature service.

END OF EXHIBIT A

EXHIBIT B
Use as a reference:

GASKET MATERIALS USED FOR DUCTILE IRON PIPE IN WATER AND SEWERAGE SERVICE

Description:	Maximum. Service Temperature (Degree F): [1] [2]		Common Uses: [3]
Push-on:	Mechanical Gaskets:	Joint Gaskets:	
SBR (Styrene Butadiene)	150 Degrees	120 Degrees	Fresh Water Salt Water Sanitary Sewage
EPDM (Ethylene Propylene Diene Monomer)	250 Degrees	225 Degrees	Fresh Water Salt Water Sanitary Sewage Hot Water
Nitrile (NBR) (Acrylonitrile Butadiene)	150 Degrees	120 Degrees	Hydrocarbons Fats Oils Greases Chemicals
Neoprene (R) (CR) (Polychloroprene)	200 Degrees	200 Degrees	Fresh Water Salt Water Sanitary Sewage
Viton (R); Fluorel (R) (FPM) [4] (Fluorocarbon)	300 Degrees	225 Degrees	Hydrocarbons Acids Petroleum Vegetable Oils

[1] Maximum service temperatures listed are intended as general guidelines for ductile iron pipe gaskets. For service temperatures greater than those listed, consult manufacturers for specific recommendations.

[2] Minimum service temperature is not usually a meaningful parameter for piping gaskets; however, low temperatures during pipeline installation may necessitate precautions. Consult manufacturer for pertinent recommendations.

[3] Water, including sanitary sewage, with low levels of the listed contaminants.

[4] Consult manufacturer for availability of FPM push-on gaskets.

END OF EXHIBIT B

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SECTION 400531 - THERMOPLASTIC PROCESS PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. PVC pipe.
2. Fittings.
3. Accessories for plastic piping.

B. Related Requirements:

1. Section 400506 “Couplings, Adapters, and Specials for Process Piping”: Pipe penetrations, restrained joints, flexible connections, expansion joints and loops, and sleeve-type couplings.
2. Section 400507 “Hangers and Supports for Process Piping”: Hangers, anchors, sleeves, and sealing of piping to adjacent structures.
3. Section 400551 “Common Requirements for Process Valves”: Common product requirements for valves for placement by this Section.

1.3 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 PREINSTALLATION MEETINGS

A. Convene minimum one week prior to commencing Work of this Section.

1.5 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's catalog information regarding pipe and fittings.

B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, materials lists, location of all fittings, valves, and in-line accessories.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Manufacturer’s recommended butt fusion welding procedures identifying all quality control checks during the fusion procedure including the minimum and maximum allowable bead formation during the heat soak process and the final weld roll back process for the various size pipes.

C. Manufacturer to provide a sample joint for each size pipe to be supplied that is 12-inch long and has two heat fusion welds that identifies the manufacturer’s minimum and maximum allowable bead thicknesses. Provide documentation that the sample was pressure tested to 150 psi or the specified pressure.

D. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for pipe sizes and sizing methods.

E. Source Quality-Control Submittals: Indicate results of shop tests and inspections.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

A. Permanently mark each length of pipe with manufacturer's name or trademark and indicate conformance to standards.

B. Materials in Contact with Potable Water: Certified according to NSF 61.

C. Maintain One copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Georgia.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection:

1. Accept materials on Site in manufacturer's original packaging and inspect for damage.
2. Manufacturer's Packaging: Comply with ASTM D3892.

B. Storage: Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from puncture, abrasion, moisture, dust, and UV by storing in clean, dry location remote from construction operations areas.
2. Protect piping and appurtenances by storing off ground.
3. Provide additional protection according to manufacturer instructions.

1.11 AMBIENT CONDITIONS

A. Section 015000 “Temporary Facilities and Controls”: Requirements for ambient condition control facilities for product storage and installation.

B. Minimum and Maximum Temperatures: Do not install pipe when temperature is below 40 degrees F or above 90 degrees F if pipe is exposed to direct sunlight.

C. UV Protection: Provide pipe installed above ground or outside with UV protection.

1.12 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 GENERAL

A. Do not use Van Stone flanges with pinch valves, industrial butterfly valves; elastomer bellows style expansion joints or other piping system components having an elastomer liner (rubber seat) that is used as a gasket.

2.2 PVC PIPE, TUBE, AND FITTINGS

A. PVC Pipe and Fittings:

1. Pipe and Fittings:

a. Comply with ASTM D1785, Class 12454.
b. Schedule: 40.
c. Fittings: ASTM D2466, Schedule 40, socket.

B. PVC Pipe and Fittings:

1. Pipe:

a. Comply with AWWA C900.
b. DR 18, Class 235**.**

2. Fittings:

a. Material: Molded PVC.
b. Type: Push-on, comply with AWWA C907.
c. Gaskets: Comply with AWWA C111.

3. Joints:

a. Type: Compression gasket ring.
b. Comply with ASTM D3139.

4. Materials:

a. Comply with ASTM D1784.
b. Minimum Cell Classification: 12454-C.

2.3 SUSTAINABILITY CHARACTERISTICS

A. Section 018113 “Sustainable Design Requirements”: Requirements for sustainable design compliance.

B. Material and Resource Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content.
2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project Site.

2.4 FINISHES

A. Coat machined faces of metallic flanges with temporary rust-inhibitive coating.

2.5 ACCESSORIES

A. PVC Piping:

1. Flange Bolting:

a. Hex-Head Bolts: Stainless steel; ASTM Grade 316 .
b. Hex-Head Nuts: Stainless steel; ASTM Grade 316.

2. Flange Gaskets:

a. Type: Full faced.
b. Material: EPDM.
c. Comply with ASME B16.21.

3. Push-On Joint Seals:

a. Material: EPDM.
b. Comply with ASTM F477.

4. Solvent Cement:

a. Comply with ASTM D2564.
b. Formulated for use with sodium hypochlorite and other caustic solutions.
c. Primers: Comply with ASTM F656.

2.6 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed pipe sections.

B. Owner Inspection:

1. Make completed pipe sections available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and test at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Ream pipe ends, remove burrs, and.

B. Thoroughly clean pipe and fittings before installation.

C. Cleaning: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

A. Comply with ASME B31.3 and B31.9.

B. Run piping straight along alignment as indicated on Shop Drawings, with minimum number of joints.

C. Fittings:

1. According to manufacturer instructions.
2. Gaskets:

    a. Clean seats thoroughly.
    b. Wipe gaskets clean prior to installation.

3. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer instructions.

D. Provide required upstream and downstream clearances from devices as indicated.

E. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.

F. Support exposed piping as specified in Section 400507 “Hangers and Supports for Process Piping”.

G. Provide expansion joints as specified in Section 400506 “Couplings, Adapters, and Specials for Process Piping”, and provide pipe guides as specified in Section 400507 “Hangers and Supports for Process Piping”, to compensate for pipe expansion due to temperature differences.

H. Field Cuts: According to pipe manufacturer instructions.

I. Joining:

1. Heat Joining: Comply with ASTM D2657.

    a. Butt-fusion joints to be done by a factory-qualified joining technician as designated by the pipe manufacturer.
    b. Field Samples: join two sample welds on each size of pipe to be installed using the same fusion welding equipment that will be used for completion of the entire work. These sample welds will be compared to the manufacturer's sample previously submitted in accordance with Part 1.
    c. Pipe joints with beads in excess of 3/16-inch will not be approved by the Engineer.

2. Electrofusion: Comply with ASTM F1290.
3. Primers and Cleaners: Comply with ASTM F402.
4. PVC Solvent-Cemented Joints: Comply with ASTM D2855.

J. Insulation: As indicated on Drawings.

K. Underground Piping: As specified in Section 331116 "Site Water Utility Distribution Piping".

3.4 TOLERANCES

A. Laying Tolerances: As specified in Section 331116 "Site Water Utility Distribution Piping".

3.5 FIELD QUALITY CONTROL

A. Inspection:

1. Inspect for piping defects that may be detrimental as determined by the Engineer.
2. Repair damaged piping, or provide new, undamaged pipe.
3. After installation, inspect for proper supports and interferences.

B. Pressure Testing:

1. Test Pressure: Not less than 150 psig or 1.5 times the system's working pressure, whichever is greater.
2. Conduct hydrostatic test for minimum two hours.
3. Filling:

    a. Fill section to be tested with water slowly and expel air from piping at high points.
    b. Install corporation cocks at high points.
    c. Close air vents and corporation cocks after air is expelled.
    d. Raise pressure to specified test pressure.

4. Observe joints, fittings, and valves under test.
5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.

6. Leakage:

   a. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
   b. Maintain pressure within plus or minus 5 psi of test pressure.
   c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
   d. Correct visible leaks and repeat test to verify no leaks at the required test pressures.

3.6 CLEANING

A. Keep pipe interior clean as installation progresses.

B. Clean pipe interior of soil, grit, shavings, and other debris after pipe installation.

END OF SECTION 400531

SECTION 400551 - COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Common requirements for valves.
2. Common requirements for valve actuators.
3. Valve tags.
4. Valve Schedule.

B. Related Requirements:

1. Section 400507 “Hangers and Supports for Process Piping” for product and execution requirements for valve supports specified by this Section.

1.3 COORDINATION

A. Coordinate Work of this Section with individual process valve specifications.

1.4 ACTION SUBMITTALS

A. Valve Schedule:

1. Submit valve schedule populated with all Division 40 process valves specified for this project. Include all information shown on the Sample Valve Schedule included in this project.
2. Approval of valve schedule submittal to precede all individual valve submittals. All subsequent individual valve submittals to include the approved valve tag number or group on the submittal cover sheet.

B. Valve Tags:

1. Materials, dimensions and thickness of tags, materials and gauge of cable and splicing hardware.
2. The color palette for Owner selection.
3. Full scale drawing of sample with lettering dimensions and scribe depth.
4. Valve tag lettering provided with Valve Schedule above.

C. Power Actuator Data:

1. Sizing calculations

a. Provide fluid pressure and velocity sizing basis.
b. Provide maximum valve torque based on disc shape and flow direction.
c. Clearly indicate safety factors and mechanical ratios of any intermediate gearing.

2. Maximum output torque of actuator and intermediate gearing.
3. Details of actuator mounting, including orientation of actuator and intermediate gearing.
4. Dimensional drawing of actuator assembled on valve.
5. Pneumatic/Hydraulic pressure requirements, electrical power supply, plumbing connection sizes and locations.
6. Wiring diagram, control wiring and protocol.
7. Valve cavitation limits for positioning, modulating and control valves mated to power actuator.

D. Shop Drawings: Valve and actuator model number and size, valve parts list, materials of each part including material standard designation (ASTM or other), position indicators, limit switches, actuator mounting.

E. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS-SP-61 for all valves.

1.5 DELEGATED DESIGN SUBMITTALS

A. Submit signed and sealed Shop Drawings with design calculations and assumptions for sizing of control valves.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer Instructions: Submit installation and operation instructions for each component including valve, actuator, gearbox, and any included instrumentation.

B. Source Quality-Control Submittals: Indicate results of integrators facility tests and manufacturers factory tests and inspections.

C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

D. Manufacturer Certification of Installation: Certify that equipment has been installed according to manufacturer instructions.

E. Qualifications Statement:

1. Submit qualifications for manufacturer and licensed professional.

1.7 CLOSEOUT SUBMITTALS

A. Section 017839 “Project Record Documents” for record actual locations of valves and actuators.

1.8 QUALITY ASSURANCE

A. Maintain clearances as indicated on Drawings and Shop Drawings.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Mate valves to actuators at manufacturers or integrator’s facility. Fully test assembled product and certify ready for installation prior to shipment to the job site.

1. Only in special cases for extremely large assemblies where installation requires disassembly, may actuators be mounted to the valves in the field.

D. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

E. Furnish affidavit of compliance with testing and manufacturing standards referred in this specification and the individual valve specifications.

F.

F. Obtain Manufacturer’s Certification of Proper Installation for Specified valves and valve assemblies.

G. Perform Work according to City of Valdosta standards.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing valves and actuators with minimum ten years' experience.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Deliver factory mated power actuated valves on rigid wooden skids, fully braced and strapped to prevent damage to valve, actuator or coupling system.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
3. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to materials ordering or any fabrication.
2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

A. Furnish one -year manufacturer's warranty for valves and actuators.

PART 2 - PRODUCTS

2.1 VALVES

A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required.

B. Provide all valves of the same type by same manufacturer.

C. Valve Ends: Compatible with adjacent piping system and as indicated on valve schedule.

D. Operation:

1. Close by turning clockwise.
2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.

E. Valve Marking and Labeling:

1. Marking: Comply with MSS SP-25.
2. Labeling (valve tags):

a. Fiberglass reinforced plastic, ASTM D709, 70 mil thick, 2 1/2-inch diameter or 2 1/2-inch by 1 ¼-inch.
b. Lettering 1/16-inch thick of silk screening or other permanent embedment of subsurface printed graphics, permanently sealed.
c. Colors of lettering and backing as selected by Owner.
d. Two, 1/4-inch clear opening 316 stainless steel grommets at each end, center of hole 3/8-inch from tag edge.
e. 3/32-inch 316 SS cable and splice hardware.

F. Valve Construction: As Specified in Valve Sections.

G. Do not use Van Stone flanges with pinch valves, industrial butterfly valves; elastomer bellows style expansion joints or other piping system components having an elastomer liner (rubber seat) that is used as a gasket.

2.2 FINISHES

A. Valve Coating: Comply with AWWA C550.

B. Factory finishes are included in individual valve sections.

C. Exposed Valves: As specified in Manufacturer’s standard .

D. Stainless Body Valves: Do not coat.

E. Do not coat flange faces of valves unless otherwise specified.

2.3 SOURCE QUALITY CONTROL

A. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping system is ready for valve installation.

B. Fully examine valves for debris, damage and interior finish blemishes prior to installation. Do not install valves with soiled interior or any visible damage to seats, discs or interior finish.

C. Identify any piping, plant or equipment clearance issues prior to installation, bring to Engineer’s attention via job meetings, submittal process or request for information process.

3.2 INSTALLATION

A. Install valves, actuators, extensions, valve boxes, and accessories according to manufacturer instructions.

B. Inspect valve interiors before line closure for the presence of debris. At the option of the Engineer, internal inspection of valve and appurtenances may be required any time that the likelihood of debris is a possibility. Clean connecting pipes prior to installation, testing, disinfection and final acceptance.

C. Disinfect valves installed in potable water lines with approved pipeline disinfection process.

D. Rigidly support valves to avoid stresses on piping.

E. Coat studs, bolts and nuts with anti-seizing lubricant.

F. Dielectric Fittings: Provide between dissimilar metals.

G. Clean field welds of slag and splatter to provide a smooth surface.

H. Mate, adjust and fully test gearboxes, electric, hydraulic and pneumatic actuators to valves at manufacturers or integrator's facility.

1. Only in special cases for extremely large assemblies where installation requires disassembly may actuators be mounted to the valves in the field. These circumstances require preinstallation meetings.

I. Do not install stems vertically downward.

J. Unless otherwise indicated on the Drawings:

1. Install Gate, Globe, Ball valves with stem vertical in the 12 o'clock position.
2. Install Plug valves with stem horizontal and plug opening to the top of the body unless position will not allow proper actuator access, in which case stem may be vertical in the 12 o'clock position.
3. Install Butterfly valves 12 inch and smaller with stem horizontal or vertical in the 12 o'clock position,
4. Install Butterfly valves 14 inch and larger with the stem horizontal unless position will not allow proper actuator access, in which case stem may be vertical in the 12 o'clock position.
5. Install Control valves in horizontal pipelines with top works vertically upward.

K. Install all brackets, extension rods, guides, the various types of operators and appurtenances as indicated. Before properly setting these items, check all drawings and figures which have a direct bearing on their location.

L. Inspect all materials for defects in construction and materials. Clean debris and foreign material out of openings, etc. Verify valve flange covers remain in place until connected piping is in place. Verify operability of all operating mechanisms for proper functioning. Check all nuts and bolts for tightness. Repaired or replace valves and other equipment which do not operate easily or are otherwise defective.

M. Where installation is covered by a referenced standard, install and certify in accordance with that standard, except as herein modified. Also note additional requirements in other parts of this Section.

N. Unless otherwise noted, provide joints for valves and appurtenances utilizing the same procedures as specified under the applicable type connecting pipe joint. Install valves and other items as recommended by the manufacturer. Verify manufacturers' torqueing requirements for all valves.

O. Coordinate direction of flow through offset type and shaped butterfly valve discs with the mated actuator torque capacity.

P. Rotate valve operators and indicators to display toward normal operation locations. Consult with Engineer prior to installing valves with handwheels to confirm final position of handwheel.

Q. Vertically center floor boxes, valve boxes, extension stems, and low floor stands over the operating nut, with couplings as required.

1. Adjust elevation of the box top to conform to the elevation of the finished floor surface or grade at the completion of the Contract.
2. Support boxes and stem guides during concrete placement to maintain vertical alignment.

R. Install brass male adapters on each side of valves in copper-piped system and solder adapters to pipe.

S. Install 1-inch ball valves with cap for drains at main shutoff valves, low points of piping, bases of vertical risers, and equipment.

T. Install valves with clearance for installation of insulation and to allow access.

U. Provide access where valves and fittings are not accessible.

V. Pipe Hangers and Supports: As specified in Section 400507 “Hangers and Supports for Process Piping”.

W. Comply with Division 40 for Process Interconnections for piping materials applying to various system types.

X. Installation Standards: Install Work according to City of Valdosta standards.

3.3 FIELD QUALITY CONTROL

A. Valve Field Testing:

1. Test for proper alignment.
2. If specified by valve Section, field test equipment to demonstrate operation without undue noise, vibration, or overheating.
3. Engineer will witness field testing.
4. Functional Test:

a. Prior to system startup, inspect valves and actuators for proper alignment, quiet operation, proper connection and satisfactory performance.
b. After installation, open and close all manual valves in the presence of the Engineer to show the valve operates smoothly from full open to full close and without leakage.
c. Operate pressure control and pressure relief valves in the presence of the Engineer to show they perform their specified function at some time prior to placing the piping system in operation and as agreed during construction coordination meetings.

5. Field test pipelines in which the valves and appurtenances are to be installed. During these tests, adjust, remove or replace defective valve or appurtenance, or otherwise make acceptable to the Engineer. Test regulating valves, strainers, or other appurtenances to demonstrate conformance with the specified operational capabilities. Correct deficiencies, replace device or otherwise made acceptable to the Engineer.

END OF SECTION 400551

SECTION 400553 - IDENTIFICATION FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods for valves.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's catalog literature for each specified product.

B. Shop Drawings:

1. Indicate list of wording, symbols, letter size, spacing of labels, and color-coding for mechanical identification and valve chart and schedule.
2. Indicate valve tag number, location, function, and valve manufacturer's name and model number.

C. Samples: Submit two tags, labels, and pipe markers for each size to be used on Project.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

A. Piping Color Scheme and Lettering Size: Comply with ASME A13.1.

B. Perform Work according to City of Valdosta standards.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Craftmark Pipe Markers.
2. Kolbi Pipe Marker Co.
3. Pipemarker.com (Brimar Industries, inc.),
4. Seton Identification Products.
5. Furnish materials according to City of Valdosta standards.

B. Description: Laminated three-layer plastic with engraved letters on light, contrasting background color.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Kolbi Pipe Marker Co.
d. Marking Services, Inc.
e. R&R Identification Co.
f. Seton Identification Products.

2. Description:

a. Laminated three-layer plastic with engraved letters on light, contrasting background color.
b. Minimum Tag Size and Configuration: 2 inches; diameter.
c. Provide with brass hooks suitable for attaching the tag to the valve operator.
d. Stamp or etch tags with the valve number and information on the valve schedule coded in a system provided by the Owner.

B. Metal Tags:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Kolbi Pipe Marker Co.
d. Marking Services, Inc.
e. Pipemarker.com (Brimar Industries, Inc.).
f. R&R Identification Co.
g. Seton Identification Products.

2. Description:

a. Stainless-steel construction; stamped letters.
b. Minimum Tag Size and Configuration: 2 inches; diameter with finished edges.
c. Provide with brass hooks suitable for attaching the tag to the valve operator.
d. Stamp or etch tags with the valve number and information on the valve schedule coded in a system provided by the Owner.

2.3 STENCILS

A. Manufacturers:

1. Kolbi Pipe Marker Co.
2. Marking Services, Inc.
3. Pipemarker.com (Brimar Industries, Inc.),

4. R&R Identification Co.
5. Seton Identification Products.

B. Description:

1. Quality: Clean-cut symbols.
2. Letters:

OUTSIDE DIAMETER OF PIPE	SIZE OF LETTERS
3/4-in to 1-1/4-inch	1/2-inch
1-1/2-in to 2-inch	3/4-inch
2-1/2-in to 6-inch	1-1/2-inch
8-in to 10-inch	2-1/2-inch
Over 10-inch	3-inch

C. Stencil Paint:

1. Description: Semigloss enamel.

2.4 PIPE MARKERS

A. Plastic Pipe Markers:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Marking Services, Inc.
d. R&R Identification Co.
e. Seton Identification Products.

2. Description:

a. Factory-fabricated, flexible, and semi-rigid plastic.
b. Preformed to fit around pipe or pipe covering.
c. Larger sizes may be of maximum sheet size, with spring fastener.
d. Letter sizes per Stencils Article.
e. Color shall be white or black depending on background color.

B. Plastic Tape Pipe Markers:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Kolbi Pipe Marker Co.
d. Marking Services, Inc.

e. Pipemarker.com (Brimar Industries, Inc.).
f. Seton Identification Products.

2. Description:

a. Flexible, 3.5 mil vinyl film tape with pressure-sensitive adhesive backing and printed markings.
b. Letter sizes per Stencils Article.
c. Color shall be white or black depending on background color.

2.5 CEILING TACKS

A. Manufacturers:

1. Marking Services, Inc.
2. R&R Identification Co.
3. Seton Identification Products.

B. Description:

1. Material: Steel.
2. Head:

a. Color-coded.
b. Diameter: 3/4 inch.

2.6 LABELS

A. Manufacturers:

1. Brady ID.
2. Seton Identification Products.

B. Description:

1. Material: Aluminum.
2. Minimum Size: 1.9 by 0.75 inches.
3. Adhesive backed, with printed identification.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Stencil Painting: Prepare surfaces as specified in Manufacturer’s standard

3.2 INSTALLATION

A. According to manufacturer instructions.

B. Apply stencil painting as specified in Manufacturer's standard

C. Install identifying devices after completion of coverings and painting.

D. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.

E. Labels:

1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
2. For unfinished covering, apply paint primer before applying labels.
3. Titles:

    a. Locate a maximum 26 feet apart.
    b. Locate directly adjacent to pipeline breaches on each side wall.
    c. Locate adjacent to each side of the valve regulator, flow meter, strainer, cleanout and all pieces of equipment.
    d. Identify the contents by complete name at least once in each room or space and thereafter may be labeled by generally recognized abbreviations.

F. Tags:

1. Identify valves in main and branch piping with tags.
2. Install tags using corrosion-resistant chain.
3. Number tags consecutively by location.

G. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

H. Piping:

1. Identify piping, concealed or exposed, with plastic pipe markers.
2. Use tags on piping 3/4-inch diameter and smaller.
3. Identify service, flow direction, and pressure.
4. Install in clear view and align with axis of piping.
5. Locate identification not to exceed 20 feet on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

I. Ceiling Tacks:

1. Provide ceiling tacks to locate valves above T-bar-type panel ceilings.
2. Locate in corner of ceiling panel closest to equipment.

END OF SECTION 400553

SECTION 400563 - BALL VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Thermoplastic ball valves.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods related to valves commonly used for process systems.

1.3 SUBMITTALS

A. As specified in Section 400551 “Common Requirements for Process Valves”: Submittal requirements for compliance with this Section.

1.4 QUALITY ASSURANCE

A. Test valves in accordance with AWWA C504, API 598, MSS SP61 as applicable for types listed herein.

B. Provide Installation Inspection and Operator Training per Section 400551 “Common Requirements for Process Valves”.

C. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC BALL VALVES

A. Manufacturers:

1. George Fischer,
2. ASAHI,

3. Spears.
4. Hayward.

B. Description:

1. Minimum Working Pressure: As indicated on valve schedule.
2. Maximum Process Fluid Temperature: As indicated on valve schedule.
3. Ports: Full size.
4. End Connections:

a. Flanged: Comply with ASME B16.42.
b. Union.

C. Operator: Hand lever.

D. Materials:

1. Body and Ball: PVC, ASTM D1784.
2. Seats: PTFE.
3. Gasket Material:

a. O-ring : EPDM

2.2 SOURCE QUALITY CONTROL

A. As specified in Section 400551 “Common Requirements for Process Valves”.

B. Testing: Test ball valves according to AWWA C507.

PART 3 - EXECUTION

3.1 INSPECTION

A. As specified in Section 400551 “Common Requirements for Process Valves”: Submittal requirements for compliance with this Section.

3.2 INSTALLATION

A. According to AWWA C507.

B. As specified in Section 400551 “Common Requirements for Process Valves”.

END OF SECTION 400563

SECTION 400565.23 - SWING CHECK VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Swing check valves 3 inches and larger.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods related to valves commonly used for process systems.

1.3 COORDINATION

A. Section 400551 “Common Requirements for Process Valves”: valve schedule

B. Coordinate Work of this Section with piping and equipment connections as specified in other Sections and as indicated on Drawings.

1.4 ACTION SUBMITTALS

A. Comply with Section 400551 “Common Requirements for Process Valves”.

B. Product Data: Submit manufacturer's catalog information, indicating materials of construction and compliance with indicated standards.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Source Quality-Control Submittals: Indicate results of factory tests and inspections and provide required certifications.

C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

D. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and centerline elevations.

1.7 QUALITY ASSURANCE

A. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

B. Perform Work according to City of Valdosta standards.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 400551 “Common Requirements for Process Valves”.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Protect valves and appurtenances by storing off ground.
3. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
4. Provide additional protection according to manufacturer instructions.

1.10 WARRANTY

A. Furnish five-year manufacturer's warranty for swing check valves.

PART 2 - PRODUCTS

2.1 SWING CHECK VALVES 3-INCH AND SMALLER: Tag Type SCV3

A. Manufacturer:

1. Solder or thread end Hammond 1B-940, or Jenkins Figure 996.
2. Flanged end Hammond 1R-1124 or Jenkins Figure 587J.

B. Description:

1. Comply with MSS SP-71, 80.

C. Finishes: As specified in Section 400551 “Common Requirements for Process Valves”.

2.2 SOURCE QUALITY CONTROL

A. Section 400551 “Common Requirements for Process Valves”.

B. Testing:

1. Hydrostatically test check valves at twice rated pressure according to AWWA C508.
2. Permitted Leakage at Indicated Working Pressure: None.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolt-hole configurations or design and verify that new valve and flange mate properly.

3.2 PREPARATION

A. Thoroughly clean valves before installation.

B. Surface Preparation:

1. Touch up shop-primed surfaces with primer as specified in Manufacturer’s standard “.
2. Solvent-clean surfaces that are not shop primed.
3. Clean surfaces to remove loose rust, mill scale, and other foreign substances by power wire brushing.
4. Prime surfaces as specified in Manufacturer’s standard .

3.3 INSTALLATION

A. According to AWWA C508 and manufacturer instructions.

B. Dielectric Fittings: Provide between dissimilar metals.

3.4 FIELD QUALITY CONTROL

A. Inspection:

1. Inspect for damage to valve lining or coating and for other defects that may be detrimental as determined by Architect/Engineer.
2. Repair damaged valve or provide new, undamaged valve.
3. After installation, inspect for proper supports and interferences.

B. Pressure test valves with piping.

3.5 CLEANING

A. Keep valve interior clean as installation progresses.

B. After installation, clean valve interior of soil, grit, loose mortar, and other debris.

END OF SECTION 400565.23

SECTION 400593.23 – LOW-VOLTAGE MOTOR REQUIREMENTS FOR PROCESS EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single- and three-phase motors for application on process equipment provided under other Sections.

B. The manufacturer of the driven equipment shall provide the associated motor.

C. Related Requirements:

1. Section 260510, “Limited Electrical for Small Projects”.

1.3 DEFINITIONS

A. NETA ATS: Acceptance Testing Specification.

1.4 SUBMITTALS

A. Product Data: For each type and rating of motor indicated.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include nameplate data, compliance with specified standards, electrical ratings and characteristics, physical dimensions, frame size, weights, mechanical performance data, support points and the following:

    1. Descriptive bulletins, including full description of insulation system.
    2. Bearing design data.
    3. Efficiency at ½, ¾ and full load.
    4. Power factor at ½, ¾ and full load.
    5. Conduit entry points and sizes.
    6. Special features and accessories (i.e. space heaters, temperature detectors, etc.).
    7. Power factor correction capacitor rating and type (when required).

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Qualifications Statements:

1. Submit qualifications for manufacturer and testing agency.

1.5 QUALITY ASSURANCE

A. Electric motors driving identical equipment shall be identical.

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

C. Motor manufacturer to maintain a documented ISO 9001 quality assurance program implementing suitable procedures and controls to monitor all aspects of production and testing.

D. When electrically driven equipment differs from that indicated, adjust the motor size, wiring and conduit systems, disconnect devices, and circuit protection to accommodate the equipment actually installed.

E. Testing Agency Qualifications: Member company of NETA or NICET.

1.6 DELIVERY, STORAGE AND HANDLING

A. Ship motor fully assembled, capable of being lifted in one piece. Comply with Section 016000, "Product Requirements" for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on site in manufacturer's original packaging and inspect for damage.

C. Storage:

1. Store materials according to manufacturer instructions.
2. Energize motors furnished with space heaters to prevent condensation throughout the storage and construction period. Perform periodic motor insulation resistance tests per manufacturer’s storage recommendations.
3. For extended outdoor storage, remove motors from equipment and store separately.
4. Maintain bearings during storage and construction period, and periodically rotate the motor shaft per manufacturer’s storage recommendations.
5. Lubricate per manufacturer’s recommendations and inspect purged grease for water, rust, or other contaminants.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. Nidec (US Motors)
2. ABB (Baldor-Reliance)
3. TECO-Westinghouse
4. Toshiba
5. WEG
6. General Electric

2.2 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.

B. Comply with the latest revision of the following as applicable:

1. NEMA MG 1, “Motors and Generators”.
2. IEEE 841 for TEFC motors where driven equipment specification indicates equipment requires motors to be severe-duty, chemical duty, or mill duty.

C. Unless otherwise noted, all motors ½ through 100 horsepower shall be rated 230/460 Volt, three-phase, 60 Hertz A.C.; motors 125 horsepower and above shall be rated 460 Volt, three-phase, 60 Hertz; and motors below ½ horsepower shall be rated 115/230 Volt, single phase, 60 Hertz A.C.

D. Duty: Continuous duty at ambient temperature of 40 degrees C and at altitude of 3300 feet above sea level.

E. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

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

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

H. Nameplates: Engrave or emboss on 316 stainless steel fastened to the motor frame with stainless steel screws or drive pins with information per NEMA MG 1.

I. Space heater: Include 120-volt space heater for moisture control on all motors rated 50 horsepower and larger.

J. Service Factor: 1.15 service factor on sine wave power and 1.0 service factor on VFD power in a 40 degrees C ambient, unless otherwise noted.

K. Motors and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

L. Enclosures: Conform to one of the NEMA standard enclosure designs as specified under the detailed driven mechanical equipment specification. If no enclosure type is specified, provide TEFC (Totally Enclosed Fan Cooled) enclosures.

M. Motors connected to VFCs: Inverter duty rated and comply with NEMA MG 1, Part 31. First or second torsional critical speed shall be outside the operating speed range for all VFC controlled motors.

N. Three-phase motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Meet or exceed requirements for NEMA MG 1, Part 12 for Premium Efficient motors 1 HP and larger.
3. Service Factor: 1.15.
4. Multispeed Motors: Variable torque.

    a. For motors with 2:1 speed ratio, consequent pole, single winding.
    b. For motors with other than 2:1 speed ratio, separate winding for each speed.

5. Rotor: Random-wound, squirrel cage.
6. Code Letter Designation:

    a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
    b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

7. Accessories: Where specified herein, or under process mechanical specification.

2.3 THREE PHASE MOTOR CONSTRUCTION

A. Enclosure and Frame:

1. NEMA enclosure type as specified in the process equipment specification.
2. NEMA frame for the associated horsepower.
3. Motor frames: Cast iron or welded heavy plate steel construction, stiff enough to withstand the rotating forces and torques generated and designed to limit or avoid any undesirable harmonic resonances.
4. Provide a threaded, forged steel, shouldered eyebolt blind tapped into the motor frame for lifting on all frames 254T and larger.
5. Condensate drain openings: Locate drain holes at the low points in the end brackets to allow removal of accumulated moisture from enclosures. Provide corrosion resistant, breather drain plugs for severe-duty motors.
6. Hardware: Hex head, SAE Grade 5 or better, plated for corrosion protection.
7. Nameplates: Engraved or embossed stainless steel plates fastened to the motor frame with stainless steel screws or drive pins. Clearly indicate all items of information listed in the applicable part of NEMA MG 1.
8. Main terminal box: Fabricated steel or cast iron, sized per the NEC for number and size of conduit connections and conductor bending and terminations as indicated on the

Drawings. Split box top to bottom with capability to rotate entry point to any quadrant. Provide gaskets between the box and motor frame and between box and its cover. Include ground lug for equipment grounding conductor termination.

9. Bearing housings: Provide machined surfaces for attaching a magnet mounted accelerometer to monitor the motor vibration in the vertical, horizontal, and axial directions at each bearing housing.
10. Frame grounding: provide motor frame grounding pad or threaded stud where supplemental grounding to frame is indicated on the drawings.
11. Corrosion resistant mill and chemical duty paint.

B. Windings:

1. Copper
2. Insulation rating: Class F.
3. Temperature rise: Class B at 1.0 SF, Class F at 1.15 SF.
4. Insulation: Non-hygroscopic, epoxy encapsulated windings for enclosure types WP I and WP II. Provide upgraded insulation by additional dips and bakes to increase moisture resistance for totally enclosed designs. Provide vacuum pressure impregnated (VPI) epoxy insulation for moisture resistance for outdoor motors.
5. Provide chemical and humidity resistance insulation system when IEEE 841 motors are specified.
6. Provide winding surge withstand capability per NEMA 1, Part 31 for VFC driven motors.
7. Provide specified temperature sensing devices for VFC driven equipment. If not specified, provide a winding temperature detector per the accessories paragraph.

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

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

E. Rotor:

1. Forged or rolled steel shaft, machined, smooth finished, with sufficient strength for operation including 25 percent overspeed condition.
2. Shaft end coordinated with driven equipment coupling.
3. Entire assembly coated with protective coating.
4. Inpro seals on both ends of the shaft to prevent grease leakage and entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest. Severe duty motors to have improved sealing per IEEE 841.
5. Vertical Motor Shafts:

    a. Provide hollow shaft and P flange mounting to allow driven shaft to extend through provide for vertical pump applications. .
    b. Coupling for connecting the motor shaft to the driven shaft is located in the top of the motor.
    c. Where solid shaft is provided couple the driven shaft below the P flange face. .

6. Rotor Core:

    a. Solid, built-up stack of fully processed and coated, high-grade, low-loss silicon steel laminations.
    b. Die cast aluminum or fabricated copper bars or their respective alloys.
    c. Rotors on frames 213T and above to be keyed to shaft and rotating assembly dynamically balanced.

7. Rotor Assembly:

    a. Coated with corrosion resistant epoxy insulating varnish or other protective coating, thermally stable, statically and dynamically balanced.
    b. Balance weights securely attached to the rotor resistance ring by welding or similar permanent method.

F. Horizontal Bearings: roller type, grease lubricated.

1. Bearings: Anti-friction open or single-shield, vacuum-degassed steel ball or roller bearings, electric motor quality, designed for 45 degrees C maximum temperature rise. Metric size bearings are not acceptable.
2. Life: L 10 life of 100,000 hours for direct coupled applications and 26,000 hours for belted applications based. IEEE 841 motors, L 10 life increased to 150,000 and 50,000 hours respectively.
3. Shaft Seals: Provide to prevent grease leakage and the entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest.
4. Shaft Currents: Provide mitigation per this specification section unless specified in the process equipment specification.
5. Comply with ABMA and refer to process equipment specification for stricter or additional requirements.

G. Vertical Bearings: per manufacturer, thrust type.

1. Bearings: Manufacturer's standard design, constructed with thrust bearings on top to allow inspection and/or replacement without requiring complete disassembly of motor, of type and size to satisfy thrust loading requirements.
2. Life: Rated for an in-service L 10 life of 50,000 hours, designed to support the weight of the rotor plus, if required, the weight of the rotating driven equipment parts and the hydraulic thrust created by the driven equipment, with a 40 degrees C maximum temperature rise. Metric bearings are not acceptable.
3. Shaft seals: Provide to prevent grease leakage and the entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest.
4. Shaft currents: Provide mitigation per this specification section unless specified in the process equipment specification.
5. Comply with ABMA and refer to process equipment specification for stricter or additional requirements.

2.4 THREE PHASE MOTOR ACCESSORIES

A. Space heaters: Silicone rubber strip type, accessible for inspection, rated 120 Volt, single phase, designed to prevent condensation inside the enclosure when the motor is idle, with leads

brought out to a separate terminal box. Emboss the heater wattage and voltage on the motor nameplate.

B. Winding Temperature Switch: Three embedded bi-metallic temperature thermostat switches with normally open or normally closed per process equipment specification and leads terminating in the main conduit box.

C. Motor Shaft Currents: insulate the ODE bearing and provide a shaft grounding strap. Insulate bearing probes to prevent shorting out bearing insulation.

D. Anti-Backspin Device: Provide shaft mounted, mechanical non-reverse ratchet rated at 100 percent of motor full load torque for immediate protection against reversing due to phase reversals or from backspin at shutdown.

2.5 POWER FACTOR CORRECTION CAPACITORS

A. Select the PFCC rating to provide an operating power factor of the motor between 93 to 95 percent at full load and 95 to 98 percent when partially loaded. The capacitor current shall not exceed the motor no-load magnetizing current.

B. Provide the required capacitor and capacitor information to the motor control center (MCC) manufacturer for inclusion inside the MCC.

C. Capacitors: UL listed, NEMA rated and tested, three phase dry film or non-PCB dielectric liquid insulated, with three current limiting fuses rated for 100 kA interrupting capacity at 480 Volts, equipped with internal discharge resistors and fuse loss indicators, mounted in hermetically sealed steel enclosures suitable for conduit connection. Covers shall be gasketed, bolt-on type.

2.6 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Motors 1/20 HP and Smaller: Shaded-pole type.

D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

E. Insulation: Class F or better, with Class B temperature rise of 80 degrees C above ambient, 1.15 service factor. Locked rotor current to be no greater than specified in NEMA MG 1, Design "N".

F. Standard enclosure: Fully gasketed, totally enclosed air over or fan cooled in conformance with NEMA MG 1.

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

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

I. Class 1, Division 1 and 2 locations: Explosion proof, marked with a T3B temperature code label, and UL listed for use in Class 1, Division 1, Groups C & D, and Class II, Groups E, F, & G hazardous location. The temperature code marking to appear on the nameplate.

2.7 SOURCE QUALITY CONTROL

A. Factory Testing: Prior to shipment perform manufacturer’s standard tests in accordance with NEMA MG 1 and IEEE 112.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Upon delivery of motor and prior to unloading, inspect equipment for damage.

B. Comply with DELIVERY, STORAGE, AND HANDLING article within this specification.

3.2 INSTALLATION

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

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

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

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

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

F. Install motor branch circuit conduits and conductors in accordance with NEC and local code requirements. Connect motors to rigid conduit system by a short section of liquid-tight flexible conduit to isolate the conduit system from motor vibration. Where motors are installed outdoors, bring conduit into bottom of motor terminal box to avoid standing water at connection point.

G. Terminate the motor leads as shown on the connection diagrams using products intended for vibration applications.

H. Ground equipment according to Section 26056, “Grounding and Bonding for Electrical Systems.”

I. Tighten electrical connections and terminals according to manufacturers' published torque values.

J. Install conduit and wiring between motor auxiliary devices and associated indicators, controllers and protective devices in accordance to installation drawings.

K. Connect devices sensitive to electromagnetic interferes such as RTD's, thermistors, thermal protector switches, vibration sensors with shielded instrumentation wiring per installation drawings.

L. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260510, “Limited Electrical for Small Projects.” Identify field-installed conductors, interconnecting wiring, and components.

3.4 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until motors are ready to be energized and placed into service.

B. Lubrication and Shaft Rotation: Lubricate parts and rotate shaft periodically according to manufacturer’s written instructions until motors are ready to be energized and placed into service.

3.5 FIELD QUALITY CONTROL

A. Perform inspections and tests Inspect and test according to the Inspection and Test Procedures for Rotating Machinery state in NETA Acceptance Testing Specification paragraph 7.15.1. Options tests are not required unless called for within the process equipment specification.

B. Perform the following infrared (thermographic) scan tests and inspections, for all motors 250 hp and larger, and prepare reports:

1. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each motor exterior for detection of hot spots in stator or bearings.
2. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each motor 11 months after date of Substantial Completion.
3. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

C. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Motors will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies the motor and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP AND ADJUSTMENT

A. Complete installation and startup checks according to manufacturer's written instructions. Confirm motor is structurally, mechanically, and electrically ready for start-up. Checks include support system, vibration isolation, alignment, lubrication system, and cleanliness.

B. Start-up motor in accordance with process equipment specification.

C. Verify correct phase rotation at motor with driven equipment uncoupled. Correction for phase rotation to be made in the motor terminal box.

D. Prepare inspection and test reports.

3.7 DEMONSTRATION / SYSTEM FUNCTION TESTS

A. Run motor for system testing as required in motor controller and driven equipment specifications.

B. Confirm correct operation of all protective and metering devices.

C. Measure voltage and motor running current and evaluate relative to load conditions and nameplate full load amperes. Corrective action is required for any current imbalance 10 percent or greater.

D. Prepare driven equipment system testing report. Include results of all tests and check made, meter readings and recordings, and summary adjustments made. Clearly identify any discrepancies and concerns.

END OF SECTION 400593.23

SECTION 406100 - PROCESS CONTROL AND ENTERPRISE MANAGEMENT SYSTEMS GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes procurement of the services of a Process Control System Supplier (PCSS) to provide all materials, equipment, labor, and services required to achieve a fully integrated and operational system as specified herein, in "Related Requirements" under this Article, and in related drawings, except for those services and materials specifically noted.

B. Under this contract, the Owner will serve as the Applications Engineer System Supplier (AESS) as defined in this Section.

C. Summary of the PCSS scope of supply is as follows:

1. Coordinate integration of Vendor provided equipment between Vendor and AESS/Owner.
2. Furnish and install all components pertaining to ventilation monitoring and alarming as shown on the Instrumentation Drawings, and Sheet MD-1, Detail D.
3. Coordinate integration of ventilation monitoring and alarming equipment with AESS/Owner.

D. Items specifically excluded from the PCSS scope include the following:

1. Programming of the Belt Filter Press PLC and OIT.
2. Programming of the PLC in SCADA Panel LCP-DB.
3. Programming of the Owner's SCADA system.

E. Include auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, whether indicated on the Drawings or not.

F. All equipment and installations to satisfy applicable Federal, State and local codes. Refer to Electrical drawings for area classifications for Class and /Division ratings.

G. Use the equipment, instrument, and loop numbering scheme indicated on the Drawings and in the specifications in the development of the submittals. Do not deviate from or modify the numbering scheme.

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Applications Engineering System Supplier (AESS): The entity that provides all programming, configuration, and related services for the plant area LCP-DB and SCADA system interfacing with equipment provided by the PCSS. Under this contract, the Owner will serve as the AESS.

C. Maintenance of Plant Operations (MOPO): A construction plan which prevents or limits process disruptions during construction.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site for coordination**.**

B. Conduct a project kickoff coordination meeting within two weeks after submitting the Project Plan. The purpose of the meeting is to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. The meeting will last up to 4 hours.

C. Conduct a submittal review coordination meeting after the Hardware, Panel Drawing, and Loop Drawing Submittal package has been reviewed by the Engineer and returned to the PCSS. The purpose of this meeting is to review comments made on the submittal package; to refine scheduled deadline dates; coordinate equipment installation activities; and provide a forum for any further required coordination between the PCSS, Vendor, and AESS/Owner. The meeting will last up to 4 hours.

D. Attendance at MOPO meeting.

E. Bi-Weekly conference call coordination meetings with Engineer, Contractor, Vendors, and AESS as required prior to any field start-up or activity testing begins.

F. Schedule the mandatory coordination meetings as described herein. Hold the meetings at the Owner's designated location and include attendance by the Owner, the Engineer, the Contractor, the Vendor Project Engineer, and the AESS/Owner Project Engineer, if applicable. Other Division 40 specifications may require additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. Schedule the meeting for a minimum of one week before the requested meeting date.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, mountings, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of control equipment, control panels, and instrumentation as specified herein.
4. Include diagrams for power, signal, and control wiring.

C. Qualifications Submittal:

1. Submit, within 30 calendar days after Notice to Proceed, detailed information on staff and organization to indicate compliance with the Quality Assurance requirements of this Section. The Qualifications submittal is required to be submitted and approved before any further submittals will be accepted. Failure to meet the minimum requirements is grounds for rejection as a PCSS. The Qualifications Submittal to contain the following:

    a. Copies of ISA CCST Level 1 certificates for all field technicians or resumes demonstrating field experience.
    b. Notarized statement from the firm's financial institution demonstrating ability for the firm to meet the obligations necessary for the performance of the work.
    c. Copy of UL-508A certificate for panel fabrication facilities.
    d. Project references for water or wastewater projects as defined in the “Quality Assurance” paragraphs.
    e. Documentation to demonstrate the ability to complete this project including resumes of key staff, financial capacities, details on engineering, design, fabrication, and field service capacity, and location of staff responsible for responding to the site within four hours to resolve startup issues.

D. Project Plan, Deviation List, and Schedule Submittal:

1. Submit, within 45 calendar days after Notice to Proceed, a Project Plan. Submit for approval the Project Plan before further submittals are accepted. The Project Plan to contain the following:

    a. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. Include a general discussion of startup, replacement of existing equipment with new, switchover (Maintaining Plant Operations during system transition), approach to testing and training, and other tasks as required by these specifications.
    b. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each of these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.

c. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include sample of control system architecture.
d. Provide detailed information so Engineer can review the following characteristics for each type of tag, label, or nameplate for the different types of components provided above:

1) Size or range of size of the tag, label or nameplate.
2) Font style.
3) Material.
4) Color(s).

E. Hardware and Software Packages Submittal

1. Complete system architecture drawing(s) showing in schematic form the interconnections between major hardware components including, control panels, computers, networking equipment, control panels with PLC systems and I/O modules, local operator interfaces, process equipment vendor panels with PLCs. The PCSS is required to provide unique network architecture drawings for the following networks:

a. SCADA

2. Develop the system architecture drawing(s) in accordance with the following information and guidelines:

a. Show power connections to each piece of equipment or grouping of equipment with voltage and power sources noted such as 120VAC UPS battery, 24VDC battery, or 120VAC from LP (lighting panel). Indicate specific UPS number or circuit number whenever possible.
b. All communication cable types should be uniquely identified with a specific line type, and cable characteristics clearly indicated in a key or legend located on drawing(s). For example, 50/125-micron multimode mode fiber, or CAT6 Ethernet copper cabling. Any multiconductor communication cables will be clearly labeled above each individual communication with a note added to drawing those states if no quantity exists above a linetype, there is only one communication cable between devices. If a multi-conductor cable has multiple colors, legend to clearly indicate which colors are used for which networks (i.e., a multi-pair fiber optic cable used for dedicated networks such as SCADA, Electrical, Security, HVAC, etc.)
c. All communication cables need to be assigned a unique cable identification label and shown in either a table or above the communication line.
d. Identify network protocols for each communication path or for system indicated in a key or legend as appropriate. Examples are Allen-Bradley EtherNet/IP, Modbus TCP/IP, or DNP3.
e. Indicate which port or connection number the communication cable is terminating at any device that has multiple ports or connection points. For multiple devices, this could be shown once in a key or legend and noted on architecture as appropriate.
f. For each PLC control panel or network communication enclosure provided by PCSS, the architecture drawing clearly references other drawings provided by the PCSS for detailed panel wiring diagrams with a note near that PLC panel or

communication enclosure indicating referenced drawing numbers. A placeholder is acceptable at the time of submission if these drawings are to be submitted later.

g. Use symbology and/or icons whenever possible to represent a device and differentiate between devices that are different form factors (i.e. tower computer vs. desktop computer vs. rack mounted). Vendor CAD libraries are preferred for symbols.
h. Develop a diagram that will allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature.
i. Use a minimum sheet size of 11"x17" and use of more than one sheet is acceptable with a logical breakout between sheets (i.e., head end on one sheet and plant control system on another). Clearly identify line continuations between drawings.

F. Panel Layout Drawings and Wiring Diagrams Submittal:

1. Submit Drawings for all new panels and modifications of existing panels.
2. Panel Layout Drawings: Draw panel assembly and elevation drawings to scale, and detail all equipment in or on the panel. Use 11"x17" sheet size for panel drawings and include the following:

a. Clearly indicate a legend sheet with all symbols used on drawings and with voltage, color and size of each wire.
b. Interior and exterior panel elevation drawings to scale.
c. Nameplate schedule.
d. Conduit access locations.
e. Panel construction details.
f. Cabinet assembly and layout drawings to scale. Include a bill of material on the assembly drawing with each panel component clearly defined. Cross-reference the bill of material to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.
g. Fabrication and painting specifications including color (or color samples).
h. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
i. Submit evidence that all control panels are constructed in conformance with UL 508A and bear the UL seal confirming the construction. Specify if UL compliance and seal application accomplished at the fabrication location or by field inspection by UL inspectors. Costs associated with obtaining the UL seal and any inspections are be borne by Contractor.

3. Wiring Diagrams Submittal:

a. PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. Include drawings in Final O&M submittal. Leaving this information blank on Final Documentation drawings is not acceptable.
b. Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. Panel wiring diagrams include power and signal connections, UPS and normal power sources, all panel ancillary equipment,

protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring includes the device ISA-tag and a unique numeric identifier. Diagrams identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer. I/O wiring numbered with rack number, slot number, and point number. Two-wire and four-wire equipment to be clearly identified, and power sources noted. Submit final wire numbering scheme. Provide panel drawings that are 11-inch x 17-inch in size.

G. Testing Plan Submittals:

1. Refer to Section 406121.20 “Process Control System Testing” for specific testing submittal requirements.

H. Training Plan Submittals:

1. Refer to Section 406126 “Process Control System Training” for specific training submittal requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Coordinate "Qualification Data" Paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as may be supplemented in "Quality Assurance" Article.

B. Product Test Reports: Refer to individual instrument, component or hardware specifications for specific requirements.

C. Evaluation Reports: Refer to individual instrument, component or hardware specifications for specific requirements.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For all PCSS supplied hardware to include in operation and maintenance manuals.

1. Submit in accordance with Section 017823 “Operation and Maintenance Data.”
2. Include the following information on the operations and maintenance manuals:

a. Table of Contents:

1) Provide a Table of Contents for the entire manual with the specific contents of each volume clearly listed. Include the complete Table of Contents in each volume.

b. Equipment Lists:

1) Develop the following lists in Microsoft Excel format:

a) An equipment list or spreadsheet for all non-instrument devices supplied listing description, specification section and paragraph

number, manufacturer, model number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

c. Equipment Operations and Maintenance Information:

1) Provide either new documentation written specifically for this project or modified standard vendor documentation to the vendor O&M documentation for each device, piece of equipment, or OEM software. Indicate with arrows or circles all portions that apply to all standard vendor documentation furnished. Neatly line out or cross out all portions that do not apply. Remove groups of pages or sections that do not apply to the specific model supplied.
2) Provide the record documentation of the completed test forms with signoffs as specified in Section 406121.20 “Process Control System Testing.”
3) Include instrument/equipment calibration and configuration forms.

d. As-Built Drawings:

1) Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. Include on the drawings all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS. Provide electronic files for all drawings produced. Provide drawings in AutoCAD ".dwg" format.
2) Include on as-built documentation information from submittals, as described in this Specification, updated to reflect the as-built system. Incorporate errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests.

B. Electronic O&M Information:

1. In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of configuration files, on DVD or USB thumb drive. Supply electronic documents in Adobe Acrobat format.
2. Provide electronic files for all custom-developed manuals including training manuals. Supply text in Microsoft Office and Adobe Acrobat formats.
3. Provide electronic files for all drawings produced. Supply drawings in AutoCAD ".dwg" and in Adobe Acrobat formats. Provide drawings using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
4. Back up each computer system hardware device onto DVD or USB thumb drive after Substantial Completion and turn over to the Owner.
5. If specified in the training section, provide digital copies of all training videos. Format videos so they are readable by standard DVD players and by standard PC DVD drives, a minimum of 800 by 600 pixels, and include sound.

C. Include information as specified in Section 017823 “Operation and Maintenance Data” on the cover and edge of each volume.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Control panel fabricator to hold a valid UL-508A certification for their panel fabrication facility.

B. Installer Qualifications: Fabricator of products.

C. Responsible for the technical supervision of the installation by providing on-site supervision to the installers of the various components.

D. The Process Control System Supplier (PCSS) to be a “systems integrator” regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a “systems integrator” means an organization that complies with all of the following criteria:

1. Employs personnel on this project who have successfully completed ISA or manufacturer’s training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel to hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel include, as a minimum, the lead field technician.
2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion is defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references for projects where the PCSS's contract was of similar size to this project.
3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.

E. Maintain a permanent, fully staffed and equipped service facility within 120 miles of the project site with full-time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. Respond to on-site problems within 12 hours of notice. Provide an on-site response within four hours of notification starting at two months before scheduled startup to two months after startup completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 "Product Requirements" for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Environmental Requirements: Refer to Electrical Drawings for specific environmental and hazardous area classifications.

B. Elevation: Design equipment to operate at the project ground elevation.

C. Temperature:

1. Outdoor area equipment to operate between -4 to 122 degrees F (-20 to 50 degrees C) ambient.
2. Equipment in indoor locations operate between 50 to 95 degrees F (10 to 35 degrees C) degrees ambient minimum.
3. Storage temperatures range from 32 to 122 degrees F (0 to 50 degrees C) degrees ambient minimum.
4. Furnish additional cooling or heating if required by the equipment specified herein.
5. Relative Humidity. Air-conditioned area equipment operates between 20 to 95 percent relative, non-condensing humidity. All other equipment operates between 5 to 100 percent relative, condensing humidity.

D. Do not ship control system equipment located in the control room until the control room areas comply with specified ambient temperature and humidity and free of dust and debris.

1.11 WARRANTY

A.

PART 2 - PRODUCTS

2.1 GENERAL

A. Electrical Requirements for Control System:

1. Operate equipment on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above to be provided between power supply and interconnected instrument loop. Supply constant voltage transformers where equipment requires voltage regulation.
2. With the exception for field device network connected devices, all electronic instrumentation utilizes linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).
3. Outputs of equipment that are not of the standard signals as outlined, have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.
4. All switches have double-pole, double-throw (DPDT) contacts rated at a minimum of 600 VA, unless noted otherwise.
5. Switches and/or signals indicating an alarm, failure or upset condition wired in a fail-safe manner as shown on the P&IDs**.** A fail-safe condition is when an open circuit generates an alarm state (i.e., contact opens).
6. Materials and equipment UL approved whenever such approved equipment and materials are available.
7. All equipment furnished designed and constructed so that in the event of power interruption, the systems specified all go through an orderly shutdown with no loss of

memory and resume normal operation without manual resetting when power is restored, unless otherwise noted.

8. Surge protection requirements for control system power, signal, and communication lines are specified in Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where control panels and instrumentation will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION

A. The shield on each process instrumentation cable to be continuous from source to destination and be grounded at only one ground point for each shield.

3.3 IDENTIFICATION

A. Provide identification system for all PCSS provided hardware, instrumentation, and communication cabling. Provide details as specified in “Project Plan”.

3.4 FIELD QUALITY CONTROL

A. Refer to individual hardware and instrument specification sections.

3.5 STARTUP SERVICE

A. Refer to Section 406121.20 “Process Control System Testing.”

B. Refer to Section 406126 “Process Control System Training.”

C. Engage a factory-authorized service representative to perform startup service as specified in individual hardware and instrument specification sections.

D. Weekly on-site coordination meetings with Engineer, Contractor, Vendors**,** as required during active construction period.

END OF SECTION 406100

SECTION 406121.10 - PROCESS CONTROL SYSTEM TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes process control system testing, where the Vendor provided local control panels (Polymer and Belt Filter Press) testing is performed by the Vendor and the SCADA interface is performed by the AESS/Owner.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 019113 “General Commissioning Requirements.”

C. Furnish all labor, materials, equipment and incidentals required to complete the testing of all devices and systems furnished and installed as detailed on Drawings, and as specified herein.

D. A third party, referred to as Applications Engineering System Supplier (AESS), has been pre-selected to perform Applications Engineering. Provide support services to AESS as defined herein.

E. Vendor to program those Vendor provided PLCs, HMIs, and OITs shown on Drawings. AESS/Owner to program those PLCs, SCADA shown on Drawings. Similar equipment provided by equipment vendors to be programmed by respective equipment vendor.

1. Vendor scope of work includes Programmable Logic Controller (PLC) programming, testing of PLC logic, Operator Interface Terminal (OIT) graphics development, OIT software configuration, and startup/training activities associated with the configured portions of the Vendor provided PLC/OIT system.
2. AESS/Owner scope of work includes area Programmable Logic Controller (PLC-DB) programming of ventilation fan monitoring and alarm stations, testing of PLC logic, Human Machine Interface (HMI) graphics development, HMI software configuration, database development, report development, and startup/training activities associated with the configured portions of the PLC/HMI/OIT system.

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS. Under this contract, the Owner will serve as the Applications Engineer System Supplier (AESS).

C. Vendor: The entity who provides all programming, configuration, and related services for the control system equipment provided by the Vendor.

D. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.

E. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

F. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

G. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

H. Uninterruptible Power Supply (UPS): A device capable of providing emergency battery power when the main power source fails.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Conduct a factory testing coordination meeting two weeks prior to factory acceptance testing. The purpose of this meeting is to discuss specifics of PCSS's proposed tests and to provide a forum for coordinating required AESS factory testing. Meeting will last up to one business day.

C. Conduct a field-testing coordination meeting every two weeks prior to start of field acceptance testing. Purpose of this meeting is to discuss specifics of PCSS's proposed tests and to provide a forum for coordinating required AESS field-testing. Meeting will last up to one business day.

1.5 ACTION SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Testing Submittals - Submit, in one submittal, the following testing related documents:

1. Status Signoff Forms:

a. Develop and submit project specific I/O Status signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.

1) Example forms are shown in the Appendices.

2) Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
3) Submit testing forms prior to start of testing.

2. Testing Procedures:

a. Submit detailed procedures proposed to be followed for the PCSS portion of each of the tests specified herein. The test procedures serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified.

3. Calibration Forms. See paragraph 3.2.G.2 in this Section.

1.6 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For Test Documentation of system:

1. Upon completion of each required test, document the test by submitting a copy of the signed off Testing Status forms. Testing is not considered complete until the signed-off forms have been submitted and approved. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.7 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING - GENERAL

A. Refer to Section 406100 “Process Control and Enterprise Management Systems and General Provisions.”

B. Track results of testing on a project specific status sign off form or similar document. The PCSS is responsible for maintaining the sheet. Appendix of this Section has an example template for this sheet.

C. Tests the PCSS is required to perform are as follows:

1. Field Testing:

a. Operational Readiness Test (ORT).
b. Site Acceptance Test (SAT).

D. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.

E. PCSS to coordinate all required testing with Contractor, affected Subcontractors, Engineer, and AESS/Owner.

F. Engineer reserves the right to test or re-test any functions.

G. Correction of Deficiencies:

1. Correct deficiencies in workmanship and/or items not meeting specified testing requirements at no additional cost to Owner.
2. Repeat testing, as specified herein, after correction of deficiencies is made until specified requirements are met. Perform this work at no additional cost to Owner.

3.2 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

A. Purpose of ORT is to check that process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test will determine if the equipment is ready for operation.

B. This test takes place prior to startup. Prior to starting this test, install relevant process equipment and mechanically test, install instruments and control panels, and complete field wiring.

C. Required Documents for Test:

1. Master copy of the PCSS developed field testing signoff forms.
2. Testing procedures.
3. Calibration forms.

D. These inspections, calibrations, and tests do not require witnessing. However, Engineer may review and spot-check the testing process periodically. The PCSS to correct all deficiencies found prior to start-up.

E. PCSS to maintain Sign-off forms and Calibration forms at job site and make them available to Engineer/Owner at any time.

F. Perform the following steps as part of the ORT:

1. Instrument calibration, configuration, and set-up.
2. PCSS hardware and I/O testing
3. I/O Testing to the HMI with AESS.
4. Testing of Automatic control strategies with AESS.

G. Instrument calibration, configuration, and set-up:

1. Calibrate, configure, and set-up all components and instruments to perform the specified functions.

2. Calibration form:

    a. For any component or instrument requiring dip switch settings, calibration, or custom configuration, maintain a calibration form in field documenting this information. These forms summarize the actual settings used in field to allow an Instrument technician to replace device entirely and configure it to function as it did before.
    b. Add this information to Instrument data sheet, to a copy of manufacturer's standard "Configuration Sheet," or create a separate form.

        1) If a separate form, list the Project Name, Loop Number, ISA Tag Number, I/O Module Address, Manufacturer, Model Number/Serial Number, Output Range and Calibrated Value.

    c. Some examples of required information are:

        1) For Discrete Devices: Actual trip points and reset points.
        2) For Instruments: Any configuration or calibration settings entered into instrument.
        3) For Controllers: Mode settings (PID).
        4) For I/O Modules: Dip switch settings, module configuration (if not documented in the native programming documentation).

    d. Maintain a copy of these forms in field during testing and make them available for inspection at any time.
    e. For any device that allows a software back-up of configuration files to a laptop, make configuration files available to Engineer/Owner for inspection. Submit as part of O&M Manual as specified in Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

H. Input/Output (I/O) Testing to the HMI with AESS/Owner.

1. Purpose of the I/O testing to HMI and OITs with AESS/Owner is to check that the Instruments and field equipment are connected properly and work from the end device, through PLC, to HMI and OIT units.
2. PCSS in conjunction with the Contractor and AESS/Owner to test signals under process conditions. Preferred test method will always be to execute the test wherever possible to the end elements. For example, the preferred test will prove valve open/close limit switches by operating the valve, not by installing a jumper on the limit switch contacts. However, if equipment or process is not available to test signal over its entire calibrated range, PCSS may test using a simulation method and make a note on sign-off form. Coordinate with Owner to maximize availability of field equipment in manual mode as required.
3. Perform the following I/O tests:

    a. Discrete Input: At the device or instrument, change signal condition from the inactive to active state. Observe results on all indicators within loop such as HMI screens, OIT screens, pilot lights, horns, beacons, etc.
    b. Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50 percent, and 100 percent as well as on increasing and decreasing range. Observe results on all indicators within loop such as HMI screens, OIT

screens, recorders, digital indicators, etc.

c. Discrete Output: Test signals by switching the equipment to manual control at HMI and OIT nodes and turning the output on or using other means to turn the output on. Then verify equipment responds accordingly.

d. Analog Output: Test signals by switching the equipment to manual control at HMI and OIT nodes and ramping the output up and down. Then verify equipment responds accordingly.

3.3 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

A. After system is started-up and running treatment process in automatic control to extent possible, system to undergo a test as defined in Section 019113 “General Commissioning Requirements.”

B. While this test is proceeding, Engineer and Owner have full use of system. Allow only plant operating personnel to operate equipment associated with live plant processes. Plant operations to remain the responsibility of Owner and decision of plant operators regarding plant operations is final.

C. During this test, PCSS personnel to be present to address any potential issues that would impact system operation. PCSS is expected to provide personnel for this test who have an intimate knowledge of equipment supplied as part of this system. When PCSS personnel are not on-site, provide cell phone/pager numbers that Owner personnel can use to ensure that support staff are available by phone and/or on-site within four hours of a request by operations staff.

D. PCSS to analyze and correct any malfunctions during test. In event of rejection of any part or function, perform repairs or replacement within 5 days.

E. Throughout duration of SAT, do not make software or hardware modifications to system without prior approval from Owner or Engineer.

END OF SECTION 406121.10

APPENDIX 406121.10 -A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM

An example template for I/O Status signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

4-Jun-14

[Project Name] Appendix A - Input/Output (I/O) Status Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Field Testing.
Instrument Alarm Setpoint - Setpoint for any alarms set by PCSS
Wiring Complete - Signal wired from field device to PLC
I/O Tested - Signal tested from field device to SCADA HMI

PLC	Signal Tag	Description	Range or Active State when closed	P&ID	Signal	Rack	Slot	Channel	Instrument Alarm Setpoint	Calibrate, config., and Wiring complete	Date	I/O Tested	Date	Notes
PLC-SC	LIT-4000-1	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1	0						
PLC-SC	LIT-4010-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1	1						
PLC-SC	SI-4100-1	RAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	2						
PLC-SC	SI-4100-4	RAS Pump No. 4 Speed Feedback	0-100%	15	AI	2	1	3						
PLC-SC	FIT-4102-1	RAS Flow Pumps 1-3	0-1900 GPM	14	AI	2	1	4						
PLC-SC	SI-4110-1	WAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	5						
PLC-SC	N/A	Spare Slot	N/A	N/A	Spare	2	5	N/A						
PLC-SC	SC-4100-1	RAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	0						
PLC-SC	SC-4100-2	RAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7	1						
PLC-SC	SC-4100-3	RAS Pump No. 3 Speed Setpoint	0-100%	14	AO	2	7	2						
PLC-SC	SC-4110-1	WAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	3						
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	4						
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	5						
PLC-SC	TSH-4000-1	Secondary Clarifier No. 1 High Temp	Normal	8	DI	3	1	0						
PLC-SC	XA-4000-1	Secondary Clarifier No. 1 Motor Overload	Normal	8	DI	3	1	1						
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	2						
PLC-SC	WAHH-4000-1	Secondary Clarifier No. 1 High High Torque	Normal	8	DI	3		3						
PLC-SC	YRI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1	4						
PLC-SC	YCI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1	5						
PLC-SC	YFI-4100-1	RAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	6						
PLC-SC	FAL-4100-1	RAS Pump No. 1 Low Flow	Normal	14	DI	3	1	7	50 GPM	RJM	12/18/2011	JAS	12/22/2011	Example completed line
PLC-SC	Spare	Spare	Normal	14	DI	3	1	8						
PLC-SC	YRI-4100-1	RAS Pump No. 1 Running	Running	14	DI	3	1	9						
PLC-SC	YCI-4100-1	RAS Pump No. 1 In Remote	In Remote	14	DI	3	1	10						
PLC-SC	YFI-4110-1	WAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	11						
PLC-SC	FAL-4110-1	WAS Pump No. 1 Low Flow	Normal	14	DI	3	1	12						
PLC-SC	Spare	Spare	Normal	14	DI	3	1	13						
PLC-SC	YRI-4110-1	WAS Pump No. 1 Running	Running	14	DI	3	1	14						
PLC-SC	YCI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	15						
PLC-SC	HSS-4000-2	Secondary Clarifier No. 2 Start Command	Start	8	DO	4	6	0						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	1						
PLC-SC	HSS-4100-2	RAS Pump No. 2 Start Command	Start	14	DO	4	6	2						
PLC-SC	HSS-7000-2	Sludge Holding tank Blower No. 2 Start Command	Start	17	DO	4	6	3						
PLC-SC	HSS-4100-5	RAS Pump No. 5 Start Command	Start	15	DO	4	6	4						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	5						
PLC-SC	HSS-4105-1	Secondary Scum Pump No. 2 Start/Stop	Start	15	DO	4	6	6						
PLC-SC	HSS-4110-2	WAS Pump No. 2 Start/Stop Command	Start	15	DO	4	6	7						
PLC-SC	7160-FQI-1	Sludge Loadout LCP Pumping Indicator	Pumping	17	DO	4	6	8						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	9						
PLC-SC	HSS-7115-2	Sludge Holding Tank Mixer No. 2 Start	Start	17	DO	4	6	10						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	11						
PLC-SC	HSO-7117-2	Sludge Holding Tank Discharge Valve No. 2 Open CMD	Open	17	DO	4	6	12						
PLC-SC	HSC-7117-2	Sludge Holding Tank Discharge Valve No. 2 Close CMD	Close	17	DO	4	6	13						
PLC-SC	HSS-7120-2	TS Transfer Pump No. 2 Start Command	Start	17	DO	4	6	14						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	15						

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SECTION 406126 - PROCESS CONTROL SYSTEM TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes process control system training for provided devices and systems.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.4 ACTION SUBMITTALS

A. Training Plan Submittal:

1. Submit specific proposed training plan with the following:

a. Definitions, objectives, and target audience of each course.
b. Schedule of training courses including proposed dates, duration, and locations of each class.
c. Complete copy of all proposed handouts and training materials bound and logically arranged with all materials reduced to a maximum size of 11 inch by 17 inch, then folded to 8.5 inch by 11 inch for inclusion into the binder.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Directly relate the training and instruction to the system being supplied. Training program represents a comprehensive program covering all aspects of the operation and maintenance of the system.

B. Coordinate all training schedules with and at the convenience of Owner, including shift training required to correspond to Owner's working schedule.

C. All onsite instructors must be intimately familiar with the operation and control of Owner's facilities.

D. Provide detailed training manuals to supplement the training courses including specific details of equipment supplied and operations specific to the project. Provide the manuals in hardcopy for each student. Provide electronic copy of each training manual in PDF format for Owner's future use.

E. Make use of teaching aids, manuals, or slide/video presentations as required. After training services, deliver training materials to Owner.

F. Owner reserves the right to videotape all custom training sessions. Training tapes become sole property of Owner.

3.2 TRAINING SUMMARY

A. Provide following training courses listed in the summary table below:

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Ventilation Flow Switches and Alarm Stations	1	4	1	Maintenance, Operations, Administrator

B. Definitions of Audience Roles:

1. Administrator: Personnel responsible for maintaining the HMI / SCADA system.
2. Maintenance: Personnel responsible for maintaining the field controller hardware and instrumentation system.
3. Operations: Personnel responsible for daily plant operations.
4. Management: Non-daily operations personnel.

3.3 ONSITE TRAINING

A. Training personnel are required to be intimately familiar with the control system equipment, its manipulation, and configuration. Training personnel are required to command knowledge of system debugging, program modification, troubleshooting, maintenance procedure, system operation, and programming, and capable of transferring this knowledge in an orderly fashion to technically oriented personnel.

B. Instrument Training:

1. Provide instruction on the maintenance of the field instrumentation and alarm panels. Conduct this training before FDT, but no more than 1 month before and at a time suitable to Owner. This training takes place at Owner's facility. Training program is required to include the following elements:

    a. Training in standard hardware maintenance for the instruments provided.
    b. Specific training for the actual instrumentation configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up for this Contract.
    c. Testing, adjustment, and calibration procedures.
    d. Troubleshooting and diagnosis.
    e. Maintenance and frequency.

END OF SECTION 406126

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SECTION 406763 - CONTROL PANEL MOUNTED UPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes control panel mounted uninterruptible power supplies (UPS).

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.

1.3 DEFINITIONS

A. Uninterruptible Power Supply (UPS): A device capable of providing emergency battery power when the main power source fails.

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 SINGLE PHASE UPS - INTERNAL TO CONTROL PANELS

A. Manufacturers

1. Manufacturers and their products are subject to compliance with requirements.:

a. Sola Hevi Duty SDU UPS.
b. Substitutions: Or equal.

B. System Description:

1. Provide an industrially rated continuous-duty, on-line, solid state, line interactive, single-phase uninterruptible power system.
2. UPS to provide power conditioning and power backup for PLC, communications hardware, and other critical electronic loads as indicated on Drawings.
3. UPS system consists of the following major components:

a. Rectifier and battery charger.
b. Inverter.
c. Batteries.
d. Other features as described in this Section and as indicated on Drawings.

C. General Requirements:

1. Provide battery protection via an internal circuit breaker disconnect.
2. Current limiting circuitry to protect inverter output under any load condition.
3. AC output neutral be electrically isolated from UPS chassis.

a. UPS chassis to have an equipment ground terminal.
b. Provide provisions for installation of a bonding connector.

4. Suitable for installation in a UL508A listed panel.
5. DIN rail mountable.
6. UL recognized components for industrial applications in accordance with UL508 without derating.

D. Performance Requirements:

1. Ratings:

a. Output power: As shown in the schedule in PART 3.

b. Battery runtime: 14 minutes at full-load, 34 minutes at half-load.

2. Environment:

a. Ambient temperature: 0 to 40 degrees C.
b. Elevation: Up to 500-ft above mean sea level.
c. Relative humidity: 1 to 95 percent non-condensing.

3. System Input - Primary source:

a. Nominal Input Voltage: As shown in the schedule in PART 3.
b. Frequency: 45 to 65 Hz.
c. Input Power Factor: 0.95 lag minimum, 50 to 100 percent load.
d. Input Surge Withstandability: Per IEEE 587/ANSI C62.41. Category A and B, (6 kV).

4. System Output:

a. Nominal Output Voltage: As shown in the schedule in PART 3.
b. Frequency: 60 Hertz plus or minus 3 Hertz.
c. 100 percent load with 3:1 Crest Ratio
d. Frequency Slew Rate: 1 Hz/second. (Adjustable at startup)

5. AC to AC Efficiency (100 percent load @ rated PF): 88 percent online, 86 percent on battery.
6. Acoustical Noise:

a. Noise generated by UPS under normal operation does not exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 25 degrees C (77 degrees F) and full load.

7. EMI Suppression:

a. UPS to meet FCC Rules and Regulation 47, Part 15, Subpart J, for Class A devices.

E. Modes of Operation:

1. UPS to operate as a line interactive on-line, fully automatic system in the following modes:

a. Normal:

1) Critical load continuously supplied with filtered and regulated AC power by inverter. Rectifier/battery chargers derive power from preferred AC source and supply DC power to inverter while simultaneously floats charge the batteries.

b. Emergency:

1) Upon failure of preferred AC power source, critical load continues to be supplied by inverter. Inverter power supplied without switching from

storage battery. No interruption to critical load upon failure or restoration of preferred ac sources. If AC source cannot be restored before battery discharges to its low voltage dropout value, UPS automatically shuts itself down in an orderly manner.

c. Recharge:

1) Upon restoration of AC source, rectifier/battery charger to power inverter and simultaneously recharge batteries. This to be an automatic function causing no interruption to critical load.

F. Rectifier/Charger:

1. Solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to inverter and for battery charging.
2. Solid-state SCR/IGBT power transistor type with constant voltage/current limiting control circuitry.

G. Inverter:

1. Include all solid-state equipment and controls to convert DC power from rectifier/charger or battery to a regulated AC power for powering critical load.

a. Use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.

2. Capable of supplying current and voltage for overloads exceeding 100 percent.

a. Provide 150 percent of full load for 30 seconds and 125 percent of full load for 2 minutes.
b. Status indicator and audible alarm indicate overload operation.

3. Maintain output voltage to within plus or minus 5 percent.
4. Output voltage total harmonic distortion (THD) not greater than 5 percent at full load.

H. Batteries:

1. High Temperature sealed, maintenance-free, high-rate discharge, lead-acid cells suitable for use indoors with no off gassing, or water addition requirements.

a. Require no special ventilation.
b. One or more battery banks with number of cells required to meet requirements of rest of these specifications.

2. Battery Design Life: 2 to 4 years

I. Controls and Monitoring:

1. Microprocessor-controlled circuitry:

a. Provide fully automatic operation of UPS through use of a microprocessor-based controller.

b. Operating and protection parameters firmware-controlled.
c. Logic includes system test capability to facilitate maintenance and troubleshooting.
d. Startup, battery charging, and transfers to be automatic.

2. Front Indicators: As a minimum, the following indicators to be provided on UPS control panel:

a. On-line (UPS is using utility power to power the load).

1) In bypass mode.
2) On battery.
3) Overload.
4) Replace battery / battery disconnected.
5) Fault.
6) Bar graph for utility voltage.
7) Bar graph for battery.

b. Front Panel UPS Controls:

1) Power On/Off.
2) Self-test.
3) Alarm silence.
4) Cold start.
5) Load off.

c. Remote alarm and status indication: Isolated SPDT dry contacts provided to indicate UPS status for remote monitoring. Contacts rated for 250VAC @ 5A or 30VDC @ 5A

1) Individual contacts provide for separate annunciation of the following alarm and status conditions:

2.2 24 VDC UNINTERRUPTIBLE POWER SUPPLY

A. Manufacturers

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Phoenix Contact Quint Series.
b. Siemens SITOP Series with signaling contact module.
c. Sola HD Series.
d. Substitutions: Or approved equal

B. Type:

1. 24 VDC uninterruptible primary switched mode power supply unit.

C. Operation:

1. Provide uninterrupted 24 VDC power to outputs upon loss of input power.
2. When 24 V supply voltage is applied, connected battery module is charged.
3. In event of a supply voltage failure, battery module is connected to the output, and stored power ensures that all connected devices continue to operate without interruption. UPS supplies a 24 VDC voltage with a load current up to 10 A.

D. Functional:

1. Input voltage range: 22.5 - 30 VDC.
2. Nominal Output Voltage: 24 VDC.
3. Output Current: 10 A.

E. Controls:

1. Dry contacts provided for remote monitoring of UPS conditions:

a. UPS on battery.
b. Fault.

F. Physical:

1. Mounting: horizontal DIN rail mounting.
2. Operating temperature range: 32 to 122 degrees F.
3. Degree of protection: IP20.

G. Performance:

1. UPS provides a minimum of 15 minutes of run time for calculated full load.

a. Internal or external batteries as necessary to support runtime requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.2 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.3 IDENTIFICATION

A. Refer to drawings and specifications for tagging designations

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Uninterruptible power supplies will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121. 20 Process Control System Testing.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

END OF SECTION 406763

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Polymer Solution mixing pump
2. Mixing and blending chambers
3. Skid mounted supports, frames and floor stands.
4. Local control panel

B. Related Requirements:

1. Section 033010, “Miscellaneous Cast-in-Place Concrete” for requirements for equipment base pad.
2. Division 26, “Electrical work not specified herein.
3. Section 400506, “Couplings, Adapters, and Specials for Process Piping” for equipment connections.
4. Section 400507, “Hangers and Supports for Process Piping” for piping restraints.

C. PREINSTALLATION MEETINGS

1. Convene minimum one week prior to commencing Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer information, including system materials, component equipment, and performance characteristics.

B. Shop Drawings:

1. Certified shop and erection drawings showing all important details of construction, dimensions, and anchor bolt locations.
2. Descriptive literature, bulletins and/or catalogs of the equipment.
3. The empty and operating weight of each item of equipment. The operating weights of the mixing and aging tanks shall be based on the tanks filled with polymer solution as specified in this Section.
4. A total bill of materials for all equipment.
5. Motor data in accordance with Section 400593.23 “Low-Voltage Motor Requirements for Process Equipment”.
6. Master piping and wiring diagrams, elementary or control schematics and suitable control panel outline drawings.
7. A list of the manufacturer’s recommended spare parts.

8. Recommended lubricants along with alternative references to equal products of other manufacturers.
9. Manufacturer’s complete description of surface preparation and shop prime and finish painting.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Products meet or exceed specified requirements.

B. Operation and Maintenance Data: Operation and maintenance instruction prepared specifically for this Project, including all cuts, drawings, equipment lists and description.

C. Manufacturer Instructions: Detailed instructions regarding installation requirements, including storage and handling procedures, special field procedures, anchoring, and layout.

D. Source Quality-Control Submittals: Results of factory tests and inspections and provide required certifications.

E. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

F. Manufacturer Reports: Equipment has been installed according to manufacturer instructions.

G. Qualifications Statements:

1. Submit qualifications for manufacturer and installer.
2. Submit manufacturer's approval of installer.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record installed locations and final orientation of equipment and accessories.

1.6 QUALITY ASSURANCE

A. Materials in Contact with Potable Water: Certified according to NSF 61 and 372.

B. Maintain a copy of each standard affecting Work of this Section on Site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection: Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

1. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Document field measurements on Shop Drawings.

1.10 WARRANTY

A. Furnish five year manufacturer's warranty for polymer blending and feed equipment.

PART 2 - PRODUCTS

2.1 POLYMER SOLUTION FEED EQUIPMENT

A. Description: A skid mounted system capable of mixing polymer solution with dilution water and feeding diluted polymer solution at the controlled rates to the application point.

B. The basis of design for the polymer skid and feed system is Roedos Model L–2.10, to be provided by Charter Machine Company.

C. Performance:

1. Polymer Solution Viscosity: Approximately 200 cp
2. Polymer Emulsion Solution Concentration: 40 percent.
3. System Design Capacity: 6 gallons per hour.

D. Components:

1. Diluted Polymer Solution Feed Pump:
2. Type: Diaphragm type metering pump as specified in Section 463342, “Diaphragm-type Metering Pump”.
3. Operation: Manual and automatic, with 4 to 20 mA Vdc pacing signal.
4. Motor: Totally enclosed fan cooled.
5. Provide manual override device on stroke length and motor speed adjustment.
6. Provide stroke length auto-lock mechanism.
7. Signal Converters if required.

E. Multi-Zone Mixing Chamber (High Energy):

1. Inject polymer into water stream by the feed pump to a kinetic mixing chamber to create thorough mixing energy.
2. Include a motor driven impeller to create a high impact energy and low fluid shear.
3. Provide consistent activation efficiency over the entire dilution water range.
4. Provide recirculation through the mixing chamber to ensure mixing has occurred.
5. Provide a transparent section after the mixing chamber to observe the solution consistency.

F. Multi-Zone Acrylic Blending Chamber (Low Energy):

1. Design the blending chamber to provide additional retention time to achieve the highest mixing performance.

G. Assembly and Frame:

1. Provide a prefabricated skid mounted assembly to include the metering/feed pump, mixing chamber, pre plumbed pipework and all accessories.
2. Material: Type 304 Stainless Steel

H. Dilution Water Assembly:

1. Dilution Flow Rate: 16 gallons per minute.
2. Provide water rate adjusting valve, solenoid valve, Rota-type flow indicator.

I. Variable Area Flowmeter:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

   a. ABB FAM540
   b. Brooks MT3809
   c. King Instrument Company.
   d. Omega Engineering, Inc.
   e. Performance and Design Criteria:

      1) Design: According to AWWA M33.
      2) Flow Rate Range: 0 to 150 GPM.
      3) Scale: Zero to 10 markings.
      4) Accuracy: Plus, or minus 5 percent of full scale.
      5) Maximum Operating Temperature: 150 degrees F.
      6) Maximum Operating Pressure: 100 PSIG.

   f. Materials:

      1) Tube Shield: Polycarbonate plastic**.**
      2) Flow Tubes: PTFE**.**
      3) Floats: PTFE**.**
      4) Wetted Parts: PTFE**.**

J. Operation.

1. Electrical Characteristics:

a. Voltage: 120 V, single phase, 60 Hz.

2. Control Panel (LCP-906-1):

a. NEMA Type 4X, 304 Stainless steel
b. Single point power connection and ground lug.
c. The 120 VAC power supply is from the Belt Filter Press Control Panel BFP-910-1.
d. The polymer system is equipped with a standard NEMA-20P plug. A 20-amp receptacle is required within 6ft of the polymer skid, the equipment is safely powered down by being unplugged.

3. PLC:

a. Not used.

4. Control:

a. Selector Switch:

1) Polymer System LOCAL-OFF-REMOTE.
2) Post Dilution Flow On/Off
3) Metering Pump Prime-Off-Auto

b. Indicator Lights:

1) Polymer System Running.
2) Low Water Flow Alarm

c. Modes:

1) The polymer system can be run in LOCAL or REMOTE mode.

a) In LOCAL mode power is applied to the control box by turning the selector switch to LOCAL.
b) In REMOTE mode power is applied to the control circuit via closing a dry contact run command in the MAIN CONTROL PANEL.

2) When the METERING Pump selector switch is turned to Auto, the METERING Pump will be called to run whenever the Polymer System is running.

a) Switching between metering pacing control locally at the pump itself via the touchpad or remotely from the Main Control Panel via 4-20mA analog signal is done on the pump itself via the Internal/External toggle button.
b) The stroke size is set by adjusting the knob on the Metering Pump while in operation.

3) When the METERING PUMP selector switch is turned to PRIME, the Metering Pump will run immediately regardless of the status of the Polymer

System selector switch. This is intended for priming the pump head and maintenance activities.

5. Normal Operation

a. The METERING PUMP selector switch is set to AUTO. The POST DILUTION selector switch is set to ON or OFF depending on whether POST DILUTION is desired.

b. The POLYMER SYSTEM is called to RUN by turning the POLYMER SYSTEM selector switch to REMOTE and issuing the POLYMER SYSTEM RUN command at the MAIN CONTROL PANEL, or by turning the POLYMER SYSTEM selector switch to LOCAL.

1) WATER INLET SOLENOID is OPENED
2) If POST DILUTION selector switch is turned to ON, POST DILUTION SOLENOID is OPENED
3) MIXER PUMP is STARTED
4) DC POWER SUPPLY is POWERED ON

a) DISCHARGE FLOW SENSOR is POWERED ON

5) POLYMER SYSTEM RUNNING indicator lamp is ON.
6) POLYMER SYSTEM RUNNING status signal is ACTIVE
7) METERING PUMP is POWERED ON

a) METERING PUMP will pump at the STROKE SIZE set with the selector knob and the pacing speed chosen:
b) If the pacing signal input is set to INTERNAL, speed is controlled with the touchpad on the METERING PUMP
c) If the pacing signal input is set to EXTERNAL, speed is controlled with the analog POLYMER SPEED REFERENCE 4-20mA input signal from the MAIN CONTROL PANEL
d) The pacing speed is displayed on the METERING PUMP LCD display.

8) Turning the POLYMER SYSTEM selector switch to OFF will shut down all components of the POLYMER SYSTEM. Indicator lights will be OFF, all solenoids will CLOSE, all pumps and motors will STOP.

a) If the POLYMER SYSTEM is being run in REMOTE mode, and has been running for at least 15 minutes, then removing the REMOTE RUN signal at the MAIN CONTROL PANEL will initiate a flush cycle:
b) POLYMER SPEED REFERENCE is SET to 0%
c) POLYMER FLUSH TIMER (in MAIN CONTROL PANEL PLC) is STARTED (user-set, typically the same as POST-WASH TIMER)
d) POLYMER FLUSH TIMER is EXPIRED
e) All remaining components are turned OFF. (Same as step 3, but the POLYMER SYSTEM remains in REMOTE mode and can be called to run by the MAIN CONTROL PANEL at any time.
f) NOTE: The flush cycle logic is not integral to the Polymer System, it is standard PLC logic programmed into the Main Control Panel.

6. Polymer System Alarms

    a. Low Water Flow Alarm

        1) The DISCHARGE FLOW METER has a preset digital output for the minimum flow rate. This 1=OK signal is maintained provided flow rate is above the setpoint. When flow rate falls below the setpoint the LOW WATER FLOW Alarm indicator light will turn ON after 5-10 seconds at which point a LOW WATER FLOW Alarm signal will be transmitted to the MAIN CONTROL PANEL via dry contact.

7. The Polymer System is additionally has discrete outputs for POLYMER SYSTEM RUNNING and POLYMER SYSTEM in REMOTE
8. Blending Chamber: Acrylic.
9. Mixers:

    a. Shaft: Type 304 Stainless steel.
    b. Impellers: Type 304 Stainless steel
    c. Bolts, washers, cap screws: Type 316 stainless steel.
    d. Nuts: Stainless steel of lesser hardness than the bolts.

K. Accessories:

1. Refer to Section 463342 “Diaphragm-type Metering Pump” for accessories.
2. Piping Supports: As specified in Section 400507, “Hangers and Supports for Process Piping.”

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Control Panel:

1. Factory test of completed control panel by demonstrating operation of control functions and provide certified test results.
2. Factory assemble and test each control and alarm function.
3. Test sequence of operation.

C. Owner Inspection: Make completed polymer blending and feed system available for inspection at manufacturer's factory prior to packaging for shipment.

1. Notify Owner at least seven days before inspection is allowed.

D. Owner Witnessing: Allow witnessing of factory inspections and test at manufacturer's test facility.

1. Notify Owner at least seven days before inspections and tests are scheduled.

E. Certificate of Compliance:

1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that designated areas, clearances, structural requirements, piping, utility connections, and electronic signals are ready to receive equipment.

3.2 INSTALLATION

A. According to manufacturer instructions.

B. Piping:

1. Equipment Connections: Provide flexible connectors as specified in Section 400506, “Couplings, Adapters, and Specials for Process Piping.”
2. Harness or anchor flexible connectors as necessary.

C. Base Pads:

1. Using templates furnished with equipment, install anchor bolts and accessories to the existing concrete base for mounting and anchoring equipment.

3.3 FIELD QUALITY CONTROL

A. Field Testing: Provide service of a factory trained engineer for the following tasks.

1. Supervision: Checking the installation of all components before power is applied.
2. Check out: Placing the equipment into operation and making necessary adjustments.
3. Instruction: Instructing Owner's personnel in the use, operation and maintenance of all the equipment.
4. Working under the direction of the manufacturer's representative, conduct in the presence of the Engineer, tests to indicate or demonstrate:

    a. Each item of equipment in each polymer system conforms to this Section.
    b. Equipment is in proper alignment.
    c. No undue noise, vibration or overheating.

5. Supply all electric power, water and liquid polymer to complete the field tests. Use the type of concentrated liquid polymer approved by the Engineer for testing.

B. During the field test, include at least two batches of dilute polymer solution made for each system with batch concentrations as directed by the Engineer.

C. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 2 days on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.

D. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.

E. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

A. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner's personnel.

END OF SECTION 463333

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SECTION 463342 – DIAPHRAGM-TYPE METERING PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Diaphragm-Type Metering Pumps and Drivers:

    a. Mechanically actuated with NEMA frame motor.

2. Motor controllers/Variable frequency drives.
3. Valves and accessories.
4. Field instruments.
5. Pump shelves/stands.
6. Factory fabricated and tested complete piped and wired skid systems.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves” for execution requirements for valves specified by this Section.
2. Piping and valves, other than those specified in this Section, are included in Division 40.
3. Electrical work, except as specified in this Section is included in Division 26.
4. Section 406100 “Process Control and Enterprise Management Systems.”
5. Section 407819 “Switches and Pushbuttons.”
6. Section 407853 “Relays.”

1.3 DEFINITIONS

A. AESS – Applications Engineering System Supplier. See Section 406100 “Process Control and Enterprise Management Systems” for definition.

B. Failsafe – Normally closed contacts that open on alarm condition.

C. I/O – Input/Output (signals)

D. LCP – Local Control Panel.

E. MCC – Motor Control Center.

F. PCSS – Process Control System Supplier. See Section 406100 “Process Control and Enterprise Management Systems” for definition.

G. P&ID – Process and Instrumentation Diagram.

1.4 ACTION SUBMITTALS

A. Furnish a tabbed Table of Contents at the beginning of the submittal package which clearly indicates all equipment, materials, and services included in the submittal and provided by supplier/manufacturer. Include the following:

1. Listing all equipment, materials, and services provided by Manufacturer and/or supplier.
2. Specified scope items excluded from submittal, and reasons for exclusion.
3. Exceptions to Scope items and reasons for exception.
4. Clarifications to Scope items.

B. Product Data:

1. Catalog Data Sheets including model numbers, capacity range, dimensions, connection sizes, materials of construction, and finishes.
2. Guaranteed Performance Curves: showing pump speed (rpm or percent), volumetric output (gph or gpm), and operating head (psi) for the specified design conditions.
3. Integral Pump/Motor Controllers Data: Enclosure, insulation, temperature limits, features, wiring diagram, network connection and type, and electrical connection requirements.
4. Wetted Materials Compatibility: Manufacturers chemical compatibility references of all wetted materials with respective service chemicals at concentrations and temperature specified.
5. Complete Manufacturers Spare Parts List for pumps, motors, integral controllers and pump mounted accessories with current itemized pricing.
6. Valve, piping, tubing, fitting, anchor and accessory catalog data sheets indicating size, manufacturing standards and materials of construction.
7. Complete Lubricant List including type and grade and current itemized pricing.
8. List of Spare Parts and Lubricants included with the Scope of Supply.
9. Manufacturer’s warranty, compliant with this Specification.
10. Variable frequency drive data sheets with wiring diagrams and sizing calculations showing compatibility with submitted motor.
11. Control panel component and device data sheets indicating conformance with Division 40.
12. Instrumentation catalog data sheets indicating ranges, specific features/options identified and electrical characteristics/power requirements.
13. Complete Manufacturers Spare Parts List for controllers and panel components, with current itemized pricing.

C. Shop Drawings:

1. Manufacturer’s fully dimensioned shop drawings of pump, motor, and baseplate showing materials of construction, total weight, and anchorage.
2. Manufacturer’s fully dimensioned shop drawings with minimum three views of pump skid(s) showing proposed arrangement of all skid mounted components, materials of

construction, total weight, and anchorage. Reference all components to a materials table identifying component, quantity, equipment/part number or other pertinent information.

3. Unit Responsibility form or letter, signed by authorized representative and consistent with the submitted Scope of Supply.
4. Manufacturer's fully dimensioned shop drawings of pump, motor, reducer, baseplate and anchorage locations. Indicate materials of construction, total weight, and anchorage. Reference all components to a materials table identifying component, quantity, equipment/part number or other pertinent information.
5. Range and settings for all indicators, instruments, pressure regulating valves, back pressure valves, timers and other related devices.
6. Complete, dimensionally correct control panel drawings showing all components, door mounted and internal, with complete wiring diagrams showing all signals and adherence to failsafe wiring requirements (normally closed contacts that open on alarm condition) specific for this project shown on Electrical and Instrumentation Drawings. Reference all panel components to a materials table identifying component, quantity, equipment/part number or other pertinent information.
7. Complete listing of I/O signals to/from the plant control system.
8. Network interface/communication protocol used to communicate with plant control system.

1.5 INFORMATIONAL SUBMITTALS

A. Provide complete description of surface preparation, shop prime painting and finish painting.

B. Field Quality Control Submittals:

1. Proposed Testing and Training Plan identifying testing methods for field start-up testing and training to demonstrate compliance with contract requirements. Identify the Standard Methods or other industry best practices to be used, duration of the performance tests, and detailed test procedures. Provide procedure for testing of all functions/signals/communication/integration with associated systems identified on the P&IDs and control narratives in the Contract Documents.
2. Qualifications of Factory service representative who will perform installation inspection and operator training.
3. Qualifications of Factory service representative who will perform start-up, testing, and integration of any networked components with the plant control system.
4. Certificate of Installation, prepared by manufacturer's authorized representative stating that equipment has been installed according to manufacturer's instructions.
5. Signed performance test report including field pump curves, notes, corrections made.
6. Training services agenda and training materials no less than 30 days prior to proposed training date.
7. Certificate of Owner Personnel Training prepared by manufacturer's authorized representative and signed by instructor and Owner's Representative.
8. Documentation of controls revisions performed in the field during commissioning by manufacturer's representative.

C. Test and Evaluation Reports.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

B. Testing Affidavits: Signed on supplier's letterhead by Authorized Factory Service Representative and Owner's witness including testing of all signals to the plant control system in the presence of the control system programmer.

C. Software Documentation: Network configuration of pump, sign-off sheets confirming all logic and communication has been tested and integrated with plant control system programmer, and copies of all programs.

D. Operation and Maintenance Data:

1. Submit manufacturers Installation Operation and Maintenance literature for each product furnished. Label with manufacturer's name and model number.
2. Compile data in an Operating and Maintenance Instruction Manual for equipment and accessories supplied specifically for this project. Include tables, drawings, graphics, equipment lists, descriptions, wiring diagrams, panel diagrams (as applicable).

E. Training and Evaluation Affidavits: Completed by the Owner's staff attending the training to demonstrate training was deemed satisfactory.

F. Warranties per Section 017700 "Closeout Procedures".

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Furnish the following:

1. For Each Pump:

a. One diaphragm replacement kit.
b. Two sets of ball checks, seats, and seals.
c. Two replacement volumes each of gearbox oil and liquid end oil as applicable.

B. Tools: Furnish one sets of special tools and other devices required for Owner to maintain and calibrate equipment. Label tools as to their use.

1.8 QUALITY ASSURANCE

A. Furnish the pumping systems specified under this Section by a single supplier (System Supplier). The System Supplier bears the sole responsibility for submittal preparation, equipment acquisition, fabrication, manufacturing, assembly, testing, documentation, shipping, delivery, inspection, training, installation and startup assistance, tuning and calibration, repair and warranty of all equipment, controls, components, and appurtenances specified.

B. Materials in contact with potable water or in contact with chemicals added to potable water: Certified according to NSF 61 and NSF 372.

C. Equipment of Same Type: Products of a single manufacturer.

D. Equipment Manufacturer Experience Under Same Name: Minimum 10 years.

E. System Supplier/Fabricator in Business Performing Similar Work: Minimum 10 years.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept pumps and associated equipment on-site in manufacturer's original packaging. Inspect for damage.

B. Store products in areas protected from weather, moisture, or possible damage.

1. Do not store products directly on ground.
2. Handle products to prevent damage to interior or exterior surfaces.
3. Protect parts from damage or deterioration during a prolonged delay from time of shipment until installation completion and made ready for operation.
4. Do not dismantle factory assembled parts and components for shipment unless permission is received in writing from the Engineer.
5. Protect finished surfaces of exposed flanges by wooden blind flanges, strongly built and securely bolted to the flanges.
6. Protect unfinished and machined finished ferrous surfaces to prevent rust and corrosion.
7. No shipment to be made until approved by Engineer in writing.

1.10 WARRANTY

A. Furnish Three years Manufacturer's Warranty transferrable to the Owner.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION:

A. Factory assembled, wired and tested pump skid systems including control panels , motor controllers , piping, flow meters, isolation valves , back pressure valves, check valves, and mixers as shown on the Contract Drawings and as specified.

B. Refer to Section 463333 "Polymer Blending and Feed Equipment" for skid details.

C. Pumps and pump bases.

D. Pump stands.

E. Control panels, instrumentation, valves and accessories indicated under their related specification sections.

F. Application Schedule:

1. Supply diaphragm metering pumps for the following applications:

a. Pump Tag No: P-906-1

1) Chemical: Emulsion Polymer.
2) Formulation: Polytec PT-1128MH.
3) Solution Strength Weight Percentage: 0.5 percent.
4) Solution pH: 4-6 at 5 g/L.
5) Specific Gravity @ 25 degrees C: 1.0-1.1.
6) Viscosity, cp: Approximately 200

G. Metering Pump Schedule:

1. Pump Tag: P-906-1

a. Pump Type: Mech dia .
b. Operation Range, gph: 0.008 – 4.0.
c. Max Operating Discharge Pressure, psi: 80.
d. Pump Discharge Capacity, gph: 0.008 – 4.0.
e. Pump Pressure Capacity, psi: 80.
f. Max stroke Rate, 1/min: 100.
g. Rated Motor Power: 0.5 HP.
h. P&ID Reference No.: I-3.

2.2 STEPPER MOTOR MECHANICALLY ACTUATED DIAPHRAGM METERING PUMPS

A. Manufacturers:

1. LMI.

B. Description:

1. Microprocessor-controlled, simplex, reciprocating, mechanically actuated diaphragm. Physical separation of liquid end using back plate with weep hole. NSF 50, 61 Certification.

C. Feature Variant:

1. Pump Tag: P-906-1

a. Enclosure: NEMA 4X/IP 65.
b. Check Valves: Single.
c. Viscosity Design: High.
d. Discharge Valves: Manual Prime.
e. End Connections: FNPT.

D. Materials Variant:

1. Pump Tag: P-906-1

a. Discharge Head: PVC.
b. Diaphragm: PTFE Composite (Fluorofilm).
c. Check Valves: Ceramic valve balls, PVC.
d. Seats/guides: EPDM.
e. Seals: Viton (FKM).

E. Fluid Characteristics:

1. Refer to “Application Schedule”.

F. Capacity:

1. Refer to “Metering Pump Schedule”.

G. Controls:

1. Description:

a. Refer to Control Logic per Section 406196 “Process Control Descriptions” for coordination with plant control system.

2. Control Elements Integral to Pump:

a. Display: Digital LCD.
b. Local/Manual and remote input stroke frequency adjustment.
c. Analog Stroke Frequency Output.
d. Analog pump capacity output 0 to 100 percent of rated pump capacity based on stroke frequency setting and stroke length setting.
e. Analog-to-Digital Converter: To convert 4-20 mA dc pacing signal to pulse output signal for controlling pump stroke frequency.
f. Flow Monitor on discharge head with pulse output for remote monitoring.
g. Priming feature - drives pump to 100 percent speed.
h. Calibration feature.
i. Diaphragm leak detection feature with dry contact for remote monitoring.
j. Password protected configuration menu.
k. Furnish all special cables required between pumps and control panels.

3. LCP Furnished by Pump Supplier:

a. Refer to Section 463333 “Polymer Blending and Feed Equipment” for control panel details.
b. Refer to the P&IDs for requirements for control panel requirements (i.e., lights, switches, indicators) and I/O signals to plant control system.

H. Pump Power Supply: 120 VAC 50/60 Hz 15 amps. Insulated 3 Prong Grounded Cord: 6 feet.

I. Piping:

1. Material: PVC.
2. Thickness class:

    a. Thermoplastic: Schedule 80.

3. Joint Type:

    a. Thermoplastic: solvent cement.

4. Fittings:

    a. Thermoplastic: same as pipe joints, threaded only where required for instrument connections.

J. Valves:

1. Isolation Valves: True Union, full port ball type, PVC body suitable for intended chemical use.

    a. Seats: PTFE.
    b. O-rings and Seals: EPDM or Viton for acid and polyacrylamide service.

2. Discharge Side Multifunction Valves: PVC.
3. Backpressure Valve: PVC, suitable for intended chemical use. Field adjustable; initial setting set at factory.

    a. Diaphragm: Teflon.
    b. O-Rings and Seals: EPDM or Viton.
    c. Working Pressure: 150 psig.
    d. Setpoint: as shown on P&IDs.

4. Pressure Relief Valve: PVC body and seat, suitable for intended chemical use. Field adjustable; initial setting set at factory as shown on Drawings.

    a. Diaphragm: Teflon.
    b. Ports: Two as required by the piping system.

K. Calibration Column:

1. Supply one per pump.
2. Materials of construction:

    a. Cylinder: Clear PVC.
    b. End caps: PVC.

3. Cylinder Guard: Required.
4. Bottom End connections: FPT
5. Top End Cap: Same as bottom.
6. Size: 20 second drawdown at pump maximum output.

7. Permanent Graduations: gal.
8. Independently supported, rigidly installed, not supported from the piping system.

L. Pulsation Dampeners: Furnished and installed on the discharge line of each pump per approved shop Drawings.

1. Type: Pneumatic, vertical design, two piece, rebuildable with PTFE bladder or diaphragm.
2. Minimum Safety Margin: Burst pressure to maximum working pressure; 4:1.
3. Sized by pump manufacturer.
4. Charged per manufacturers recommendations based on pump operating pressure.
5. Wetted Materials: Compatible with process fluid.
6. Manufacturer: Baloch Industries.

M. Inlet Strainers: Wye strainers with 1/32 inch perforations.

1. Size: One size larger than suction line in which strainers are installed.
2. End connections: Same as piping system.
3. Screen Removal: Performed without inlet and outlet piping disassembly.
4. Cleanout Plug Removal: Without inlet and outlet piping disassembly.
5. Wye Plug: 1/2 inch nipple and ball valve for purging and flushing water into the suction line when servicing metering pumps.
6. Operating Pressure Rating: 100 psi.
7. Construction Materials: Compatible with process fluid.
8. Thermoplastic Strainer Manufacturers:

    a. ASAHI.
    b. George Fischer.
    c. Approved equivalent.

N. Pressure Gauge / Switch Assembly:

1. Panel Mounting: on skid backplate.
2. Connection to Discharge Piping: Flexible tubing with isolation valve at each end of tubing; compression end type.
3. Switch and Gauge Isolation: Single diaphragm seal, on a rigid 316 SS tee, hard piped to instrument side of seal.
4. Instrument Side Connections: NPT.
5. Gauge and Instrument Piping: Mineral oil fill.
6. Process fluid side of diaphragm seal housing to be compatible with process fluid.
7. Flushing port in housing.
8. Teflon Diaphragm: 2-inch diameter.
9. Pressure Switch Rating: 10-amp SPDT at 120 VAC, UL/CSA rated.

    a. Enclosure: NEMA 4X.
    b. Adjustable dead band.
    c. Trip setpoint repeatability of 1 percent of actual pressure.
    d. Pressure switch settings: 80 percent of pump capacity.

10. Pressure Gauge: Liquid fill, 4-1/2 inch face, phenolic case.
11. Face: White background with black markings, hermetically sealed.

12. Pressure connection: 1/2-inch NPT bottom mount.
13. Bourdon Tube: Type 316 Stainless Steel and 300 series stainless steel movement.
14. Snubber: Type 316 Stainless Steel.
15. Gage Scale: 110 percent of rated pump pressure.

2.3 ANCHOR BOLTS

A. Skids, Wall Mounts and Individual Pumps More than 30 lbs in Weight:

1. Strong Acids: Hastelloy C.
2. All other chemicals: Type 316 Stainless Steel.
3. Supply nuts and washers of same material.
4. Supply anchor bolt type as defined on Drawings - J type or insert/adhesive.

B. Individual Pumps less than 30 lbs Weight: Vinyl Ester FRP bolts, nuts, and washers. Furnish vinyl ester epoxy adhesive for setting anchor bolts.

2.4 ACCESSORIES

A. Piping systems, devices, valves, and appurtenances within this system package as specified in Division 40 and as shown on the Contract Drawings.

B. Materials of construction compatible with the process fluids specified herein.

C. Coordinate size and type of fitting connection (socket, flange, spigot, etc.) needed for piping components necessary for system specified and depict accurately in Shop Drawing submittals.

2.5 SURFACE PREPARATION AND COATINGS

A. As specified in Manufacturer’s standard .

1. Shop Primer: Compatible with finish paint as specified in Manufacturer’s standard .

B. Factory coat all ferrous components with two part epoxy paint system compatible with the chemical service to withstand product spills.

1. Submit paint system with shot submittals for Engineer approval.

C. Do not paint stainless steel and thermoplastic pump components.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pumps per manufacturer's instructions and recommendations in locations shown on the Drawings. Set anchor bolts per manufacturer's recommendations and setting plans.

B. Review Drawing layout with Engineer to confirm equipment placement prior to pouring equipment pads or stubbing up electrical equipment.

C. Review pipe routing, support and alignment plans with Engineer. Routing is not always detailed fully on Drawings, coordinate routing and alignment to insure egress and room for equipment maintenance.

D. Meet with electrical installer and Engineer to determine conduit, panel, enclosure and support locations and methodology.

1. Meet to ascertain pipeline flushing, cleaning and drying requirements appropriate for individual chemicals conveyed by the pumps specified.

E. Install process piping and electrical equipment so that access to equipment for maintenance is provided.

F. Do not install electrical conduits up through floor of chemical containment areas.

G. Complete piping system pressure testing.

H. Complete emergency shower and eyewash installation, test and confirm full functionality prior to introducing any chemicals to any part of the storage system, pumping system and associated piping.

I. Flush piping with fluid or gas compatible with chemical piping will serve prior to connecting equipment.

3.2 FIELD QUALITY CONTROL

A. Installation, Testing, Calibration and Start-Up Services:

1. Furnish materials, labor, equipment, power and incidentals to assist manufacturers certified representative and execute successful installation inspection, testing, calibration and start-up of equipment specified.
2. Prepare, submit and obtain approval of testing and start-up plans prior to execution.
3. Furnish services of manufacturer’s certified representative experienced in products and controls furnished under this Section for installation, inspection, and field testing of equipment interface with the plant control system programmer to ensure all signals are functional and operating in accordance with Section 406196 “Process Control Descriptions”.
4. The listed man-day requirements of manufacturer’s certified representative are exclusive of travel time. This does not relieve the obligation to provide sufficient service necessary to place the equipment into fully satisfactory and functioning condition.

    a. Pre-Operational Testing: Two separate trips, 8-hours per day.
    b. Calibration and Start-up: Two separate trips, 8-hours per day.

B. Pre-Operational Testing:

1. Review installation of pumps and accessories.

2. Hydrostatically test system piping for leaks per piping schedule.
3. Hydrostatically test associated tanks for leaks.
4. Test all control interfaces including I/O signals connections to plant control system with the PCSS and AESS.
5. Test all hardwired and software interlocks associated with the system.
6. Complete point to point I/O check.
7. Check motor rotation.
8. Calibrate and test all instrument functions and settings.
9. Installation Certificate: From equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

C. Startup and Performance Testing:

1. Place pumps into operation, making and recording all necessary adjustments.
2. Produce certified field performance curves.
3. Respond to network communication/configuration, programming, or signal problems between the plant control system and vendor equipment.
4. Assist AESS during commissioning of the plant control system as necessary.
5. Operate each chemical feed system for continuous period of 4 hours under supervision of manufacturer's representative.
6. Adjust, repair, modify, and replace components of system failing to perform, and repeat tests.
7. Make final adjustments to equipment under direction of manufacturer's representative.
8. Supply written certification from manufacturer's certified representative that installation is complete and operable, and no conditions exist which may affect the warranty.

3.3 DEMONSTRATION AND TRAINING

A. Manufacturer Services: Furnish services of manufacturer's certified representative experienced in operation and maintenance of products in this Section for on-Site training of Owner's personnel in operations and maintenance of pumps and associated system package.

1. Operation and maintenance instruction: Two 4-hour days.

B. Training: Execute per approved testing and training plan submittals.

1. Provide training instruction on operation and maintenance of equipment, including operation, troubleshooting, lubrication, maintenance and safety.

    a. Start-up and shutdown.
    b. Troubleshooting
    c. Lubrication.
    d. Maintenance and safety of pumps and associated mechanical equipment.

2. Demonstrate system performance and functionality including control functions, alarms, and monitoring status for all modes of operation (e.g., local, remote, manual, auto, etc.) as required in the Contract Documents.

3.4 COMMISSIONING

1. Commissioning Period: Owner operated system as noted in Division 01, or 14 days, whichever is greater.
2. Contractor Responsibilities:

    a. Adjustments, repairs, modifications, and/or component replacements for systems failing to perform as specified.
    b. Final Adjustments: Under direction of manufacturer's representative.
    c. Significant Repairs or Alternations: Deemed as such in the sole opinion of the Owner; requires Contractor to repeat field testing and re-start the commissioning period.

3. Acceptance Upon Completion of the Commissioning Period:

    a. Unless non-conformance issues are communicated in writing by the Owner to the Contractor at the end of the commissioning period, the equipment and/or package system is deemed Acceptable.

3.5 IDENTIFICATION AND MARKING

A. Prior to Substantial Completion:

1. Mark and identify chemical pumping systems and applicable components as required by applicable jurisdictional building codes, statutes, standards, regulations, and laws.

    a. At a minimum, mark and identify health warnings, flammability, and reactivity of hazardous materials.

END OF SECTION 463342

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SECTION 467621 - BELT FILTER PRESSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Belt filter presses and accessories.

B. Related Requirements:

1. Division 40, “Process Integration”.
2. Section 463333, “Polymer Blending and Feed Equipment” for polymer makeup and feed systems.

1.3 DEFINITIONS

A. HDPE: High-density polyethylene.

B. Solids Capture: Percent of the feed solids that remain in the sludge cake discharged from the belt press on a weight basis.

1. Percent Capture: (C/F) x (F-E)/(C-E) lx 100 where:
2. C: Sludge cake total solids (Percent TS).
3. F: Sludge and polymer feed total suspended solids (Percent TSS).
4. E: Filtrate total suspended solids (Percent TSS).

C. TS: Total solids.

D. TSS: Total suspended solids.

E. UHMW: Ultra-high-molecular weight.

F. VSS: Volatile suspended solids.

G. Wash Water: Plant water.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's information for system materials and component equipment, including electrical characteristics.

B. Shop Drawings:

1. System materials and component equipment.
2. Complete bill of materials for equipment and components provided.
3. Certified shop and erection drawings showing important details of construction including frame, rollers, bearings, dewatering belts, drive system, doctor blade, sludge feed and conditioning tank, belt wash water systems, high pressure or hydraulic belt tensioning and tracking systems, drainage systems, discharge chute and dimensions.
4. Total weight, weight of single largest component that will require removal during life of the unit and gross operating weight.
5. Static and dynamic operating loads (both horizontal and vertical components) applied to each structural frame support location, installation and anchoring requirements including embedment length, fasteners and other details.
6. Typical range of operation of belt tension and recommended belt tension for the application.
7. Belt changing procedure that identifies the size of the largest component to be removed or lifted, and the time (manhours) estimated to do a complete belt change.
8. Statement that rollers can be removed within the space provided and a description of how they should be removed assuming a bridge crane is not available.
9. Wash water and compressed air requirements for belt press during operation.
10. Submit complete master wiring, elementary diagrams and control schematics, including ISA loop information, wire tags, terminals and numbers and PLC I/O addresses.

    a. Certified main control panel drawings showing important details of construction, dimensions and anchor bolt locations.

        1) Drawings to include front elevations with designation of devices and equipment on doors and internal to the enclosures.
        2) Show internal layout of components including dimensions and space requirements.
        3) Standard preprinted sheets or drawings simply marked to indicate applicability to this contract will not be acceptable.
        4) Submit a complete bill of materials for all components associated with the main control panel.

    b. Catalog information and performance specifications for electrical devices such as, but not limited to, fused disconnects, motor starters, VFDs, metering, circuit breakers, terminal blocks, drive controllers, harmonic mitigation equipment, alarms, switches, lights, timers, relays, and related equipment.

11. Interconnection Diagrams: Actual wiring connecting to all terminal points in complete systems with other complete systems and other isolated units or power sources; interconnections of instruments to be shown on instrument loop diagrams in accordance with ISA Standards.
12. Functional description of internal and external instrumentation and controls supplied, including list of parameters monitored, controlled and alarmed.

13. Software Documentation including the following as a minimum.

    a. Two sets of documented unprotected as-built electronic PLC, OIT, VFD and other required software files on CD-ROMs in native machine-readable format, final software programs and configurations developed under this Contract.
    b. Documentation including complete external and internal I/O coil, contact and signal cross-referencing, addressing and rung numbering.
    c. Documentation clearly distinguishing between internal and real I/O. Incorporate extensive documentation to identify contact, coil and signal functions and for labeling and description of program, sub-program and rung purpose and action.
    d. Listing of external and internal I/O address assignments, register assignments and preset constant values along with functional point descriptions. List unused and undefined I/O and data table registers available.
    e. Memory map of PLC registers to the Process Control System Supplier (PCSS) no later than 30 days prior to scheduled shipment of the equipment to the site.
    f. Coordinate with PCSS ensuring compatible configuration of the PLC in order to match the facility's Ethernet network.
    g. Configure network addresses to equipment provided to match the addresses as determined by the PCSS.
    h. Provide software communications in contiguous registers.

        1) One set of registers for writing discrete-type information.
        2) One set for reading discrete-type information.
        3) One set of registers for writing floating-point information.
        4) One set for reading floating-point information.

    i. Detailed system memory map defining memory segments used and spare memory segments available for system memory, I/O tables, Data Tables and control program.
    j. Complete database listing including listings for log, report and alarm file setups.

1.5 DELEGATED DESIGN SUBMITTALS:

A. Submit signed and sealed Shop Drawings for the design calculations and assumptions for belt filter press, washwater booster pump and motor assembly, and equipment anchorage details.

1.6 ACTION SUBMITTALS

A. Specification Compliance:

1. Include a copy of this specification confirming compliance with each paragraph. For deviations, provide detailed commentary to explain the deviation.

1.7 INFORMATIONAL SUBMITTAL

A. Manufacturer's Certificate:

1. Products meet or exceed specified requirements.

2. Calculations for frame design, bearing life and roller deflection at maximum loading and tension that meet or exceed specified requirements.

B. Manufacturer's warranties for belt press frames, rollers, bearings and belts.

C. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures, anchoring, and layout.

D. Source Quality-Control Submittals:

1. Factory test procedures, check lists, equipment to be used, and testing tolerances prior to testing.
2. Results of factory tests and inspections.
3. Factory testing reports.

E. Field Quality-Control Submittals:

1. Certificate from the equipment manufacturer's representative attesting that the equipment has been properly installed and is ready for startup and testing.
2. Field testing procedures and check lists for testing prior to start-up, functional testing, acceptance testing and performance testing.
3. Field testing reports.
4. Certify that field test equipment has been calibrated and checked.

F. Qualifications Statements:

1. Submit qualifications for Manufacturer's field representative required in Part 1 and Part 3 of this Specification.

1.8 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of installed belt filter press equipment.

B. Operation and Maintenance Data: O&M Manual with the following:

1. Complete operations and maintenance data for all equipment included under this section.
2. Detailed theory of operation and effect of varying operating and machine settings.
3. Lubrication/maintenance schedules.
4. Troubleshooting procedures.
5. Start up and shut down procedures.
6. Cleaning instructions.
7. Safety procedures and precautions.
8. Lubricant/adhesive/elastomer grades, quantities, and manufacturers.
9. Detailed machine disassembly and assembly procedures.
10. Weights and handling methods of individual assembly components.
11. Clearance requirements for assembly and disassembly and maintenance.
12. Wear tolerances, tension tolerances, temperature and vibration tolerances.
13. Wear material grades, fastener grades, torque values.
14. Exploded views of all subassemblies keyed to parts lists.
15. Complete spare parts lists, indicating materials, sizes and ordering information.

16. Panel wiring diagrams and ladder diagrams specific to the furnished panel.
17. Manufacturers variable frequency drive and harmonic mitigation controller manuals.
18. Mechanical component shop data tabulated with applicable subsystems.
19. Electrical component shop data tabulated with applicable subsystems.
20. List of special tools and their function.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts:

1. Belts per Unit: One set.
2. Roller Bearings: Two of each size and type.
3. Doctor Blade per Unit: One.
4. Tension Roll Scraper Blade per unit: One.
5. Complete Sets of Rubber Seals for Gravity and Wedge Zones per Unit: One.
6. Complete Sets of Rubber Sealing Strips for Belt Wash Station Enclosures per Unit: One.
7. Plows with Holders per Unit: Four.
8. Limit Switches: One set per unit.
9. Hydraulic filters : One set per unit.
10. Gaskets and O-rings for Each Wash Water Pump: One set.
11. Shaft Sleeve and Mechanical Seal for Each Wash Water Pump: One.
12. Radial and Thrust Bearings for Each Wash Water Pump: One set

B. Tools: Furnish special wrenches and other devices required for Owner to maintain and calibrate equipment.

1.10 QUALITY ASSURANCE

A. Maintain a copy of each standard affecting Work of this Section on Site.

1.11 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Storage: Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Protect piping and equipment from entry of foreign materials by using temporary covers.
3. Provide additional protection according to manufacturer instructions.

1.13 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Verify booster pump suction pressure prior to pump selection.
3. Indicate field measurements on Shop Drawings.

1.14 WARRANTY

A. Belt Filter Press Frame and Coating System: Three year manufacturer's warranty.

B. Rollers: Three year manufacturer's warranty.

C. Roller Bearings: Five year manufacturer's warranty.

D. Belt Life: 2,000 hour manufacturer's warranty.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Components: Structural frame, sludge/polymer mixer, sludge inlet assembly, gravity dewatering zone, wedge zone, pressing belts in the pressure zone, cake discharge assembly, filtrate drainage system, drive system, belt tracking and tensioning systems, belt wash station, wash water pump, roller assemblies, bearings, electrical components, instruments, and main control panel.

2.2 BELT FILTER PRESS

A. Manufacturers:

1. Charter Machine Company, Model BP22.81S
2. Or Approved equal

B. Design Criteria:

1. The basis of design for the Belt Filter Press was Charter Machine Company’s Belt Filter Press, Model BP22.81.
2. Belt operating width: 2.2 m: .
3. Sludge Type: Waste activated Anaerobically digested.
4. Operation: continuous, 8 h/day, 5 days/wk.
5. Feed TSS range: 0.9 percent to 1.5 percent with Average at 1.2 percent.
6. Hydraulic Loading Range per Unit: 165 to 170 gpm exclusive of polymer addition with Average at 161 gpm.

7. Dry Solids Loading Range per Unit: with Average at 1100 lb/h
8. Conditioning Agent: liquid polymer.
9. Polymer Dosage Range: 10 to 30 active lbs polymer/dry ton feed solids.
10. Belt Speed: Gravity Belt Thickener – 10-75 ft/min, Press – 3-20 ft/min.
11. Available Plant Water Flow: 120 gpm.
12. Available Plant Water Pressure at Booster Pump Suction: 30 psig.
13. Maximum Connected Horsepower: 7.5 Hp

C. Performance Requirements:

1. Hydraulic Loading Rate: 161 gpm per unit exclusive of polymer addition.
2. Dry Solids Loading Rate: 1100 lb/hper unit.
3. Minimum Cake Dry Solids: 15.0 percent.
4. Minimum Solids Capture: 95.0 percent.
5. Maximum Polymer Dosage: 30 lb of 100% active polymer/dry ton feed solids.

D. Structural Frame: ASTM A36 rolled structural steel and/or bolted frame.

1. Carry intended loads and minimum tensioning loads of 40 lb/linear inch of actual belt width operating at the highest speed without excessive vibration or deflection during operation.
2. Welding: Per ANSI/AWS D1.1.

    a. Minimum Safety Factor Under Maximum Load: five times the design yield strength of the member at a belt tension of 40 lb/linear of actual belt width.
    b. Maximum Deflection Under Maximum Loading: Limited to 0.01 inches.

3. Steel Frame Members and Plates:

    a. Cleaned and sandblasted to near white metal per SSPC SP-10.
    b. Hot dip galvanize with minimum 6 mil thickness finish per ASTM A123.

4. Stainless Steel Welds: Acid passivated with pickling paste by brushing on all welds and overlapping into heat affected zones.

    a. Paste to be left on for 1 to 2 hours before water flush and neutralization.
    b. Blemishes and weld to be blended smooth and the complete surface to be glass bead polished, rinsed and then passivated with citric acid solution and rinsed.

5. Anchor Bolts, Nuts and Washers: Type 316 stainless steel.

E. Gravity Drainage Zone:

1. Minimum Effective Gravity Drainage Surface area: 90 sq ft based on the measured width between containment barriers on top of the belt.
2. Support: Minimum 10-gauge, Type 304 stainless steel grid plate, 2 inch wider than the belt width to support the belt and wipe water away from the bottom of the belt during operation.

    a. Fitted with replaceable and adjustable UHMW polyethylene wiper bars .

3. Contain sludge on top of belt by Type 304 stainless steel side channels fitted with edge seals along full length of the gravity drainage section to prevent leakage.
4. Furrowing Plows:

    a. Minimum six rows of plows (chicanes) to furrow the conditioned sludge to facilitate gravity drainage through the belt.
    b. Plow Support Rods: Type 304 stainless steel rods along length of belt within the gravity zone, spaced at a maximum 6 inches o.c. across width of belt.
    c. Furnish plows with set collars or clamps to position plows along the support rod.
    d. Counterweight plows, so they are capable of pivoting independently of other rows of plows.
    e. Plows must be able to pivot up to allowing them to pass over any obstruction on the belt.
    f. Mounting:

        1) Provide equally spaced individually adjustable sludge plows for even distribution.
        2) Provide one piece grid assembly for each row of the plows.
        3) The plow assembly shall be operated by using a four-way hydraulic valve to enable the entire plow assembly to be raised from the filter belt for cleaning purposes.

    g. Plows: UHMW polyethylene, adjustable and replaceable.

F. Low Pressure/Wedge Zone: Following the gravity zone.

1. Increase compression/pressure of solids for dewatering where upper and lower belts gradually converge creating a sandwich of sludge between the belts.
2. Minimum Effective Surface Area: 80 sq ft utilizing the combined surface area of each belt actually contacting the sludge while the wedge opening is at maximum.
3. Wedge Angle: Adjustable while press is in operation.
4. Operate without extrusion of sludge out the sides of the belts.
5. Sludge inlet height at wedge zone entrance: Adjustable between 1 and 3 inches.
6. Support: Minimum 10 gauge, 304 stainless steel grid plate or UHMW square bars 2 inches wider than the belt width to support the belt and wipe water away from the bottom of the belt during operation

G. High Pressure/Shear Zone: Following the low pressure/wedge zone.

1. Eight rollers minimum in decreasing diameter in the running direction oriented in a S-shaped (serpentine) roller configuration applying maximum pressure and shear to dewater the sludge.
2. Minimum Surface Area: 118 sq ft utilizing the combined surface area of each belt actually contacting the curved rollers.
3. Transition areas between the “S” roll tangents are not included in the minimum effective dewatering area determination.
4. First roller in configuration shall be a 1.5” diameter tubular design drum of outside diameter of 26" with a special design that allows for a minimum 89% open area. Any manufacturer with a dandy/perforated roller with less than 89% open area will not be considered acceptable.

H. Drive Assembly:

1. Motor: Inverter duty, TEFC, 5 Hp , 480 Volt, 3 phase, 60 Hz, severe duty with winding temperature thermostats as specified on Section 400593.23, “Low-Voltage Motor requirements for Process Equipment.”

    a. Electric Gear Motor: AGMA Service Factor 1.5 based on motor nameplate horsepower.

2. Gear Reducer: AGMA 6013 right-angle helical type gear reducer, fully enclosed, oil-tight, Class 30 cast iron housing.
3. Drive Coupling: Direct coupled to drive roller or coupled by means of chain and sprockets with OSHA guards.
4. Speed Control: Variable frequency AC controller. Adjustable while press is in full operation.

I. Belts: Three dewatering belts per press. Sludge travels on top of one belt in the gravity zone and then is sandwiched between the two belts in the wedge and high pressure zones where pressure and shear are applied as it travels through the press to dewater the sludge.

1. Material: Monofilament polyester.
2. Edges: Reinforced l/2 inch plastic band. Heat-sealed edges are unacceptable.
3. Belt Selection and Mesh Opening Sizes: As recommended by belt press manufacturer based on type of sludge to be dewatered, the conditioning agent to be used and the manufacturer’s experience dewatering similar sludges at other facilities.
4. Pre-stretch belts to limit elongation to less than three percent of total belt length.
5. Seams: Single, low-profile, Type 304 stainless-steel split alligator-pin type.
6. Minimum Tensile Strength: Minimum five times the maximum dynamic tension to which the belt is subjected.
7. Minimum Life: 2,000 hours.
8. No disassembly of the structural frame will be allowed to replace the belts.

J. Roller Assemblies:

1. One: Type 304 stainless steel drainage roller located at end of wedge zone, configured to allow filtrate to be conveyed away from cake.
2. Two: A53 carbon steel rollers, minimum 1/2 inch wall thickness in the gravity zone.
3. Eight: A53 carbon steel rollers, minimum 1/2 inch wall thickness arranged in serpentine pattern in high pressure zone.
4. Spiral-welded steel rollers will not be accepted.
5. Minimum Width: 3 inches wider than belt.
6. Maximum Deflection: 0.05 inch at roller center during maximum loading.

    a. Maximum Loading:

        1) Belt Tension: 50 lb/inch of belt width.
        2) Friction forces.
        3) Roller mass forces.
        4) Elasticity forces of the belts caused by the inner belt having shorter travel distance than the other belt as the belt and sludge sandwich travel around the roller.

7. Weld Depths: Equal to roller shell wall thickness.
8. Total Indicated Runout: Roller shell relative to journals, 0.010 inch maximum.
9. Furnish Total Surface Machining: Provide a smooth surface for coating and/or cladding.
10. Roller Shafts: Stub shaft type secured by an end plate and an internal bulkhead. Shaft to be A572, Grade 50 forged steel or A53 carbon steel.
11. Drive Roller: Covered with minimum 1/4 inch thickness of Buna-N rubber.

    a. Tensile Strength per ASTM D412: 2,500 psi.
    b. Tear Strength, Die C per ASTM D624: 250 psi.
    c. Elongation at Break per ASTM D412: 160 percent.
    d. Hardness, Shore A per ASTM D676: 79.

12. Other Rollers: Covered with minimum 25 mil continuous coating of thermoplastic nylon or Type 304 stainless steel.

    a. Nylon Coating Properties, Test Method: Value
    b. Hardness, Shore D, ASTM D2240: 77.
    c. Specific Gravity, ASTM D792: 1.06 to 1.20.
    d. Impact, RT & 45 F, ASTM D2794: 160 in-lbs, Direct Pass
    e. Tensile Strength, ASTM D638: 6,000 psi .
    f. Elongation, ASTM D638:15 percent.
    g. Melting Point, ASTM D789: 370 degrees F.
    h. Abrasion Resistance, ASTM D4060: 8 to 18 mg wt. loss (varies with color), CS17/1000/1000: (Taper Abrader).

13. Roller coatings to extend up to the point of insertion into the bearing block.
14. Carbon steel roller surfaces are not to be exposed to sludge or moisture.
15. No disassembly of the structural frame will be allowed to replace the rollers.

K. Bearings: Double row spherical roller type, according to ABMA 11.

1. Greaseable while press is in full operation.
2. Mounting: All bearing housings shall be class 30 cast iron one-piece pillow block type with gasketed and bolted nylon coated steel end plate as manufactured by Charter Machine Company. Bearing housings shall be coated with Rilsan Nylon II to a minimum thickness of 12 mils by the Electro Static, Fusion Bonded Rilsan Powder Dispersion Process.

    a. Non-Steering Roller Bearings: Self-aligning in metallic cages. Mounted in fixed pillow block housings.
    b. Steering Roller Bearings: Non-self-aligning cylindrical roller type. Mounted in pivot mounted pillow block housings.
    c. L10 Life: 500,000 hours at 40 PLI tension at rated speed.
    d. Location: Outboard (externally) mounted.
    e. Grease Fittings: Extend to outside face of structural frame with Type 304 stainless steel tubing.

L. Belt Tensioning System:

1. Automatic and continuous belt tensioning monitoring and maintaining selectable belt tension setpoint while belt filter press is operating.

2. Belt Tensioning Roller: Positioned by hydraulic actuators on each tensioning roller end or torque arm type system using one tensioning actuator.
3. Simultaneous and parallel movement of tensioning roller ends during adjustment.
4. Belt Tension: Directly proportional to dewatering pressure.

    a. Adjustments in belt tension will immediately change the dewatering pressure.

5. Minimum of 3 percent belt stretching during useful life of the belt.

M. Belt Tracking System:

1. Automatic and continuous belt tracking system monitoring belt position, controlling the aligning roller, and affecting minor belt position adjustment to maintain the belt in the center of the rollers.

    a. System to be hydraulically actuated while belt filter press is operating.

2. Limit Switches: NEMA 4X switches on each side of belt to make minor belt position adjustments.

    a. NEMA 4X switches detect major misalignment of belt and relays an alarm signal to the local control panel.
    b. Limit switches to control belt position adjustments alone are unacceptable.

3. Furnish hydraulically actuated pilot valve(s) mechanically linked to an alignment roller to skew the roller from its traverse position and steer the belt to the left or right depending upon the pivot angle.

N. Hydraulic Systems: Operate the belt tensioning and tracking systems at the anticipated maximum working pressures and have appropriate safety factors.

1. Dedicated Hydraulic System: For each press.

    a. Oil Pump: Variable displacement pressure compensated.
    b. Storage Reservoir: 10 gallon.
    c. Pressure Gauges: One upper and one lower belt.
    d. High pressure switch.
    e. Low pressure switch.
    f. Pressure relief valve.
    g. Oil filter.
    h. Piping, Valves and Controls. Piping, type 304 stainless steel.
    i. Pump Motor: TEFC, 1.5 Hp maximum, 480 VAC, 3 phase, 60 Hz, 1,200 rpm, C-faced mounted to pump.

O. Sludge Feed:

1. Vertical Upflow Retention Tank: Type 304 stainless steel.

    a. Feed Connection: 6 inches diameter.

        1) Flanged and drilled to 125 lb. ANSI B16.1 Standard.

2) Drain Connection: 3 inches diameter.
3) Drain and stainless steel drain valve (ball type) for floc formation and uniform distribution of feed mixture.

2. Distribution Chute: Uniformly distribute polymer-conditioned feed sludge across entire working width of belt.

a. Furnish vertical adjustment for leveling and clearance from belt.

P. Sludge Discharge Assembly:

1. Discharge Doctor Blade: UHMW polyethylen**e**. 3 inches wider than belt width.

a. Mounting:

1) Blade Holder: Type 304 stainless steel.
2) Blade Positioner: Mechanism to adjust blade position and force of blade against belt. Use counterweights, stainless steel leaf springs, or coil springs.
3) Mechanism to lift blade over belt seam protecting the seam and reducing belt wear.

b. Quick release, adjustment, and lock of doctor blade for inspection and servicing. Lift and lock blade 2 inches or more above belt during belt replacement.

2. Discharge Hopper/Chute: Minimum 10 gauge, Type 304 stainless-steel chute.

a. Vertical sides and 45 degree minimum bottom slopes.
b. Top cover with access hatches and 72 x 12 inch flanged outlet connection compatible with conveyor location as shown on the Drawings.
c. Mounting: Independent of doctor blade assembly.

Q. Filtrate Drainage Pans: Collect and discharge filtrate from belts. Configured to prevent rewetting the downstream cake solids.

1. Material: 14 gauge Type 304L stainless steel for corrosion resistance.
2. Extend minimum 3 inches beyond belt width on both sides.
3. Attach to structural frame and accessible for cleaning.
4. Drainage Pipes: Minimum 3 inch diameter, self-venting, Sch 40 PVC from the pan’s flanged pipe connection down to the concrete drainage sump below the structural frame.
5. Secure to the structural frame and independent of the belt wash water system.

R. Belt Wash Stations: Clean full width of belts continuously with wash water as belts return from discharge point to feed point.

1. Maximum Wash Water Demand: 120gpm per unit of wash water. Units requiring more will not be accepted.
2. Available Wash Water Pressure: 30 psig
3. Wash Box Enclosure: Minimum 14 gauge, Type 304 stainless steel.

a. Spray Pipe: Type 304 stainless steel
b. Spray Nozzles: Non-clog stainless-steel having overlapping spray pattern.

c. Internal Cleaning Brush: Manually operable by an external handwheel.

1) A half-turn of handwheel will cause brush bristles to enter nozzle spray and dislodge accumulated solids.

d. Separate drain down to concrete drainage sump below the structural frame
e. Replaceable urethane or rubber seals to prevent leakage as belt passes through the box.

4. Wye strainer, pressure regulator, 120 VAC solenoid valve, pressure gauge, low pressure switch, rotameter and globe valve for throttling, all mounted on the structural frame,

S. Wash Water Booster Pump: For each belt press.

1. Dedicated wash water booster pump delivering wash water at the flow and pressure required by the unit.
2. Vertical multi-stage centrifugal ANSI pump coupled to a motor with flexible coupling and OSHA guard mounted on a common steel fabricated frame.
3. Available pressure at pump suction: 30 psi.
4. Pump suction and discharge pipe: 1 ½ inch.
5. Motor: Constant speed, TEFC, maximum 15 HP, 480 Volt, 3 phase, 60 Hz, with winding temperature thermostats as specified in Section 400593.23, “Low-Voltage Motor Requirements for Process Equipment.”

T. Safety Trip Cord: Yellow nylon coated 304 stainless steel safety trip.

1. Along all sides of thickener, mounted with type 304 stainless steel hardware.
2. Interrupt all power to the system when pulled.
3. Switch: NEMA 4X with manual reset. One set of normally open and one set of normally closed contacts. Rated 10 amps at 120 volts.

U. High Level Switches: For sludge feed retention tanks.

1. Float Type Level Switches: Detect high sludge level for alarming and shutdown.

a. Intrinsically safe. Continuous duty rating of 10 amp at 120 volts, 60 Hz, single pole double throw contacts.

V. Main Control Panel (MCP): NEMA 4X free-standing enclosure. Type 304 stainless steel, 12 gauge minimum, brushed finish, front access, with externally operated flanged main power circuit breaker disconnect switch.

1. Nameplates and Labels: Laminated phenolic material with engraved letters for all face mounted devices.
2. Programmable Logic Controller (PLC): Allen Bradley MicroLogix 1400 series.

a. Face mounted Allen Bradley Panel View Plus 7 operator interface terminal (OIT) with 24 VDC power supply, 10-in diagonal, color, NEMA 4X, touchscreen, display.

3. Ability to connect to plant SCADA through CAT 6 cable via a five port Ethernet switch using Ethernet/IP protocol.
4. The MCP shall operate on a single-point 480 VAC, 3 phase, 3-wire, 60 Hz power supply connection and grounding lug as shown on the Drawings.
5. The MCP consists of a main circuit breaker, variable frequency drive, motor circuit protector (MCP) and motor controller for each motor, and a 120V control power transformer (fused on the primary and secondary) along with other devices specified herein. Mount all control components in one common enclosure.
6. Control panels containing PLCs shall contain a UPS or battery ride-through for the PLC in accordance with Division 40 specifications.
7. The MCP door shall be mounted via 3 removable pin-hinges and provided with a pad-lockable vault type 3-point latch. The enclosure shall be equipped with a door and shall incorporate a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Door(s) shall be interlocked with main circuit breaker and provided with pad-locking provision.
8. Enclosure: Operating handle for main circuit breaker shall be flange mounted.
9. Submit heat load calculations. Provide additional temperature control if required to meet UL temperature rating of internal components. If forced air ventilation is required, the enclosure shall be pressurized. Air filters shall be of commercially available types and sizes.
10. All operating control and instruments shall be securely mounted on the exterior door. All controls and instruments shall be clearly labeled to indicate function. All exterior mounted equipment shall be NEMA 4X.
11. Print storage pockets shall be provided on the inside of each panel. Pocket shall be of sufficient size as required to hold all prints necessary to service the equipment.
12. Main Breaker: Thermal-magnetic air circuit breaker, Schneider Electric/Square D PowerPact or equal.
13. Motor Circuit Protectors: Molded case motor circuit protector with adjustable magnetic trip only, Schneider Electric/Square D “Mag-Gard” or equal.
14. Full Voltage Motor Starting: Open frame, across-the-line, NEMA-rated magnetic motor starter, Schneider Electric/Square D Class 8536 or equal. Solid state overloads with Class 10/20 selectable tripping.
15. Overload relays shall be self-powered solid-state type and provide the following features: tamper guard over trip adjustment setting, ambient insensitive, harmonic immunity, phase loss and phase unbalance protection, manual reset, and push-to-test.
16. Overload reset buttons shall be mounted on dead front door.
17. Normally open and normally closed auxiliary motor overload contacts wired to terminal blocks shall be provided for each motor starter within the control panel.
18. Variable Frequency Drive: For control of belt drive.
19. NEMA Rated Motor Starters: For the booster pump and hydraulic belt tensioning/tracking/alignment systems.
20. Surge Protective Device (SPD): The main control panel shall be provided with a surge protective device rated for 200kA per mode for the incoming power. SPD shall be mounted within the control panel enclosure. Lead lengths shall not be longer than 12 inches from the main circuit breaker.
21. Control Power Transformer: 480-120V CPT, fused on primary and secondary sides, capacity as required.
22. Control operators and indicators shall be heavy duty type, full size (30.5mm), NEMA 4X.
23. Indicating lights shall be LED, full size (30.5mm), full-voltage, push-to-test type.
24. Alarm horn: weatherproof rated with gasket (Federal Signal Corporation, Cat. #350 or equal) for NEMA 4X applications.

25. Alarm beacon: Red lens and solid-state flasher (Ingam Products Inc. LRX-40 or equal) for NEMA 4X applications.
26. Silence and reset pushbuttons shall also be furnished. A common failure reset pushbutton shall be provided to reset the alarm conditions (reset shall occur only if fault condition has been cleared).
27. A phase monitor shall be provided for the control panel, monitors shall be model SUA-440-ASA as manufactured by Diversified Electronics Inc., or equal.
28. Corrosion Inhibitor Emitter: Inclusion of an industrial corrosion inhibitor emitter, selected by the manufacturer, to protect internal components of control panel from corrosion for up to one year.
29. Breather assemblies, to maintain interior pressure and release condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
30. Power and control wire shall be 600 Volt class, Type MTW insulated stranded copper and shall be of the sizes required for the current to be carried, but not smaller than No. 14 AWG. All wiring shall be enclosed in PVC wire trough with slotted side openings and removable cover.
31. Wiring shall be stranded copper, minimum size #16 AWG (except for shielded instrumentation cable), with 600 Volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation.
32. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks. Terminal strips shall be Allen Bradley catalog #1492-CA-1 or equal.
33. Terminal Blocks: 600V heavy duty type, tubular clamp type to receive input and output control signals plus 20 percent spares.
34. The main control panel shall include a copper ground bar with sufficient terminals for all field and panel ground connections shall be provided.
35. All signal wiring entering and exiting the control panel shall be provided with surge protection. Surge protection shall be as specified in Division 40.
36. Duplex GFCI Receptable: Mounted in the interior 15 Amp, 120 VAC duplex powered from the control power transformer within the main control panel.
37. LED Type Service Lamp: Door activated switch, powered by the control power transformer within the main control panel.
38. Electrical Equipment Within the Main Control Panel: Rated for a short-circuit current of 42,000 Amps RMS symmetrical. The completed Main Control Panel assembly shall be UL 508A certified.
39. All control panel wiring shall be numbered at both ends with type written heat shrinkable wire markers.
40. The control diagrams and overload tables shall be laminated to the inside of the door except where door space is limited the laminated documents shall be in the print storage pocket.
41. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed using an epoxy process (inner door nameplates shall be fastened with stainless steel screws). Nameplates shall be laminated plastic, engraved black letters with a white background.
42. The control panel shall be provided with two nameplates located on the exterior door. The first nameplate shall identify the control panel name. The second nameplate shall identify the power source.
43. Each terminal at terminal blocks shall be individually labeled.

44. Incoming phase conductor terminals shall be clearly identified. All wiring within the control panel shall be color coded or coded using electrical tape in sizes where colored insulation is not available.
45. Discrete Input and Output Modules: 120 VAC, individually isolated, normally open contact type. Provide 20 percent spare inputs and outputs.
46. Analog Input and Output (current or voltage) Modules: Individually isolated. Rated 0 to 20 mA. Provide 20 percent spare inputs and outputs.
47. OIT Graphic Displays: For local controls, data entry, process monitoring, status monitoring and alarm monitoring of the belt press process to include Owner and Engineer input,
48. Manufacturer to include costs for developing control interface specifically for this project, and the final modes of control that are determined during the shop drawing submittal phase.
49. Face Mounted Devices:

    a. Provide devices and controls per process and instrumentation diagram.

50. Alarm System: Audible horn and rotating red beacon light, to indicate belt press alarm conditions, associated sludge pumping, polymer, conveyer, and wash water off normal conditions to protect press from damage. Alarm acknowledgements to be through the OIT.

    a. Two pushbuttons:

        1) Alarm acknowledgement. Silences the horn and causes the red beacon to burn steady.
        2) Reset. Manually reset control circuits and de-energize the beacon.

51. Field Instruments deriving 120 VAC input power from Control Panel: Must have a separate power distribution circuit with circuit breaker or fuse with a fuse indication.
52. Field Instruments and Panel Devices. 24 VDC power supplies as required.
53. Wiring in Control Panels:

    a. Color coded, identified with a number code and all external connections brought to a numbered terminal strip.
    b. Comply with applicable requirements of latest edition of NEC.

54. Controls:

    a. Press may be operated in Manual or Auto Mode. Auto mode will, through a combination of PLC inputs/outputs and timers/logic in the programming, operate the Belt Filter Press and ancillary equipment, with the exception of speed inputs (belt speed, sludge feed rate, polymer rate), by turning components on and off in the proper order and timing.
    b. When operated manually, the press should be operated in approximately the same manner, with the operator manually starting and stopping each piece of equipment along similar intervals to those created by the timers in AUTO MODE.
    c. AUTO MODE

        1) MAIN CONTROL PANEL is powered on according to the instructions on the CB-A RESET TAG near the main DISCONNECT LEVER on the front

of the panel. (All emergency stop devices must be reset, in the operating position)

2) Operator presses and holds the CB-A RESET pushbutton while raising the Disconnect Lever.
3) CONTROL POWER ON/OFF selector switch is turned to the on position.

    a) This powers on the 120V control circuit, which includes the PLC and operator interfaces.

4) RESET pushbutton is pressed to clear any alarm states.

    a) All Alarm Indicators will be OFF and/or OIT will display “NO FAULTS”

5) Auto Mode is selected via AUTO MODE ON/OFF selector switch.

    a) Auto Mode indicator is active.

6) AUTO START pushbutton is pressed.

    a) Hydraulic Unit is called to Run.
    b) PRESSURIZATION TIMER is Started (user set, default 30 seconds)

7) PRESSURIZATION TIMER Expires

    a) WASHWATER VALVE is called to Open.
    b) AUTO MODE is Running (Control Panel Indicator & SCADA Output)
    c) PREWASH INDICATOR is Active
    d) Belt Drives are called to Run.
    e) Conveyors are called to Run.
    f) PREWASH TIMER is Started (User set, typically ~30 seconds)
    g) DETENSION SOLENOID is Active (reducing MILLING BELT dry run pressure)

8) PLC receives the input that the valve is fully OPEN.

    a) BOOSTER PUMP is called to RUN,

9) PREWASH Timer Expires

    a) POLYMER SYSTEM is called to RUN.
    b) PRE-SLUDGE POLYMER TIMER is STARTED (User set, typically 10-15 seconds)

10) PRE-SLUDGE POLYMER TIMER Expires

    a) SLUDGE VALVE is called to OPEN.
    b) SLUDGE FEED PUMP is called to RUN.

11) Press is Now In NORMAL OPERATION.

    a) PRESS RUNNING SCADA output is ACTIVE.

b) DETENSION SOLENOID DEACTIVATION Timer is STARTED (60 Seconds)

12) DETENSION SOLENOID Timer EXPIRES

a) DETENSION SOLENOID is Deactivated (MILLING BELT returns to Operator Setting)

This proceeds with the Operator making adjustments to BELT SPEED, SLUDGE PUMP Speed, AND POLYMER Speed as needed until OPERATOR is ready for WASHDOWN**:**

13) Operator presses the AUTO STOP pushbutton.

a) SLUDGE FEED PUMP is called to STOP.
b) POLYMER SYSTEM is called to STOP.
c) BELT SPEEDS are automatically set to 10%
d) POSTWASH TIMER BEGINS (user set, typically not less than 15 minutes)
e) POLYMER FLUSH CYCLE BEGINS (If armed, see Polymer Control Summary)

14) POSTWASH TIMER EXPIRES

a) BELT DRIVES are called to STOP.
b) HYDRAULIC UNIT is called to STOP.
c) CONVEYORS are called to STOP.
d) WASHWATER BOOSTER PUMP is called to STOP.
e) WASHWATER VALVE is called to CLOSE.

15) CONTROL POWER ON/OFF selector switch is turned to OFF.

a) Machine and Control Panel are now OFF.

16) When operated manually, the press should be operated in approximately the same manner, with the operator manually starting and stopping each piece of equipment along similar intervals to those created by the timers in AUTO MODE

a) Manual, semi-automatic, and automatic operation.

d. Emergency Shutdown:

1) Immediate shutdown without belt wash cycle upon pulling the safety trip cord or depressing the EMERGENCY STOP pushbutton on the MCP.
2) This condition will energize a red e-stop light, a red beacon and sound a horn on the MCP.

e. Normal Automatic Start-up:

1) Energize SYSTEM START pushbutton with all H-O-A’s in AUTO.
2) The belt tensioning system will energize.

3) When selected belt tension is achieved, the belt drive motor will energize, then the wash water pump and solenoid valve will energize to pre-wet the belt for a pre-selected time and PRE-WETTING CYCLE ON pilot light will energize.
4) When pre-wetting timer times out and all press operations are normal the PRESS READY pilot light will energize.
5) Polymer may now be fed to the press followed by sludge feed.
6) Once polymer and sludge flow to the press is verified at the MCP, the PRESS RUNNING pilot light will energize.
7) When operating, the sludge feed and polymer addition can be adjusted at the MCP.

f. Normal Automatic Shutdown:

1) Energize SYSTEM STOP pushbutton with all H-O-A's in AUTO.
2) The sludge and polymer will stop and the PRESS RUNNING pilot light will de-energize.
3) The PRESS WASHING pilot light will energize and belt washing will continue for a preselected time to ensure all solids have been washed from the belt.
4) After timing out, the PRESS WASHING pilot light will de-energize, the wash water pump will stop, the wash water solenoid valve will close, the belt drive will stop, the belt tensioning system will de-energize and the PRESS OFF pilot light will energize.

g. When any of the following alarms occur in AUTO, the condition will energize an amber pilot light, a red beacon and sound a horn on the MCP and initiate an automatic shutdown sequence.

1) Hydraulic System Fault.
2) Washwater Fault.
3) Belt Drive Fault.
4) Sludge Feed Pump Fault (from SCADA).
5) Polymer System Fault (from SCADA).
6) Conveyor Fault.
7) Belt Overtravel/No Tension.

h. MCP Discrete Outputs to SCADA:

1) Polymer System Running
2) Polymer System in Remote
3) Polymer System Common Alarm
4) Conveyor System Running
5) Sludge Pump Feed Running
6) Booster Pump Running
7) Booster Pump Fault
8) Belt Filter Press Running
9) Belt Filter Press Fault

i. MCP Analog Outputs to SCADA:

1) Total Press Amps
2) Total Press Power Consumption (KVA)
3) Total Press Power Consumption (KW)
4) Polymer Pump Speed Feedback
5) Sludge Feed Flow Rate

j. MCP Discrete Inputs from SCADA:

1) Polymer System Start
2) Conveyor System Call to Start
3) Sludge Pump Run Command
4) Belt Filter Press Emergency Stop

k. MCP Analog Inputs from SCADA:

1) Polymer Pump Speed Setpoint
2) Sludge Pump Speed Setpoint

l. Belt Filter Press Alarms Summary:

1) The following chart lists each alarm, its logical trigger, and the equipment/sub systems stopped by the alarm to protect the equipment and properly contain sludge.
2) The SILENCE pushbutton turns off the ALARM HORN and/or ALARM BEACON, which are activated when an alarm state is triggered, but leaves the alarm state active in the PLC and on the ALARM STATUS INDICATORS.
3) The RESET pushbutton clears the alarm, and returns the system to normal operation, provided the fault triggering the alarm has been cleared.
4) On the OIT touchscreen, the alarm type will be displayed in an alarm banner on the screen and must be acknowledged by the OPERATOR, and the status window of the MAIN CONTROL SCREEN will display any active alarms or “NO FAULTs” if no alarms are active.

Charter Machine Co.
Belt Filter Press Alarm Chart

ALARM DESIGNATION	TRIGGERED BY	STOPS THESE SUBSYSTEMS				
		SLUDGE	POLY	BELTS	WASH	MCP OFF
HYDRAULIC RUN VERIFY	Hyd. Unit called to run and motor starter does not close	X	X	X		
LOW TENSION PRESSURE	Hyd. Unit is running and pressure sensor is below set point	X	X	X		
WW VALVE FAIL TO OPEN	WW Valve is called to open and no opened signal received	X	X	X	X	
WW VAVLE FAIL TO CLOSE	WW Valve is called to close and no closed signal received	X	X	X	X	
WWBP RUN VERIFY	WWBP is called to run and motor starter does not close	X	X	X	X	
LOW WATER PRESSURE	WW Valve is open and water pressure sensor is below set point	X	X	X	X	
BELT DRIVE RUN VERIFY	Belt Drive is called to run and VFD is not in running status	X	X	X		
BELT DRIVE MOTOR HIGH TEMPERATURE	Belt Drive Motor Integral Temperature switch is opened	X	X	X		
BELT OVERTRAVEL	Belt Drive is called to run and overtravel limit switch is opened	X	X	X		
BELT NO-TENSION	Hyd. Unit is called to run and cylinders are fully retracted	X	X	X		
CONVEYOR RUN VERIFY	Conveyor is called to run and motor starter does not close	X	X	X		
CONVEYOR ZERO SPEED	Conveyor is called to run and zero speed switch sends fault	X	X	X		
CONVEYOR MOTOR HIGH TEMPERATURE	Conveyor Motor Integral Temperature switch is opened	X	X	X		
SLUDGE PUMP RUN VERIFY	Sludge Pump is called to run and VFD is not in running status	X	X			
SLUDGE PUMP MOTOR HIGH TEMPERATURE	Sludge Pump Motor Integral Temperature switch is opened	X	X			
POLYMER SYSTEM FAULT	Polymer System Sends any Fault Signal	X	X			
EMERGENCY STOP	ESTOP Pushbutton pressed or Lanyards Pulled	X	X	X	X	X

W. Finishes: Shop priming and finishing of all ferrous or steel components, supports, and bracing to meet the requirements of Manufacturer's standard.

1. Provide exposed, non-machined stainless steel surfaces with an ASTM A480, Class 2B finish.
2. Do not apply protective coating to stainless steel surfaces.

2.3 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed belt filter press.

B. Owner Inspection: Make completed belt filter press available for inspection at manufacturer's factory prior to packaging for shipment.

1. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing: Allow witnessing of factory inspections and test at manufacturer's test facility.

1. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance: If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that facility, piping, and electrical Work are ready to receive belt filter press.

3.2 INSTALLATION

A. According to manufacturer instructions.

1. Level unit to ensure that belts are level and true.
2. After belt filter press has been set in position and shimmed to the proper elevation, grout space between bottom of the belt filter press base and concrete pier with non-shrink grout.

3.3 FIELD QUALITY CONTROL

A. Inspect components for proper alignment, connection and installation.

B. Installation Certificate: furnish prior to start-up, from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for start-up and functional testing.

C. Testing:

1. Provide a detailed test procedure for each test to the Engineer at least six weeks prior to the start of testing.
2. Test procedures: Describe testing methods, schedules and an outline of testing laboratory facility requirements.

    a. Tests will not commence without the Engineer's approval of the test procedures.
    b. Tests will be conducted in the presence of the Engineer and Owner.

3. Functional Testing: Startup presses with appurtenances without the addition of sludge and polymer.

    a. Test system components for a minimum of four hours to demonstrate satisfactory operation without mechanical or electrical problems over the full range of operating conditions.

4. Acceptance Testing: Upon satisfactory completion of the functional testing.

    a. Test presses with sludge and polymer for five, 8 hour continuous days to establish press performance and system reliability without alarms over full range of operating conditions.
    b. Adjust, repair, or modify, as needed to ensure proper operation and performance.
    c. Shutdowns to replace components failing to perform as specified will require the acceptance test to be repeated.

d. Make final adjustments to equipment under direction of manufacturer's representative.

5. Performance Testing: Upon satisfactory completion of the acceptance testing.

a. Test one press with sludge and polymer to verify the unit meets minimum performance requirements as specified for final acceptance of the equipment.
b. Prior to performance testing, conduct bench-scale testing of at least two**]** polymers to confirm polymer selection and dose will result in optimal performance.
c. Manufacturer's representative to recommend the polymer for use in testing.
d. Contractor to provide labor, equipment, and chemicals (polymer) required to conduct the performance test and collect all samples.
e. Test the equipment for 5 continuous days, 8 hours per day per test period during which the average performance of the unit must equal or exceed the specified performance parameters.
f. If the unit fails to equal or exceed that required or cannot operate continuously for the test period due to equipment failure, that days test period will be repeated.
g. During each day's performance test, collect all required samples and measurements at 1-hour intervals from the beginning of the test in order to make the following determinations:

1) Sludge feed: Total solids.
2) Filtrate and wash water: Total solids
3) Filtrate and wash water: Suspended solids.
4) Cake discharged from press: Total solids.
5) Plant water (one of two daily composites): Total solids.
6) Feed to press (sludge + polymer + dilution water):m Total solids.
7) Sludge feed rate: gpm.
8) Polymer feed rate: gpm.
9) Sludge Feed rate: lb/hr.
10) Cake discharge rate: lb/hr.
11) Solids capture: Percent.
12) Setting for polymer feed pump speed.
13) Setting for sludge feed pump speed.
14) Setting for press belt speed.
15) Setting for venturi mixer.
16) Setting for press belt tension.
17) Sludge feed volatile solids: Percent.

6. Solids Determinations: Made by an independent laboratory acceptable to Engineer at no additional cost to Owner.
7. Data Collected During Performance Testing: Made available for analysis by Engineer.

a. No data from a single day to fall more than 40 percent below the specified criteria.
b. Discard test data that is in apparent error.
c. Discarding more than one-third of the data will invalidate the test.
d. If the any one of the performance requirements are not met, make adjustments and modifications as needed to meet the requirements and retest as described above, at no additional cost to the Owner.
e. Written test report covering raw data collection, test results, problems encountered and calculations for establishing polymer dose, and solids capture.

8. After completion of additional tests, if equipment fails to meet the performance requirements, the Engineer retains the option to require the Contractor to test and evaluate a one-meter trailer mounted belt press of similar design of another manufacturer.

    a. Should tests using the trailer mounted press meet the performance requirements, replace the installed belt presses and appurtenances with full-scale equipment made by the trailer mounted manufacturer at the Contractor’s expense.
    b. Conduct a full-scale performance test to demonstrate compliance with requirements as specified.

9. Manufacturer Services: Manufacturer's representative experienced in installation of products furnished under this Section for not less than 2 days on Site for installation, inspection, startup, functional testing, acceptance testing, performance testing, and instructing Owner's personnel in operation and maintenance of equipment in accordance with Section 017900.

3.4 ADJUSTING

A. After belt filter press has been leveled and set in position, level and align each individual roller assembly.

B. If required, reposition roller assembly bearing housings and shim to attain proper belt tracking.

C. Check all control functions and adjust as required.

3.5 CLEANING

A. Blow systems clear of moisture and foreign matter.

3.6 DEMONSTRATION

A. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 467621

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