Collier County, Florida

Foxfire Wells
(Mechanical and Aboveground Facilities)

Contract Documents and Technical Specifications

Prepared for:

Collier County

Issue Date:

July 2024

CDM Smith

Water Science Associates

DOCUMENT 000107 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

A. Process Mechanical Engineer:

1. Isaac D. Holowell
2. License #83413.
3. Responsible for Divisions
   Division 40, Sections 400506 to 400578.19
   and Division 43

THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY ISAAC D. HOLOWELL ON THE DATE ADJACENT TO THE SEAL.

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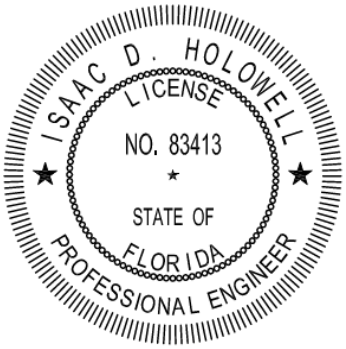

Isaac D Holowell
FL PE# 83413

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B. Structural Engineer:

1. Kevin M. Francoforte
2. License #73949.
3. Responsible for
   Division 03 and Division 13.

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Kevin M Francoforte
FL PE #73949
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C. Electrical Engineer:

1. Spencer J. Perry Jr.
2. License #62587.
3. Responsible for Division 26.

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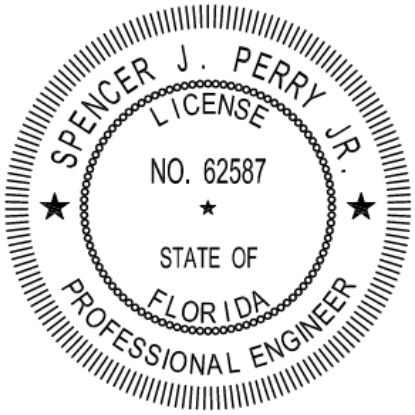

Spencer J Perry
FL PE 62587
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D. Instrumentation and Controls Engineer:

1. Michael John Graham
2. License #71194.
3. Responsible for
   Division 27 and
   Division 40, Sections 406100 to 407856.

THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY TBD ON THE DATE ADJACENT TO THE SEAL.

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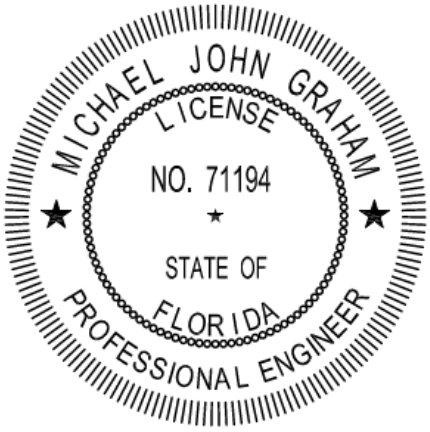

Digitally signed by Michael J Graham
Location: Florida PE 71194
Date: 2024.08.02 11:41:30-04'00'

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SECTION 011000 - SUMMARY

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. Project information.
2. Work covered by Contract Documents.
3. Contractor’s use of site and premises.
4. Work restrictions.
5. Specification and Drawing conventions.
6. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 “Execution” for coordination of Owner-installed products.

1.3 DEFINITIONS

A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

A. Project Identification: Foxfire Wells Mechanical and Above Ground Facilities.

1. Project Location: 5500 Radio Road, Naples, FL 34104.

B. Owner: Collier County, FL.

C. Engineer: CDM Smith Inc.

1. Engineer's Representative: Mark J. Sunyak, P.E., PMP; Project Manager; sunyakmj@cdmsmith.com; (239) 938-9604.

1.5 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. Mechanical and above ground portions of two new wells at the Foxfire Ground Storage Tank site, including the well pumps, wellheads, piping, electrical equipment, and instrumentation and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveway and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

a. Schedule deliveries to minimize use of driveway and entrance by construction operations.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to between 7:00 a.m. to 7:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.

E. Employee Identification and Screening: All Employees of the CONTACTOR shall obtain a Facilities Contractor badge from Collier County Facilities Management (address provided below). Such Facilities Contractor badge must be prominently displayed on the outside of the Employees' clothing at all times. All Employees working at the Project site must log in and out with the Contractor each day.

Collier County Facilities Management
3335 Tamiami Trail East, Suite 101
Naples, FL 34112-5356

1.8 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.

E. Adhere to Collier County's Technical Specifications and Standards for Water Distribution Systems (https://www.colliercountyfl.gov/home/showpublisheddocument/82392/636773548867030000) (https://www.colliercountyfl.gov/your-government/divisions-f-r/public-utilities-planning-and-project-management/utilities-standards-manual) sections. These include but are not limited to:

1. 330503 Polyvinyl Chloride (PVC) Pipe and Fittings
2. 330518 Laying and Jointing Buried Pipelines

F.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011000

SECTION 012500 - SUBSTITUTION PROCEDURES

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 substitutions.

B. Related Requirements:
   1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

   1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
   2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

   1. Substitution Request Form: Use form acceptable to Engineer.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

      a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
      b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section.

Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of Engineers and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Engineer's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Engineer does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed unless otherwise indicated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012500

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

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 provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Project meetings.

B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Engineer, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and in prominent location on the project site. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.6 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Engineer will return without response those RFIs submitted to Engineer by other entities controlled by Contractor.

2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Owner name.
3. Owner’s Project number.
4. Name of Engineer.
5. Engineer’s Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Use form acceptable to Engineer.

1. Attachments shall be electronic files in PDF format.

D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Engineer's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt by Engineer of additional information.

3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit change proposal according to Section 10 “CHANGES IN THE WORK” of the CONSTRUCTION AGREEMENT.

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within 48 hours of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Engineer.
4. RFI description.
5. Date the RFI was submitted.
6. Date Engineer's response was received.
7. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
8. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

F. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Engineer's Digital Data Files: Digital data files of Engineer's CAD drawings will be provided by Engineer for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
2. Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.

B. PDF Document Preparation: Where PDFs are required to be submitted to Engineer, prepare as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within three days of the meeting.

B. Preconstruction Conference: Engineer will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Responsibilities and personnel assignments.
    b. Tentative construction schedule.
    c. Phasing.
    d. Critical work sequencing and long lead items.
    e. Designation of key personnel and their duties.
    f. Lines of communications.
    g. Procedures for processing field decisions and Change Orders.
    h. Procedures for RFIs.
    i. Procedures for testing and inspecting.
    j. Procedures for processing Applications for Payment.
    k. Distribution of the Contract Documents.
    l. Submittal procedures.
    m. Sustainable design requirements.
    n. Preparation of Record Documents.
    o. Use of the premises.
    p. Work restrictions.
    q. Working hours.
    r. Owner's occupancy requirements.
    s. Responsibility for temporary facilities and controls.
    t. Procedures for moisture and mold control.
    u. Procedures for disruptions and shutdowns.
    v. Construction waste management and recycling.
    w. Parking availability.
    x. Office, work, and storage areas.
    y. Equipment deliveries and priorities.
    z. First aid.
    aa. Security.

bb. Progress cleaning.
cc. List of major subcontractors and suppliers.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Progress Meetings: Conduct progress meetings at monthly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site use.
8) Temporary facilities and controls.
9) Progress cleaning.
10) Quality and work standards.
11) Status of correction of deficient items.
12) Field observations.
13) Status of RFIs.
14) Status of Proposal Requests.
15) Pending changes.
16) Status of Change Orders.
17) Pending claims and disputes.
18) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013100

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

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 documenting the progress of construction during performance of the Work, including the following:

1. Contractor's Construction Schedule.
2. Construction schedule updating reports.
3. Site condition reports.
4. Unusual event reports.

B. Related Requirements:

1. Section 014000 “Quality Requirements” for schedule of tests and inspections.
2. Section 4 “PROGRESS PAYMENTS” of the CONSTRUCTION AGREEMENT for requirements for schedule of values and schedule for Applications for Payment.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file.
2. PDF file.

B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

C. Construction Schedule Updating Reports: Submit with Applications for Payment.

D. Site Condition Reports: Submit at time of discovery of differing conditions.

E. Unusual Event Reports: Submit at time of unusual event.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Engineer's request.

1.6 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Program Description:

1. A Critical Path Method (CPM) construction schedule shall be used to control the Work and to provide a basis for determining job progress. The construction schedule shall be prepared and maintained by the Contractor. All work shall be done in accordance with the established CPM schedule. The Contractor and all subcontractors shall cooperate fully in developing the construction schedule and in executing the work in accordance with the CPM schedule.
2. Construction schedule shall consist of a computerized CPM network (diagram of activities) presented in a time-scaled graphic (print-out) with reports, as specified herein.

B. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

C. Qualifications:

1. Contractor shall have the capability of preparing and utilizing the specified CPM schedule, or engage the services of a specialized scheduling professional to do so. Within seven days of the award of contract, provide a résumé or qualifications statement for the individual within Contractor's organization, or the outside consultant, who is being proposed as the responsible party for development and maintenance of CPM schedule. Résumé or qualifications statement shall demonstrate that the proposed responsible party has successfully developed and maintained CPM schedules for at least three construction projects of the same size or greater than this project. Proposed responsible party for CPM schedule is subject to approval by Engineer and Owner. If the proposed responsible party for CPM schedule is not approved by **[Engineer] [Construction Manager]** and/or Owner, Contractor shall resubmit a more-appropriate candidate for approval.

D. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

E. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 30 days, unless specifically allowed by Engineer.
2. Activities to facilitate the Work: Indicate start and completion dates for the following as applicable:

    a. Securing of approvals and permits required for performance of the Work.
    b. Temporary facilities.
    c. Construction of mock-ups, prototypes, and samples.
    d. Owner interfaces and furnishing of items.
    e. Interfaces with Separate Contracts.

f. Regulatory agency approvals.
g. Punch list.

3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
6. Commissioning Time: Include no fewer than 15 days for commissioning.
7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
8. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

F. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
6. Work Restrictions: Show the effect of the following items on the schedule:

a. Coordination with existing construction.
b. Limitations of continued occupancies.
c. Uninterruptible services.
d. Partial occupancy before Substantial Completion.
e. Use-of-premises restrictions.
f. Provisions for future construction.
g. Seasonal variations.
h. Environmental control.

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

a. Subcontract awards.
b. Submittals.
c. Purchases.
d. Mockups.
e. Fabrication.

f. Sample testing.
g. Deliveries.
h. Installation.
i. Tests and inspections.
j. Adjusting.
k. Curing.
l. Building flush-out.
m. Startup and placement into final use and operation.
n. Commissioning.

8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Structural completion.
b. Temporary enclosure and space conditioning.
c. Permanent space enclosure.
d. Completion of mechanical installation.
e. Completion of electrical installation.
f. Substantial Completion.

G. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion**.**

H. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

I. Acceptability:

1. Submit the CPM schedule submittals, as specified, and resubmit as needed, until they are in compliance with Contract requirements.
2. Engineer's review of Contractor's construction schedule submittals will only be for conformance with Contract requirements, including but not limited to, Contract Time and Work sequences specified in Contract Documents. Engineer's review of schedule shall not include Contractor's means and methods of construction or safety. Engineer's concurrence, acceptance, or approval of Contractor's schedule submittals will not relieve Contractor from responsibility for complying with Contract Scope, Contract Time, or any other Contract requirement. Any indication of concurrence, acceptance, or approval of Contractor's schedule will only indicate a general conformance with Contract Requirements.
3. Engineer's review of Contractor's construction schedule submittals shall not relieve Contractor from responsibility for any deviations from Contract Documents unless Contractor has in writing called Engineer's attention to such deviations at the time of submission and Engineer has given written concurrence to the specific deviations, nor shall any concurrence by Engineer relieve Contractor from responsibility for errors and

omissions in the submittals. Concurrence of CPM Activity Network by Engineer is advisory only and shall not relieve Contractor of responsibility for accomplishing the Work within Contract completion date(s).

4. Concurrence, acceptance, or approval of Contractor's CPM schedule by Engineer in no way makes Engineer an insurer of CPM schedule's success, nor liable for time or cost overruns resulting therefrom.
5. Failure to include any element of work required for the performance of this Contract will not excuse Contractor from completing all Work required within Contract completion date(s), notwithstanding the review of the network by Engineer.
6. CPM schedules that contain activities with negative float, or which extend beyond Contract completion date, will not be acceptable.
7. Except where earlier completions are specified, CPM schedules which show completion of all work prior to Contract completion date may be indicated; however, in no event shall they constitute a basis for claim for delay by Contractor.

J. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Final Completion percentage for each activity. Activities shall not be considered to be complete until they are in fact 100 percent complete.
4. Submit a narrative report based on the CPM schedule evaluation, in a format agreed upon by Contractor and Engineer. The report shall include a description of the progress during the previous period in terms of completed activities, an explanation of each activity which is showing a delay, a description of problem areas, current and anticipated delaying factors and their estimated impact on performance of other activities and completion dates and an explanation of corrective action taken or proposed.

K. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

L. Contract completion time will be adjusted only for causes specified in this Contract. In the event Contractor requests an extension of any Contract completion date, Contractor shall furnish such justification and supporting evidence as Engineer may deem necessary to determine whether Contractor is entitled to an extension of time under the provisions of this Contract. Engineer will, after receipt of such justification and supporting evidence, make findings of fact and will advise Contractor in writing thereof. If Engineer finds that Contractor is entitled to any extension of any contract completion date, Engineer’s determination as to the total number of days extension shall be based upon the currently approved CPM schedule and on all data relevant to the extension. Such data shall be included in the next updating of the schedule. Actual delays in activities which, according to CPM schedule, do not affect any Contract completion date shown by critical path in the network will not be the basis for a change.

M. Distribution: Distribute copies of approved schedule to Engineer**,** Owner, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.8 CPM SCHEDULE REQUIREMENTS

A. Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.

    a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.

h. Work by Owner that may affect or be affected by Contractor's activities.
i. Testing and inspection.
j. Commissioning.
k. Punch list and Final Completion.
l. Activities occurring following Final Completion.
m. Maintenance of existing facilities.
n. Contract milestones.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

1.9 REPORTS

A. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

B. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013200

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SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

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 the following:

1. Preconstruction photographs.
2. Concealed Work photographs.
3. Periodic construction photographs.
4. Final Completion construction photographs.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos on CD-ROM or thumb-drive. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in file metadata tag:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Engineer.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

1.4 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.

B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

C. Metadata: Record accurate date and time from camera.

D. File Names: Name media files with date, Project area and sequential numbering suffix.

E. Usage Rights

1. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

1.5 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Preconstruction Photographs: Before commencement of the Work take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Engineer.

1. Flag construction limits before taking construction photographs.
2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:

1. Underground utilities.
2. Underslab services.
3. Piping.
4. Electrical conduit.
5. Waterproofing and weather-resistant barriers.

D. Periodic Construction Photographs: Take 20 photographs monthly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

E. Final Completion Construction Photographs: Take 20 photographs after date of Substantial Completion for submission as Project Record Documents. Engineer will inform photographer of desired vantage points.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013233

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SECTION 013300 - SUBMITTAL PROCEDURES

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. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 4 “PROGRESS PAYMENTS” of the CONSTRUCTION AGREEMENT for submitting Applications for Payment and the schedule of values.
2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
4. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
5. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
6. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
7. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Mass Submittals: Six or more submittals or items in one day or 15 or more submittals or items in one week.

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Engineer's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.5 SUBMITTAL FORMATS

A. Numbering System: Utilize the following example submittal identification numbering system to identify submittals and as file names for PDF submissions:

1. First Identifier - Alphabet Character: D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.
2. Second Identifier - Next 6 or 8 Digits: Applicable Specification Section Number. Do not mix submittals from different specification sections into a single submittal.
3. Third Identifier - Next Three Digits: Sequential number of each separate item or drawing submitted under each Specification Section, in chronological order submitted, starting at 001.
4. Fourth Identifier - Last Alphabet Character: A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc.

5. EXAMPLE: D-033000.13-008-B.

    a. D = Shop Drawing.
    b. 03 30 00.13 = Section; use only 6 digits for Sections that do not include 8 digits.
    c. 008 = the eighth different submittal under this Section.
    d. B = the second submission (first resubmission) of that particular shop drawing.

B. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Engineer.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

C. Options: Identify options requiring selection by Engineer.

D. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

E. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package and transmit to Engineer by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Engineer.

    a. Engineer will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 21 days for initial review of each submittal (and 45 days for multi-discipline reviews). Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Engineer's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
4. Repetitive Reviews: Shop drawings, O&M manuals, and other submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be performed at the Contractor's expense. Reimburse the Owner for all costs invoiced by Engineer for the third and subsequent reviews.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

1.7 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.
c. Standard color charts.
d. Statement of compliance with specified referenced standards.
e. Testing by recognized testing agency.
f. Application of testing agency labels and seals.
g. Notation of coordination requirements.
h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams that show factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

a. Project name and submittal number.
b. Generic description of Sample.
c. Product name and name of manufacturer.
d. Sample source.
e. Number and title of applicable Specification Section.
f. Specification paragraph number and generic name of each item.

3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
5. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.

8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured, and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit three sets of Samples. Engineer will retain two Sample sets; remainder will be returned.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Contractor’s Certification: Each shop drawing, working drawing, product data, and sample shall have affixed to it the following Certification Statement:

    a. "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements."

3. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
4. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
5. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
6. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
7. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.9 PROPOSED PRODUCT LIST

A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.10 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Contractor Responsible for:

1. Determination and verification of materials including manufacturer’s catalog numbers.
2. Determination and verification of field measurements and field construction criteria.
3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
4. Determination of accuracy and completeness of dimensions and quantities.
5. Confirmation and coordination of dimensions and field conditions at Site.
6. Construction means, techniques, sequences, and procedures.
7. Safety precautions.
8. Coordination and performance of Work of all trades.
9. Other requirements enumerated in Contract Documents.

C. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

1.11 ENGINEER'S REVIEW

A. Do not make mass submittals to Engineer. If mass submittals are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review mass submittals based on priority determined by Engineer after consultation with Owner and Contractor.

B. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required.

1. PDF Submittals: Engineer will indicate, via markup on each submittal, the appropriate action**.**

2. Paper Submittals: Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action**.**

C. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.

E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

F. Engineer will return without review submittals received from sources other than Contractor.

G. Submittals not required by the Contract Documents will be returned by Engineer without action.

H. Shop drawings will be returned to the Contractor with one of the following codes.

1. "APPROVED" - This code is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.
2. "APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.
3. "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. The resubmittal is to address all comments, omissions and non-conforming items that were noted. An additional box is checked to indicate whether the resubmission is for the complete package, or for parts of the package. If no box is checked, a complete resubmittal shall be provided. Review code may designate if a partial or full submittal is required. If full submittal is required, a complete resubmittal package addressing all comments shall be provided. If a partial submittal is designated, resubmittal shall only include information pertaining to those items noted in review comments requiring clarification and any portions of submittal impacted as a result of the response. Resubmittal is to be received by the Engineer within 30 calendar days of the date of the Engineer's transmittal requiring the resubmittal.
4. "REJECTED" - This code is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the Contract Documents.
5. "RECEIPT ACKNOWLEDGED (Not subject to Engineer's Approval)" - This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's approval. This code is generally used with submittals involving the Contractor’s means and methods of construction work plans, and health and safety plans.

1.12 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Use for other Projects or purposes is not allowed.

B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:

1. Use of files is solely at receiver's risk. Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Engineer of discrepancy and use information in hard-copy Drawings and Specifications.
2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.
4. Receiver shall not hold Engineer responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.
5. Receiver shall understand that even though Engineer has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
6. Receiver shall not hold Engineer responsible for such viruses or their consequences, and shall hold Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013300

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SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS

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. Preparing and implementing a Health and Safety (H&S) Plan to establish in detail the protocols necessary for protecting workers from potential hazards during the work specified in the Contract Documents.

1.3 DEFINITIONS

A. CIH: Certified Industrial Hygienist.

B. SSHO: Site Safety and Health Officer. Provide a responsible individual, competent through experience and training, to be able to identify hazards associated with Contractor’s Work and has overall responsibility for safety and health performance of Contractor’s activities, including lower tier subcontractors. The person shall be present on-site during all Contractor activities and shall ensure that requirements of Project Specific Safety and Health Plan are fully implemented. This person shall also:

1. Attend pre-work conferences and site safety and health orientations and briefings. Contractor is expected to supplement the site orientation with information related to the Contractor's scope of work.
2. Document weekly tool box safety meetings for Contractor’s employee’s onsite.
3. Submit weekly safety and health inspection reports of the construction site as it relates to Contractor's scope of work. Record hazards identified, and corrective actions taken. The weekly inspection report shall be submitted to Site Manager.
4. Report job-related accidents/illness related to Contractor’s employees and lower tier subcontractors as soon as practical to Site Manager and perform site accident and incident investigations associated with Contractor's scope of work and fully cooperate with any other accident or incident investigations which may be required.
5. Maintain safety and health statistical information and provide monthly reports to Site Manager. Reports shall include, employee hours worked, number of first aid cases, number of medical treatment cases, and number of restricted and lost workday cases as defined by the US Occupational Health and Safety Administration. These reports shall include statistical information related to all of Contractor's activities and those of lower tier subcontractors.

6. Provide Site Manager with the immediate notification of any regulatory inspection and a copy of resulting citations or notice of deficiencies.

1.4 ACTION SUBMITTALS

A. Qualifications of the CIH and the SSHO.

B. Prior to commencing work at the jobsite, Contractor must file with Engineer all required documents, such as: A copy of ***Contractor's Project Specific Safety and Health Plan*** and copies of employee training certificates, insurance certificates, construction permits, blasting permits, crane certifications and operator licenses, Steam Boiler Certifications, Elevator Certifications and any approved "OSHA Variances," or other approvals as required to safely and legally perform Contractor's Scope of Work. ***Contractor's Project Specific Safety and Health Plan*** shall as a minimum include the following:

1. Letter of corporate commitment to Safety and Health signed by CEO or President of the contractor's organization.
2. Brief description of the contractor's scope of work.
3. Project safety and health organization, responsibilities, and accountability procedures.
4. Project safety and health goals and objectives.
5. Project hazard communication and safety training. (This section shall include a minimum requirement for a site hazard communication program and weekly safety meetings.)
6. Activity hazard analyses covering activities within the contractor's scope of work describing the steps of each principle activity, the hazards associated with each activity and procedures to be used to eliminate or control the hazards.
7. Personal protective equipment. (Note: Minimum site PPE requirements shall include hard hats, safety glasses with side shields and sturdy work boots.)
8. Specialized medical surveillance and/or air monitoring procedures, if required.
9. Safe work procedures. These may be incorporated by reference to Contractor's Corporate Safety and Health Program.
10. Safety inspections and audits.
11. Project emergency response and preparedness procedures including provisions for providing first aid and notification of emergency services.
12. Contractor and any of its subcontractors must submit a Hazardous Waste Management Plan that addresses the handling, labeling, transpiration, and disposal of hazardous waste. Contractor shall be held solely responsible for compliance with the provisions of all applicable regulations associated with hazardous waste generated as a consequence of Contractor's activities.

1.5 INFORMATIONAL SUBMITTALS

A. Listed below are general conditions related to Safety and Health which Contractor is required to comply with.

1. Should a specific interpretation be required concerning special and/or unusual safety, fire protection, or environmental concerns not covered by, the National Fire Protection Association Codes, and current OSHA/EPA or other local regulations the contractor shall contact the Site Manager's Safety and Health Representative or Corporate Safety and Health Office for guidance.

2. Practices, procedures, and requirements set forth in this Appendix shall apply equally to all Contractors, and it is mandatory that each Contractor inform and enforce the provisions of this Appendix in all Contracts with its subcontractors.
3. Site Manager shall have the right to direct the removal from the jobsite Contractor or Contractor's personnel for violation of safety, health, fire protection, or environmental rules and regulations.
4. Fighting or horseplay is strictly prohibited and shall be considered grounds for removal from the project.
5. Illegal use, possession, purchase, sale or diversion of a drug or controlled substance is prohibited. Use or possession of alcoholic beverages at the jobsite is prohibited.
6. Site Manager shall have the right to direct the removal from the jobsite any defective tools and equipment, the use of which may create a hazardous situation.
7. Site Manager reserves the right to delete, modify, or supplement these procedures at any time without prior notice, but in such event, will notify all contractors affected by such change in procedures.
8. Site Manager reserves the right to evaluate Contractor's, and any of its subcontractor's, overall safety performance, compliance with these procedures, and any established supplements, at intervals Site Manager deems appropriate.
9. Prior to starting work in any jobsite area, Contractor must first obtain permission and instructions from Site Manager, or designee.

1.6 TRAINING

A. Certify that Contractor personnel assigned for the purpose of performing or supervising work in accordance with the provisions of the H&S plan have received appropriate safety training in accordance with 29 CFR 1926.65. Training shall consist of a minimum of 40 hours of health and safety training and 8 hours refresher training annually. In addition, Contractor's supervisory personnel shall have a minimum of 8 hours additional specialized training for managing hazardous waste operations.

B. Additionally, Contractor shall be responsible for, and shall guarantee that, only personnel successfully completing the required training are permitted to enter designated areas of the site where worker protection is required.

1.7 DESCRIPTION OF REQUIREMENTS

A. This Section describes the minimum health and safety requirements for this project. Develop a detailed H&S Plan using this Section as a basis and delineating additional details and requirements as deemed necessary. The H&S plan shall establish in detail the protocols necessary for protecting workers from potential hazards encountered during demolition activities.

B. Utilize the services of a certified industrial hygienist (CIH) by the American Board of Industrial Hygienists (ABIH) to develop and implement the H&S plan, including any on-site air monitoring program, conducting initial site-specific training and provide continued support for all health and safety activities as needed, including the upgrading or downgrading of the level of personnel protection.

C. In addition, a Site Safety and Health Officer (SSHO) shall assist and represent CIH in the continued implementation and enforcement of H&S Plan. SSHO shall be assigned to the site on a full-time basis during performance of activities covered by H&S plan and shall be either Contractor's employee or a subcontractor who reports to Contractor and CIH in matters pertaining to site safety and health.

D. H&S Plan shall include but not necessarily be limited to, the following components as required by OSHA 29 CFR 1926.65(b)4 and 1926.65(l)(2):

1. Site Description and Evaluation.
2. Names of key personnel and alternate responsible for site safety and health (responsibilities and chain of command).
3. Safety and health hazard assessment and risk analysis for each site task and operator (Accident Prevention Plan).
4. Education and Training.
5. Personnel Protective Equipment.
6. Medical Surveillance.
7. Air Monitoring (Environmental).
8. Standard Operating Procedures, Engineering Controls and Work Practices.
9. Site Control Measures (Work Zones, Communications and Security).
10. Personnel Hygiene and Decontamination.
11. Equipment Decontamination.
12. Logs, Reports and Record Keeping.
13. Heat/Cold Stress Monitoring.
14. Pre-emergency planning.
15. Personnel roles, lines of authority, training, and communication.
16. Emergency recognition and prevention.
17. Safe distances and places of refuge.
18. Site security and control.
19. Evacuation routes and procedures.
20. Decontamination.
21. Emergency Medical treatment and first aid.
22. Emergency alerting and response procedures.
23. Critique of response and follow-up.
24. Personnel Protection Equipment and emergency equipment.

1.8 REGULATORY REQUIREMENTS

A. Contractor is responsible for awareness, knowledge and full compliance with all applicable rules, regulations, laws, and practices applicable to Contractor’s Scope of Work, including lower tier subcontractors, prescribed by the site owner, and any other government or agency governing the safety and health of employees, other site personnel, the general public and protection of the environment. Within the United States and its Territories these include, but are not limited to regulations promulgated by the following:

1. Occupational Safety and Health Administration (OSHA).
2. Environmental Protection Agency (EPA).
3. Department of Transportation (DOT).
4. Department of Energy, Nuclear Regulatory Commission (NRC).
5. Mine Safety and Health Administration (MSHA).

B. Additional rules required by Site Manager include:

1. Each Contractor has the responsibility for instructing its employees in safe practices for the operation of tools and equipment and for the maintenance of safe conditions.
2. Contractors shall furnish for their employees' personal safety equipment such as, ANSI Z89.1 approved hard hats, ANSI Z87.1 approved eye protection with fixed side shields, ear protection, foot protection, NIOSH approved respiratory protection, fall protection and other equipment as required for safe performance of their particular work assignment. All personnel on the job site shall be required at a minimum to wear hard hats, safety glasses with side shields and proper and sturdy footwear.
3. Danger tags and locks shall be utilized to prevent personal injury and equipment damage in accordance with project electrical and mechanical tagging procedures.
4. Scaffolding and other structures utilized for elevated work platforms shall have the required decking, handrails, mid-rails, toe boards, proper access, and nets or screens.
5. Catwalks shall conform to a two-plank width minimum and, if elevated, shall have handrails and toe boards.
6. Areas in which "overhead" work is to be performed shall be blocked, decked, barricaded, netted, posted, or evacuated as instructed by project supervision.
7. Pits, trenches, and other excavations shall be shored/shielded or sloped to the proper angle of repose, barricaded, and provided with proper access.
8. When not in use, blades of bulldozers and buckets of front-end loaders shall be lowered to the ground. Also, beds of dump trucks shall be lowered when traveling or not in use. Project parking and traffic regulations shall be complied with.
9. Crane booms shall be lowered at the end of single shifts or secured against movement by attaching the hoist line to a fixed structure.
10. Specific air sampling shall be performed to determine the presence of toxic materials or dusts, flammable atmosphere, and adequate oxygen content, in accordance with project procedures. Respirators, safety harnesses, lifelines, standby personnel, and permits shall be used when appropriate.
11. Personnel involved in activities which require the use of an Air Purifying Respirator (APR) shall not have facial hair which interferes with the respirator's face seal.
12. Contractor shall provide to Site Manager a copy of MSDSs for all hazardous materials prior to their use at the site.
13. Back-up alarms shall be provided on all construction vehicles and equipment and shall alarm continuously while the vehicle or equipment is in reverse motion. For equipment not equipped with a back-up alarm, a spotter shall be used.
14. Portable generators shall have frames externally grounded or other means to ensure there is no potential for circuit to frame conductivity.
15. Electrical services used in conjunction with field activities shall be equipped with Ground Fault Circuit Interrupters (GFCI).
16. Compliance with the following fire prevention measures is mandatory:
    a. Smoking is permitted only in specific areas as designated in project rules and procedures.
    b. Open fires are prohibited. Temporary gas-fired heaters shall not be used in enclosed areas. Only UL and NFPA approved petroleum and/or electrically fired heating devices will be authorized for use.
    c. Hot work permits shall be required for all flame and spark producing work tasks.
    d. Debris, scrap, and refuse shall be segregated and controlled in metal containers and removed at appropriate intervals. Any potential fire hazard shall be controlled.

e. Each Contractor is responsible for maintaining and cleaning their work area. All walkways shall be kept clean and free of obstructions. Broken/spilled, scrap or other waste materials shall be placed in appropriate containers or waste areas as soon as practical after they are generated.
f. Flammable liquids shall be kept in UL approved safety containers and properly labeled as to contents.
g. Flammable and combustible materials shall be stored in designated locations that meet Federal, State, and local regulations.
h. All equipment such as cranes, trucks, bulldozers, graders, loaders and backhoes shall be equipped with proper fire extinguishers.
i. The use of heavy equipment with internal combustion engines is prohibited within enclosed areas.

17. Only the number of persons provided with proper seats shall ride in a vehicle. No one shall ride on running boards, stand on moving equipment or ride on a vehicle other than in a proper seated position.
18. Swing radius of all heavy equipment such as cranes, back hoes, etc. shall be clearly barricaded.
19. Contractor shall provide 100 percent fall protection for fall exposures greater than 6 feet in accordance with project procedures.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013526

SECTION 014000 - QUALITY 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 administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, 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.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance

with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" shall have the same meaning as the term "testing agency."

H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Engineer.

1.4 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated-Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Engineer regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Engineer for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel and Delegated-Designer.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award, and not less than five days prior to preconstruction conference. Submit in format acceptable to Engineer. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include Work Engineer has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.

5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Design Professional Qualifications: A professional engineer / registered architect who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Design / engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged in the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329**,** and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect, demonstrate, repair and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.10 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

C. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

F. Contractor’s Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.

6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payments.

1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Engineer.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as

possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

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SECTION 014200 - REFERENCES

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 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Abbreviations and acronyms not included in this list shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States." Information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.

25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CE - Conformite Europeenne; http://ec.europa.eu/growth/single-market/ce-marking/
51. CEA - Canadian Electricity Association; www.electricity.ca.
52. CEA - Consumer Electronics Association; www.ce.org.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.pbmdf.com.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - CSA Group; www.csagroup.com.
65. CSA - CSA International; www.csa-international.org.
66. CSI - Construction Specifications Institute (The); www.csinet.org.
67. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
69. CWC - Composite Wood Council; (See CPA).

70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECA - Electronic Components Association; (See ECIA).
73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; www.eciaonline.org.
75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; www.eima.com.
77. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
78. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org .
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); www.intertek.com.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
85. FM Approvals - FM Approvals LLC; www.fmglobal.com.
86. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridaroof.com.
88. FSA - Fluid Sealing Association; www.fluidsealing.com.
89. FSC - Forest Stewardship Council U.S.; www.fscus.org.
90. GA - Gypsum Association; www.gypsum.org.
91. GANA - Glass Association of North America; www.glasswebsite.com.
92. GS - Green Seal; www.greenseal.org.
93. HI - Hydraulic Institute; www.pumps.org.
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
95. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
96. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
97. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
98. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
99. IAS - International Accreditation Service; www.iasonline.org.
100. ICBO - International Conference of Building Officials; (See ICC).
101. ICC - International Code Council; www.iccsafe.org.
102. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
103. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
104. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
105. IEC - International Electrotechnical Commission; www.iec.ch.
106. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
107. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
108. IESNA - Illuminating Engineering Society of North America; (See IES).
109. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
110. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
111. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
112. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
113. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.

114. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
115. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
116. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
117. ISO - International Organization for Standardization; www.iso.org.
118. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
119. ITU - International Telecommunication Union; www.itu.int/home.
120. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
121. LMA - Laminating Materials Association; (See CPA).
122. LPI - Lightning Protection Institute; www.lightning.org.
123. MBMA - Metal Building Manufacturers Association; www.mbma.com.
124. MCA - Metal Construction Association; www.metalconstruction.org.
125. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
126. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
127. MHIA - Material Handling Industry of America; www.mhia.org.
128. MIA - Marble Institute of America; www.marble-institute.com.
129. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
130. MPI - Master Painters Institute; www.paintinfo.com.
131. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
132. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
133. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
134. NADCA - National Air Duct Cleaners Association; www.nadca.com.
135. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
136. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
137. NBI - New Buildings Institute; www.newbuildings.org.
138. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
139. NCMA - National Concrete Masonry Association; www.ncma.org.
140. NEBB - National Environmental Balancing Bureau; www.nebb.org.
141. NECA - National Electrical Contractors Association; www.necanet.org.
142. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
143. NEMA - National Electrical Manufacturers Association; www.nema.org.
144. NETA - InterNational Electrical Testing Association; www.netaworld.org.
145. NFHS - National Federation of State High School Associations; www.nfhs.org.
146. NFPA - National Fire Protection Association; www.nfpa.org.
147. NFPA - NFPA International; (See NFPA).
148. NFRC - National Fenestration Rating Council; www.nfrc.org.
149. NHLA - National Hardwood Lumber Association; www.nhla.com.
150. NLGA - National Lumber Grades Authority; www.nlga.org.
151. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
152. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
153. NRCA - National Roofing Contractors Association; www.nrca.net.
154. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
155. NSF - NSF International; www.nsf.org.
156. NSPE - National Society of Professional Engineers; www.nspe.org.
157. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
158. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
159. NWFA - National Wood Flooring Association; www.nwfa.org.

160. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
161. PDI - Plumbing & Drainage Institute; www.pdionline.org.
162. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
163. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
164. RFCI - Resilient Floor Covering Institute; www.rfci.com.
165. RIS - Redwood Inspection Service; www.redwoodinspection.com.
166. SAE - SAE International; www.sae.org.
167. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
168. SDI - Steel Deck Institute; www.sdi.org.
169. SDI - Steel Door Institute; www.steeldoor.org.
170. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
171. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
172. SIA - Security Industry Association; www.siaonline.org.
173. SJI - Steel Joist Institute; www.steeljoist.org.
174. SMA - Screen Manufacturers Association; www.smainfo.org.
175. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
176. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
177. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
178. SPIB - Southern Pine Inspection Bureau; www.spib.org.
179. SPRI - Single Ply Roofing Industry; www.spri.org.
180. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
181. SSINA - Specialty Steel Industry of North America; www.ssina.com.
182. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
183. STI - Steel Tank Institute; www.steeltank.com.
184. SWI - Steel Window Institute; www.steelwindows.com.
185. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
186. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
187. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
188. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
189. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
190. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
191. TMS - The Masonry Society; www.masonrysociety.org.
192. TPI - Truss Plate Institute; www.tpinst.org.
193. TPI - Turfgrass Producers International; www.turfgrasssod.org.
194. TRI - Tile Roofing Institute; www.tileroofing.org.
195. UL - Underwriters Laboratories Inc.; http://www.ul.com.
196. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
197. USAV - USA Volleyball; www.usavolleyball.org.
198. USGBC - U.S. Green Building Council; www.usgbc.org.
199. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
200. WA - Wallcoverings Association; www.wallcoverings.org
201. WASTEC - Waste Equipment Technology Association; www.wastec.org.
202. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
203. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
204. WDMA - Window & Door Manufacturers Association; www.wdma.com.

205. WI - Woodwork Institute; www.wicnet.org.
206. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
207. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.

2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.

    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.

6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS; California Department of Health Services; (See CDPH).
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservice.tamu.edu.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

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 requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner, Engineer, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Owner will pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Owner will pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Owner will pay electric-power-service use charges for electricity used by all entities for construction operations.

E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

1.5 QUALITY ASSURANCE

A. Temporary facilities shall comply with all applicable state and local ordinances, codes and regulations.

B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

D. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service, if approved by Owner.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: If approved, connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Final Completion, restore these facilities to condition existing before initial use.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.

D. Temporary Light and Power: Provide by Contractor, including 220 Volt service for welding, complete with wiring, lamps and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the project needs. Make all necessary arrangements with the local electric company for temporary electric service and pay all expenses in connection therewith.

E. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

3.3 SUPPORT FACILITIES INSTALLATION

A. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

B. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

C. Storage and Staging: Use designated areas of Project site for storage and staging needs.

D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.

E. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Final Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Final Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. Just prior to Final Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT 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 administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 011000 “Summary” for Contractor requirements related to Owner-furnished products.
2. Section 014200 "References" for applicable industry standards for products specified.
3. Section 017700 “Closeout Procedures” for submitting warranties.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycle contract materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 “Comparable Products” Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

a. Name of product and manufacturer.
b. Model and serial number.
c. Capacity.
d. Speed.
e. Ratings.

3. See individual identification Sections in Divisions 03, 26, 40, and 43 for additional equipment identification requirements.

1.5 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection for wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Engineer will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

a. Submit additional documentation required by Engineer in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Engineer, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

   a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

   a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

   a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product that complies with requirements.

   a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

   a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer that complies with requirements.

a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "match Engineer's sample," provide a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type,

function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.

3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of Engineers and owners, if requested.
5. Samples, if requested.

B. Engineer's Action on Comparable Products Submittal: If necessary, Engineer will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
2. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by Engineer of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

D. Submittal Requirements, Single-Step Process: When acceptable to Engineer, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by Engineer of Contractor' request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 016000

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SECTION 017300 - EXECUTION

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 general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certified Surveys: Submit two copies signed by land surveyor.

C. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.

1.5 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit two copies showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Professional Engineer Qualifications: Refer to Section 014000 “Quality Requirements.”

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate

and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraphs, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer in accordance to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Engineer promptly.

B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points

promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements, and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Engineer. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items onsite and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Engineer. Fit exposed connections together to form hairline joints.

J. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Engineer. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall

coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

F. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Repair Work previously completed and subsequently damaged during construction period Repair to like-new condition.

C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

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SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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 the following:

1. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner’s property.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition and construction waste become 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 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed.

1.6 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may serve as Waste Management Coordinator.

B. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

E. Waste Management in Historic Zones or Areas: Transportation equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 12 inches or more.

3.2 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. General: Except for items or materials to be salvaged or recycled, remove waste materials, and legally dispose of at designated spoil areas on Owner's property.

C. Burning: Do not burn waste materials.

END OF SECTION 017419

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SECTION 017700 - CLOSEOUT PROCEDURES

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 Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final Completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Requirements:

1. Section 5 “FINAL PAYMENT” of the CONSTRUCTION AGREEMENT for Applications for Payment for Substantial Completion and Final Completion.
2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.3 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Engineer’s use prior to Engineer’s inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's “punch list”), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
6. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
7. Complete final cleaning requirements.
8. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 5 “FINAL PAYMENT of the CONSTRUCTION AGREEMENT.
2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first, listed by well site .
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Engineer.
d. Name of Contractor.
e. Page number.

4. Submit list of incomplete items in the following format:

a. MS Excel Electronic File. Engineer will return annotated file.

1.10 SUBMITTAL OF PROJECT WARRANTIES

A. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

B. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit by email to Engineer.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining: clean according to manufacturer’s recommendations.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
p. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
q. Clean strainers.
r. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 “Execution” before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

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 preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Systems and equipment operation manuals.
3. Systems and equipment maintenance manuals.
4. Product maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit by email to Engineer. Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Engineer will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Engineer will return copy with comments.

1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.6 REQUIREMENTS FOR OPERATION AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Engineer.

7. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.
8. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name, and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.

4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017823

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SECTION 017839 - PROJECT RECORD DOCUMENTS

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 Project Record Documents, including the following:

1. Record Drawings.
2. Record Product Data.
3. Miscellaneous record submittals.

B. Related Requirements:

1. Section 8 “DAILY REPORTS, SIGNED AND SEALED AS_BUILTS AND MEETINGS” of the CONSTRUCTION AGREEMENT for maintaining and exhibiting project record documents as a prerequisite for progress payments.
2. Section 017300 "Execution" for final property survey.
3. Section 017700 "Closeout Procedures" for general closeout procedures.
4. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set of marked-up record prints.

B. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

C. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

D. Reports: Submit written report monthly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Work Change Directive.
    k. Changes made following Engineer's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

1.5 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.7 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours. As a prerequisite for monthly progress payments, exhibit the updated record documents for review by Owner and Engineer for accuracy and completeness.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017839

SECTION 020500

CONNECTIONS TO EXISTING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General Requirements

B. Submittals

C. Scheduling of Shutdown

1.2 RELATED SECTIONS

A. Section 011000 – Summary of Work

B. Section 015000 – Construction Facilities and Temporary Controls

C. Section 015526 – Traffic Regulations and Public Safety

D. Section 320117 – Pavement Repair and Restoration

1.3 GENERAL REQUIREMENTS

A. Be responsible for all connection to existing systems, cutting, fitting and patching, including attendant excavation and backfill, required to complete the work or to:

1. Make its several parts fit together properly.

2. Uncover portions of the work to provide for installation of ill-timed work.

3. Remove and replace defective work.

4. Remove and replace work not conforming to requirements of Contract Documents.

B. Coordination: Before connection is performed, verify and provide for any pipe restraint that may be required for the new connection. Perform all cutting, fitting or patching of the Work that may be required to make the several parts thereof join in accordance with the Contract Documents. Perform restoration with competent workmen skilled in the trade.

C. If changes to a “looped” water distribution system occurring during construction result in dead ends to any new or relocated water mains, connect such dead

ends to the nearest water main. In cases where no nearby water main is available, provide a flushing device in coordination with the COUNTY at no additional cost to the COUNTY.

D. Improperly Timed Work: Perform all cutting and patching required to install improperly timed work, to remove samples of installed materials for testing, and to provide for alteration of existing facilities or for the installation of new Work in the existing construction.

E. Limitations: Except when the cutting or removal of existing construction is specified or indicated, do not undertake any cutting or demolition, which may affect the structural stability of the Work or existing facilities without the ENGINEER's concurrence.

F. Collier County Damage Prevention Policy:

1. This policy has been put in place to avoid damage to Collier County underground utilities. A minimum distance of five feet (5') horizontally and eighteen inches (18") vertically must be maintained away from Collier County utilities (in accordance with pipe separation criteria located in the Design Criteria section). Any and all variations from this order must be approved by the Water or Wastewater Department.

2. **Before commencement of any excavation, the existing underground utilities in the area affected by the work must be marked by Sunshine One Call, in accordance with State Statute Chapter 556 "Underground Facility Damage Prevention and Safety", after proper notification to them by either calling 811 in Florida or toll free at 1-800-432-4770. Visit www.callsunshine.com for more information. Before commencing excavation for the work, potholing of all potential conflicts must be performed.**

3. All lines in conflict must be physically located by the contractor and verified by Collier County Locate Department personnel before performing work. Utilities under concrete or pavement may require soft dig vacuum locates which also is the contractor's responsibility to perform. All utilities will be field marked per Sunshine State One Call's statutes and guidelines. For line verification or any other information concerning locates, please call the Locate Department at 239-252-5922 during normal business hours. For line verification or emergency locates after hours, call emergency numeric pager at 239-890-0809. **In the event the potholing and/or vacuum soft dig does not locate the marked utility, work must be stopped and the affected utility owner contacted.** Failure to comply with this policy and obtain required signature(s) may result in delay or denial of permit.

1.4 SUBMITTALS

A. Submit a written request to the ENGINEER well in advance of executing any cutting or alteration which affects:

1. Work of the COUNTY or any separate contractor.

2. Structural value or integrity of any element of the project or work.

3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.

4. Efficiency, operational life, maintenance or safety of operational elements.

5. Visual qualities of sight-exposed elements.

B. Include in request:

1. Identification of the work.

2. Description of affected work.

3. The necessity for cutting, alteration or excavation.

4. Effect on work of the COUNTY or any separate contract, or on structural or weatherproof integrity of work.

5. Description of proposed work:

a. Scope of cutting, patching, alteration, or excavation.

b. Trades who will execute the work.

c. Products proposed to be used.

d. Extent of refinishing to be done.

6. Alternatives to cutting and patching.

7. Cost proposal, when applicable.

8. Written permission of any separate contractor whose work will be affected.

C. SUBMIT WRITTEN NOTICE TO THE ENGINEER DESIGNATING THE DATE AND THE TIME THE WORK WILL BE UNCOVERED.

1.5 SCHEDULING OF SHUTDOWN

A. Connections to Existing Facilities: If any connections, replacement, or other work requiring the shutdown of an existing facility is necessary, schedule such work at times when the impact on the COUNTY's normal operation is minimal. If shutdown involves the water distribution or transmission system, provide notice to

the COUNTY Water Department at least two (2) weeks prior to the proposed shutdown, including date, time and anticipated length of interruption of service. Overtime, night and weekend work without additional compensation from the COUNTY, may be required to make these connections, especially if the connections are made at times other than those specified. The connection of new or existing pipelines is prohibited from starting until CONTRACTOR assures that the system can receive the new flow.

B. Interruptions of Service: Perform cut-ins into lines at a time approved in writing by the County Manager or designee. Whenever it is required to turn off valves which may interrupt the water supply of residents or businesses, notify all concerned parties or agencies with personal contact, door hangers or written notice at least forty-eight (48) hours in advance of such cut-off, after having obtained the approval of the County Manager or designee. Provide a copy of the written notice to the Water Distribution Section by fax. ONLY COUNTY PERSONNEL MAY OPERATE COUNTY-OWNED VALVES. Maintain water service to existing connections during construction, under any and all conditions and at no additional cost to the COUNTY. Thoroughly clean and swab all pipe and fittings for cut-ins with a concentrated solution of calcium hypochlorite.

C. Request for Water System Shutdowns: When plans call for connection to existing water distribution facilities or the CONTRACTOR plans to shut down existing utilities or where damage to such facilities is likely in order to complete construction of items under this contract, furnish the County Manager or designee with a written request for connection. The COUNTY Water Distribution Section will identify the locations of all water valves needed to isolate the point of connection in the event that the existing facilities are damaged while making the connection. Identify in the request means which the CONTRACTOR proposes to use in order to provide effective shutdown of the system. Include in a connection and shutdown schedule details of shutdown time and duration. No connections to existing utilities – or construction where shutdown of, or damage to, existing utilities may occur – shall commence prior to County Manager or designee approval of the connection and shutdown plan and schedule.

D. Request for Wastewater Diversion: Submit a request for each diversion necessary during construction to the County Manager or designee and the ENGINEER sufficiently in advance of any required diversion. Identify in the request the valves, bypass piping, portable pumper trucks or any other means which the CONTRACTOR proposes to use in order to provide effective shutdown of the system. Include in a connection and shutdown schedule details of shutdown time and duration. No connections to existing utilities – or construction where shutdown of, or damage to, existing utilities may occur – shall commence prior to County Manager or designee approval of the connection and shutdown plan and schedule.

PART 2 PRODUCTS

2.1 MATERIALS

A. Comply with specifications and standards for each specific product involved.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect existing conditions of projects, including elements subject to damage or to movement during cutting and patching.

B. After uncovering work, inspect conditions affecting installation of products, or performance of the work.

C. Report unsatisfactory or questionable conditions to the ENGINEER in writing; do not proceed with work until the ENGINEER has provided further instructions.

3.2 PREPARATION

A. In cases where service to utility customers is interrupted, provide adequate equipment with backup onsite to assure prompt restoration of service.

B. Provide adequate temporary support as necessary to assure structural value or integrity or affected portion of work.

C. Provide devices and methods to protect other portions of project from damage.

D. Provide protection from elements for that portion of the project that may be exposed by cutting and patching work, and maintain excavations free from water.

E. Material Removal: Cut and remove all materials to the extent shown or as required to complete the work. Remove materials in a careful manner with no damage to adjacent facilities. Remove materials that are not salvageable from the site.

3.3 PERFORMANCE

A. Execute cutting and demolition by methods that will prevent damage to other work, and will provide proper surfaces to receive installation of repairs.

B. Execute excavating and backfilling by methods which will prevent settlement or damage to other work.

C. Employ original installer or fabricator to perform cutting and patching for:

1. Weather-exposed or moisture-resistant elements.

2. Sight-exposed finished surfaces.

D. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.

E. Restore work, which has been cut or removed; install new products to provide completed work in accord with requirements of contract documents.

F. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

G. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:

1. For continuous surfaces, refinish to nearest intersection.

2. For an assembly, refinish entire unit.

3.4 PAVEMENT RESTORATION

A. Restore all pavement or roadway surfaces in accordance with Section 320117 – Pavement Repair and Restoration.

B. Restore, replace or rebuild existing street paving, including underdrains, if any are encountered, where damaged, using the same type of construction as was in the original. Be responsible for restoring all such work, including subgrade, base courses, curb and gutter or other appurtenances where present. The County Manager or designee will obtain the permits listed in the Contract Documents. Obtain and pay for at CONTRACTOR’s expense any additional local or other governmental permits as may be required for the opening of streets and be satisfied as to any requirements other than those herein set forth which may effect the type, quality and manner of carrying on the restoration of surfaces by reason of jurisdiction of such governmental bodies.

C. This section does not describe the construction of new road surfaces or the complete resurfacing of existing pavements.

D. In all cases, the CONTRACTOR will be required to maintain, without additional compensation, all permanent replacement of street paving, done by him under this Contract for a period of 12 months after the acceptance of the Contract, including the removal and replacement of such work wherever surface depressions or underlying cavities result from settlement of trench backfill.

E. Perform all the final resurfacing or repaving of streets or roads, over the excavations made and be responsible for relaying paving surfaces of roads that have failed or been damaged at any time before the termination of the maintenance period on account of work done by him. Resurface or repave over any tunnel jacking, or boring excavation that settles or breaks the surface, repave to the satisfaction of the County Manager or designee and at the CONTRACTOR's expense. Conform backfilling of trenches and the preparation of subgrades to the requirements of excavation and backfilling of pipeline trenches.

F. Where pipeline construction crosses paved streets, driveways or sidewalks, the CONTRACTOR may elect, at no additional cost to the COUNTY, to place the pipe by the jacking and boring, horizontal direction drilling, or tunneling method in lieu of cutting and patching of the paved surfaces. Such work shall be accomplished in accordance with all applicable sections of the Contract Documents.

END OF SECTION

NO TEXT FOR THIS PAGE

SECTION 022501

LEAKAGE TESTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Testing for any signs of leakage in all pipelines and structures required to be watertight.

1. Test gravity sewers and drain lines by infiltration/exfiltration testing.

2. Test all other pipelines with water under the specified pressures.

B. Operation of Existing Facilities: Conduct all tests in a manner to minimize as much as possible any interference with the day-to-day operations of existing facilities or other contractors working on the site.

1.2 PERFORMANCE REQUIREMENTS

A. Written Notification of Testing: Provide written notice when the work is ready for testing, and make the tests as soon thereafter as possible.

1. Personnel for reading meters, gauges, or other measuring devices, will be furnished.

2. Furnish all other labor, equipment, air, water and materials, including meters, gauges, smoke producers, blower, pumps, compressors, fuel, water, bulkheads and accessory equipment.

1.3 REFERENCES

A. Codes and standards referred to in this Section are:

1. AWWA C 600 - Installation of Ductile-Iron Water Mains and Their Appurtenances

1.4 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. Testing Report: Prior to placing the sewer system in service submit for review and approval a detailed report summarizing the leakage test data, describing the test procedure and showing the calculations on which the leakage test data is based.

1. Reference Sewer Line Data

a. For Low Pressure Testing

(1) The length and diameter of the section of line tested (MH to MH), including any laterals.

(2) A complete description of the test procedure, including:

(a) Trench backfilling and sewer cleaning status

(b) Type of plugs used and where

(c) Depth of sewer, and ground water pressure over sewer pipe

(d) Stabilization time period and air pressure

(e) Actual air test pressures used if ground water is present

(f) The time allowed by specifications

(g) The actual test time

(h) The air pressure at beginning and end of test

(3) The name of the inspector/tester and the date(s) and time(s) of all testing performed, including any retesting.

(4) A description of any repairs made.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 LEAKAGE TESTING

A. All new sewer and water pipelines installed shall be tested for leakage. The test used will be Hydrostatic Testing for pressure lines and Infiltration/Exfiltration Testing for gravity lines. Tests to be performed will be indicated by the ENGINEER and witnessed by the ENGINEER and the County Manager or designee.

1. Flushing

a. Full-bore flush all mains to remove all sand and other foreign matter. Flushing shall be terminated at the direction of the ENGINEER. Dispose of the flushing water without causing nuisance or property damage. Full bore flushes on force mains shall only be required where sufficiently sized water mains are present.

b. Install temporary flush out connections on all dead end water mains at the locations shown on plans and in accordance with the Collier County Standard Details.

2. Hydrostatic Testing for DIP and PVC Pipelines:

Perform hydrostatic testing of the system as set forth in the following, and conduct said tests in the presence of the County Manager or designee and other authorized agencies, with 48 hours advance notice provided.

Piping and appurtenances to be tested shall be within sections between valves unless alternate methods have received prior approval from the County Manager or designee. Testing shall not proceed until concrete thrust blocks are in place and cured, or other restraining devices installed. Thoroughly clean and flush all piping prior to testing to clear the lines of all foreign matter. While the piping is being filled with water care shall be exercised to permit the escape of air from extremities of the test section, with additional release cocks provided if required.

Perform hydrostatic testing with a sustained minimum pressure of 150 psi for a period of not less than two (2) hours. If sustained pressure goes 5 psi above or below 150 psi during the first two (2) hours, the test fails (AWWA regulation). After two (2) hours, use the AWWA formula if less than 5 psi to determine whether test fails. Testing shall be in accordance with the applicable provisions as set forth in the most recent edition of AWWA Standards C600 for Ductile Iron Pipe and C605 for PVC Pipe. The allowable rate of leakage shall be less than the number of gallons per hour determined by the following formula:

$$L = \frac{SD\,(P)^{1/2}}{133{,}200}$$

Where,

L = Allowable leakage in gallons per hour;
S = Length of pipe tested in feet;
D = Nominal diameter of pipe in inches;
P = Average test pressure maintained during the leakage test in pounds per square inch

For 150 psi, $L = (9.195 \times 10^{-5})\,SD$

The testing procedure shall include the continued application of the specified pressure to the test system, for the one-hour period, by way of a pump taking supply from a container suitable for measuring water loss. The amount of loss shall be determined by measuring the volume displaced for the said container.

Should the test fail, repair the fault and repeat the test until results are within the established limits. Furnish the necessary labor, water, pumps, and gauges at specified location(s) and all other items required to conduct the required testing and perform necessary repairs.

General - All sanitary sewers and associated service lines shall be constructed watertight to prevent infiltration and/or exfiltration.

3. Hydrostatic Testing for HDPE Pipelines:

Perform hydrostatic testing of all HDPE pipelines as set forth in the following, and conduct said tests in the presence of the County Manager or designee and other authorized agencies, with 48 hours advance notice provided.

Provide all labor, equipment and material required for testing the pipeline upon completion of installation, pipe laying and backfilling operations, and placement of any required temporary roadway surfacing.

Disinfect all HDPE potable water mains prior to testing in accordance with the requirements of Section 025400 – Disinfection.

Test pipelines at 150 psi.

Field test all HDPE pipelines for leakage in accordance with manufacturer's recommendations for the size and class of pipeline installed. Unless other procedures recommended by the manufacturer are approved by the County Manager or designee, pressure test the pipeline as follows:

a. Fill pipeline slowly with water. Maintain flow velocity less than two (2) feet per second.

b. Expel air completely from the line during filling and again before applying test pressure. Expel air by means of taps at points of highest elevation.

c. Apply initial test pressure and allow to stand without makeup pressure for two (2) to three (3) hours, to allow for diametric expansion or pipe stretching to stabilize.

d. After this equilibrium period, apply the specified test pressure and turn the pump off. The final test pressure shall be held for not less than two (2) hours.

e. Upon completion of the test, the pressure shall be bled off from the location other than the point where the pressure is monitored. The pressure drop shall be witnessed by the County Manager or designee at the point where the pressure is being monitored.

Allowable amount of makeup water for expansion of the pipeline during the pressure test shall conform to Table III, Test Phase Make-up Amount, contained in the manual "Inspections, Test and Safety Considerations" published by the Plastics Pipe Institute, Inc.

If any test of pipeline installed exceeds the amount of makeup water as allowed above, locate and repair the cause of leakage and retest the pipeline, without additional cost to the COUNTY. Repair all visible leaks regardless of the amount of leakage.

4. Force Main Pressure Testing: All force mains shall be subject to pressure testing at 150 PSI.

Allowable leakage on force mains shall be computed utilizing the standards for water loss in conformance with AWWA C600, the latest revision thereof.

5. Infiltration/Exfiltration Testing for Gravity Lines

The allowable limits of infiltration or exfiltration for the entire system, or any portion thereof, shall not exceed a rate of 50 gallons per inch of inside pipe diameter per mile of pipe per 24 hours. No additional allowance shall be made for house service lines. Any part of or all of the system shall be tested for infiltration or exfiltration, as directed by the ENGINEER or as required by the County Manager or designee. The procedures and limitations for conducting infiltration/exfiltration tests shall be established at the pre-construction conference on a project-by-project basis. Air testing of gravity sewer mains may be required. All testing shall be run continuously for 24 hours, unless the County Inspector can visually verify that this test duration is not required due to the observed infiltration/exfiltration rate. The amounts of infiltration or exfiltration shall be determined by pumping water into or out of calibrated drums, or by other methods approved by the Public Utilities Division, such as in-line V-notch weirs. Where infiltration or exfiltration exceeds the allowable limits specified herein, locate and repair the defective pipe, joints or other faulty construction at no additional cost to the COUNTY. If the defective portions cannot be located, remove and reconstruct as much of the work as is necessary in order to conform to the specified allowable limits. All visible leaks shall be repaired regardless of the amount of leakage. Provide all labor, equipment and materials required and conduct all testing required under the direction of the ENGINEER.

a. Infiltration: Prior to testing for infiltration, the system shall be pumped out so that normal infiltration conditions exist at the time of testing. The cumulative results of the entire collection system results shall not be a satisfactory method for gauging infiltration compliance. Each sewer section between manholes must permit infiltration no greater than the maximum allowable, as specified above.

b. Exfiltration: The exfiltration test, when required due to groundwater levels, will be conducted by filling the portion of the system being tested with water to a level 2 feet above the uppermost manhole invert in the section being tested. The cumulative results of the entire collection system results shall not be a satisfactory method for gauging exfiltration compliance. Each sewer section between manholes must permit exfiltration no greater than the maximum allowable, as specified above.

6. Low Pressure Air Testing

Contractor shall conduct air testing in accordance with ASTM specifications:

a. ASTM C-828 – for clay pipes.

b. ASTM C-924 – for concrete pipes.

c. ASTM F-1417 – for plastic pipes.

When low pressure air testing of gravity sewer mains is specifically required, all testing shall be run continuously for 24 hours, unless the County Inspector can visually verify that this test duration is not required due to the observed infiltration/exfiltration rate.

When air testing is specifically required, after completing backfill of a section of gravity sewer line, conduct a Line Acceptance Test using low pressure air. The test shall be performed using the below stated equipment, according to state procedures and under the supervision of the ENGINEER and in the presence of the County Manager or designee, with 48 hours advanced notice.

d. Equipment:

(1) Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.

(2) Pneumatic plugs shall resist internal bracing or blocking.

(3) All air used shall pass through a single control panel.

(4) Three individual hoses shall be used for the following connections:

(a) From control panel to pneumatic plugs for inflation.

(b) From control panel to sealed line for introducing the low-pressure air.

(c) From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

e. Procedure:

All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psi. The sealed pipe shall be pressurized to 5 psi. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.

After a manhole-to-manhole reach of pipe has been backfilled and cleaned and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psi. Low-pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psi greater than the average back pressure of any ground water that may be over the pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize. After the stabilization period (3.5 psi minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of the line being tested shall be termed "Acceptable", if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psi (greater than the average back pressure of any ground water that may be over the pipe) is greater than the time shown for the given diameters in the following table:

Pipe Diameter In Inches	Minutes
8	4.0
10	5.0
12	5.5
16	7.5
18	8.5
24	11.5

Time in Minutes = 0.472 D
D = Diameter of pipe in inches

In areas where ground water is known to exist, install capped pipe adjacent to the top of the sewer lines. This shall be done at the time of the sewer line is installed. Immediately prior to the performance of the Line Acceptance Test, the ground water shall be determined by removing the pipe cap, and a measurement of the height in feet of water over the invert of the pipe shall be taken. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if the height of water is 11-1/2 feet, then the added pressure will be 5 psi. This increases the 3.5 psi to 8.5 psi, and the 2.5 psi to 7.5 psi. The allowable drop of one pound and the timing remain the same).

If the installation fails to meet this requirement, determine the source of the leakage and repair or replace all defective materials and/or workmanship, all at no additional cost to the COUNTY.

B. DEP approval is required to use reclaimed (IQ) water for flushing and pressure testing of irrigation mains and potable water mains. The requirements for submitting a request to DEP are available from the County PUED.

3.2 LEAKAGE TESTS FOR STRUCTURES

A. Structure Leakage Testing: Perform leakage tests of manholes, wet wells, tanks, vaults and similar purpose structures before backfilling, by filling the structure with water to the overflow water level and observing the water surface level for the following 24 hours.

1. Make an inspection for leakage of the exterior surface of the structure, especially in areas around construction joints.

2. If visible leaks appear, repair the structure by removing and replacing the leaking portions of the structure, waterproofing the inside, or by other methods approved.

3. Water for testing will be provided by the COUNTY at the CONTRACTOR's expense.

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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.

1.5 INFORMATIONAL SUBMITTALS

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

B. 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.

C. 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, proof that the aggregate non-reactive.
2. Mill Test Reports: Conformance to ASTM standards, including chemical analysis and physical tests.

    a. Cementitious materials.
    b. Steel Reinforcing.

D. 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.

E. 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 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:

1. Provide reinforcement free from mill scale, rust, mud, dirt, grease, oil, ice, or other foreign matter that will reduce or destroy bond.
2. Deliver, store, and handle steel reinforcement to prevent bending and damage.
3. Store reinforcement off the ground, protect from moisture, keep out of standing water, and be 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 deg 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 deg 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.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. B-B (Concrete Form), Class 1 or better; mill oiled, and edge sealed.

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 concrete on forms and to prevent spalling of concrete on removal. Furnish units and ties that:

1. Leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Leave holes no larger than 1 inch in diameter in concrete surface when removed.
3. Have 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 supports 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.

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. Fly Ash: ASTM C618, Class F.
3. 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. 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.

E. 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 RELATED MATERIALS

A. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types V, load bearing, for bonding freshly mixed concrete to hardened concrete.

2.8 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: 50 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.
3. Plasticizing admixture in concrete, may be used, for placement and workability.
4. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold-weather placement requirements.

2.9 CONCRETE MIXTURES

A. Concrete Fill and Electrical Raceway Encasement:

1. Minimum Compressive Strength: 2,500 psi at 28 days.
2. Maximum W/C Ratio: 0.62.
3. Slump Limit: 3 inches plus or minus 1 inch.
4. Air Content: Not required.
5. Coarse Aggregate: ASTM C33, size 57 for concrete fill.

B. Structural Concrete:

1. Minimum Compressive Strength: 4,500 psi at 28 days.
2. Maximum W/C Ratio: 0.42.
3. Slump Limit: 4 inches to 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 delivery.
5. Coarse Aggregate: ASTM C33, size 67.

2.10 FABRICATING REINFORCEMENT

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

2.11 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 80 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 45 minutes.

2. If an approved high-range water-reducing admixture (plasticizer) is used to produce plasticized concrete, the maximum time interval between the addition of mixing water and/or cement to the batch and the final placing of concrete in the forms shall not exceed 90 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 deg 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 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 318.

B. Surface Finish 2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

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

D. 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.

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. Install and secure anchorage devices prior to placing concrete. 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 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 Owner’s inspection agency and Owner’s inspection agency release to proceed with the concreting has been obtained. Keep forms open until 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 Owner’s testing agency:
1. Testing Frequency: One composite sample for each 100 cu. yd. 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.

2. 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.
3. 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.
4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. 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.

6. 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.
7. 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.

8. 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.
9. 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.
10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. 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. Nonshrink cementitious grout.

B. Related Requirements:

1. 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. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, and conformity to the specified ASTM standards.

1. Commercially manufactured nonshrink cementitious grout.
2. Commercially manufactured nonshrink epoxy grout.

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 epoxy-type and 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. Perform Work according to Florida Building Code standards.

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

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 the 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 NONSHRINK CEMENTITIOUS GROUT

A. Manufacturers: Provide one of the following or equal:

1. Five Star Grout by Five Star Products, Inc.
2. NS Grout by The Euclid Chemical Co.
3. Set Grout by BASF Building Systems.
4. Sikagrout 212 by Sika Corp.

B. 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.

C. 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.

2.2 FORMWORK

A. As specified in this Section and in Section 033010 “Miscellaneous Cast-in-Place Concrete”.

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. Nonshrink epoxy grouts do not require saturation of concrete substrate. Do not wet concrete surfaces to receive nonshrink epoxy grout. Completely dry surfaces in contact with epoxy grout before grouting.

H. 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.

3.3 INSTALLATION - GENERAL

A. Formwork:

1. Construct leakproof forms anchored and shored to withstand grout pressures.
2. Install formwork with clearances to permit proper placement of grout.
3. As specified in Section 033010 “Miscellaneous Cast-in-Place Concrete”.

B. Placing of Grout:

1. Place grout material quickly and continuously.
2. Do not use pneumatic-pressure or dry-packing methods.
3. Apply grout from one side only to avoid entrapping air.
4. Do not vibrate placed grout mixture or permit placement if area is being vibrated by nearby equipment.
5. Thoroughly compact final installation and eliminate air pockets.
6. Do not remove leveling shims for at least 48 hours after grout has been placed.

C. Curing:

1. Prevent rapid loss of water from grout during first 48 hours [by use of approved membrane curing compound or] by using wet burlap bags, soaker hoses or ponding.
2. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
3. After grout has attained its initial set, keep damp for minimum three days.

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

3.4 SCHEDULE

A. Use particular types of grout as follows:

1. 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.
2. 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. Safety switches.
12. 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.
7. EMT: Electrical metallic tubing.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings:

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 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 1585-C8HB-S.

B. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 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. Accessories: conduit clamps, straps, hangers, rods, backplates, anchors, nuts, washers, etc. shall match channel material as listed in the SUPPORT MATERIALS APPLICATION Article.

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

E. 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. 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.

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

2.11 SAFETY SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric, a division of ABB.
2. Eaton.
3. Square D; Schneider Electric.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600VAC. UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position. Include internally mounted equipment ground kit.

2.12 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 240/120V Circuits (Single Phase):

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

2. Color for 480/277V Circuits:

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

3. Color for Equipment Grounds: Green.
4. 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 Drawings.

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

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

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 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 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.

3.9 UNDERGROUND SYSTEM INSTALLATION

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

B. Comply with Division 31 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 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 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

Table 260510-1: Raceway Application Guidelines are shown on following page.

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.
Electrical Metallic Tubing (EMT)	Not used on this project.
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

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SECTION 260573 - POWER SYSTEM STUDIES

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 a computer-based study for:

1. Short circuit report.
2. Protective device coordination report.
3. Arc flash report.

B. Study encompasses the new power distribution system for the Foxfire Well addition at the Collier County Foxfire Ground Storage Tank site located at 5500 Radio Road, Naples, Florida 34104 and the Collier County Foxfire 9 Outfall site located on Davis Blvd., Naples, Florida 34104.

C. Study includes the electric utility company's protective devices,, service entrance equipment and distribution to the well pump control panels. All power distribution to that point whether existing or new is included. Equipment included, but not limited to:

1. Substations and distribution.
2. Switchgear, switchboards, and panelboards.
3. Motor control centers.
4. Variable frequency controllers.
5. Disconnect switches.
6. Transfer switches.
7. 480V control panels.

D. The local electric utility is Florida Power and Light.

E. Obtain all data necessary to perform the study. Data included, but not limited to:

1. Up to date one-line diagrams.
2. Equipment data.
3. Cable sizes and lengths.
4. Existing protective device settings.
5. Electric utility information: available fault current, protective device equipment information and settings, X/R ratios, transformer impedances and ratings.

1.3 DEFINITIONS

A. Boundary, Arc Flash: When an arc flash hazard exists, an approach limit from an arc source at which the incident energy equals 1.2 cal/cm² (5 J/cm²).

B. Boundary, Limited Approach: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.

C. Boundary, Restricted Approach: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc-over combined with inadvertent movement.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.

E. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

F. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

G. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

H. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

I. Preliminary Short Circuit Report: Report that includes the maximum available utility fault current, proposed equipment, and existing equipment to determine if new equipment may be released for manufacturing and existing equipment is adequate for the calculated short circuit levels.

J. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.

K. SCCR: Short-circuit current rating.

L. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

M. Single-Line Diagram: See "One-Line Diagram."

N. Supplier: The person, firm or corporation identified as such to provide the power system study and means the Supplier or its authorized agent. See also Power Systems Analysis Specialist.

1.4 ACTION SUBMITTALS

A. Supplier qualifications per Quality Assurance paragraph. Submit prior to starting study. Include the following:

1. Brief description of each qualifying study.
2. Name of owner of installation on which study was performed with address, telephone number, and contact person.
3. Date of study.
4. Any other information indicating the firm's experiences and ability to perform the work and business status.

B. Power System Study Report. Report must be approved prior to energization of new major electrical equipment. Revise study as required for changes during construction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power Systems Analysis Software Developer.
2. For Power System Analysis Specialist.
3. For Field Adjusting Agency.

B. If requested, Product Certificates: For power system study software, certifying compliance with IEEE 399, IEEE 1584 and NFPA 70E.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Final power system study updated with any changes made after equipment start-up.

B. Digital computer files with full read-write access of the complete power system model and library.

1.7 QUALITY ASSURANCE

A. Perform Study using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

D. Power System Analysis Software Qualifications:

1. Design computer program to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.

2. Develop computer program under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
3. Complies with IEEE 399, IEEE 141, IEEE 242, IEEE 519, IEEE 1015, and IEEE 1584 as applicable to the project scope.

E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located and has regularly engaged in this electrical engineering study specialty for minimum of five years and has performed at least three projects of similar complexity to this project within the last three years. Perform all elements of the study under the direct supervision and control of this professional engineer.

F. Power System Study Certification: Report shall be signed and sealed by Power Systems Analysis Specialist.

G. Field Adjusting Agency Qualifications:

1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

A. Acceptable Software: Provide one of the following or equal:

1. SKM System Analysis, Inc.: Power*Tools.
2. Operation Technology, Inc.: ETAP (Electrical Transient Analyzer Program).
3. EasyPower, Inc.: EasyPower.

2.2 POWER SYSTEM STUDY REPORT GENERAL REQUIREMENTS

A. Except for one-line diagrams, standard 8-1/2-inch by 11-inch pages, with total pages numbered.

B. Electronic PDF format copy with electronic bookmarks for each section.

C. Signed and sealed by a professional engineer registered in State in which the project is located.

D. Organized in the following order:

1. Executive Summary.
2. Short Circuit Analysis.
3. Short Circuit Computer Printout.
4. Protective Device Coordination.
5. Arc Flash Hazard Analysis.
6. Utility Data.
7. Modeled One Line Diagrams.

E. Information on one-line diagrams, legible when printed at 11-inch x 17-inch. Show the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA), impedance, and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Derating factors and environmental conditions.
7. Any revisions to electrical equipment required by the study.

F. Identifiers between the one-line diagram, short circuit study, coordination study, and arc flash study to be the same.

G. Include copies of correspondence with electric utility under utility data section of report. Correspondence to include names and contact information.

2.3 EXECUTIVE SUMMARY

A. Include summary of distribution system, information received from electric utility, major assumptions, adequacy of equipment to safely clear or close on any fault, identify problem areas and recommendations for resolving problem areas.

2.4 SHORT CIRCUIT

A. Comply with IEEE 399 and IEEE 551 (new 3002 series).

B. Include normal utility powered configuration, on-site generation configuration, and alternate modes of operation (i.e. alternate utility configuration, bus ties closed).

C. Include minimum and maximum possible fault conditions. Address three-phase bolted as well as ground fault conditions.

D. Consider the fault contribution of all motors operating during the maximum demand condition of the motors.

E. Calculate short-circuit momentary duties and interrupting duties based on an assumed bolted three-phase short circuit at each high and medium voltage switchgear bus and controller, low voltage switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard and other significant locations throughout the systems. Include the X/R ratios, asymmetry factors, KVA and symmetrical fault-current in the short circuit tabulations. Provide a ground fault current study for the same system areas. Include in tabulations fault impedance, X/R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault-currents.

F. Include representation of the site power system, the base quantities selected, impedance source data, calculation methods and tabulations, one-line diagrams, conclusions, and recommendations.

G. Identify available fault current at each bus and evaluate system elements including but not limited to equipment, protective devices, and cables.

H. Base current transformers' ratio and burden calculations on a 10 percent maximum ratio error per IEEE C57.13. Identify current transformers that will not allow the protective devices to operate within acceptable IEEE error margins and recommend corrective action.

I. List momentary, interrupting, and/or withstand rating of all key elements of the distribution system along with the maximum available fault current in tabular form and clearly indicate the adequacy of the element with PASS / FAIL designation.

J. Short Circuit Computer Printout:

1. Calculations shall be in sufficient detail for easy review.
2. Back up calculations shall become part of the final report.

2.5 PROTECTIVE DEVICE COORDINATION

A. Comply with IEEE 242 (new 3004 series).

B. Utilize results from the short circuit study and balance the competing objectives of protection and continuity of service for the system specified, considering the basic factors of sensitivity, selectivity and speed. Include all system protective devices in the coordination analysis, not just overcurrent protective devices. This includes, but is not limited to, under and over voltage protective relays, frequency relays, differential relays and reverse power relays.

C. Show graphic indication of coordination between protective devices in the form of full color time-current coordination (TCC) plots with each protective device curve in a unique color for easy review.

D. Provide separate TCC plots for each mode of operation. Provide separate TCC plots for "normal" and "stand by" operation. Show maximum fault values in each case. Both power sources shown on one plot is unacceptable.

E. Provide separate TCC for phase over-current and ground fault.

F. Show no more than six devices on one TCC. Of these six curves, two (the largest upstream device and the smallest downstream device) shall repeat curves shown on other coordination plots to provide cross-reference. Designate each TCC with a unique identifier and include each TCC identifier and descriptive title in the study's table of contents.

G. Include in each TCC the following as applicable:

1. TCC name and description.
2. One-line diagram.
3. Identifiers on one-line diagram and curves.
4. Significant motor starting characteristics.
5. Appropriate NEC protection points.
6. Appropriate ANSI/IEEE protection points.
7. Magnetizing inrush points of transformers.

8. Transformer damage curves.
9. Complete operating bands for low voltage circuit breaker trip devices and fuses.
10. Relay coil taps, time-dial settings, and pickup settings.
11. Significant symmetrical and asymmetrical fault currents.
12. Power cable withstand curves.
13. Generator short circuit decrement and thermal limit curves.

H. Terminate device characteristic curve on TCC at a point reflecting the maximum symmetrical or asymmetrical fault current to which that device is exposed, based on the short circuit study.

I. Select each primary protective device for a delta-to-wye-connected transformer so the characteristic or operating band is within the transformer parameters; where feasible, include a parameter equivalent to 58 percent of the ANSI C37.91 withstand curve to afford protection for secondary line-to-ground faults.

J. Separate low voltage power circuit breakers from each other and the associated primary protective device, by a 16 percent current margin for coordination and protection in the event of line-to-line faults.

K. Separate protective relays by a 0.3-second time margin for the maximum 3 phase fault conditions to assure proper selectivity.

L. Optimize settings for breakers and relays to provide the most effective protection practicable for all modes and power sources.

M. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center and/or power distribution panelboard. Include all adjustable setting ground fault protective devices.

N. Provide tabulations of recommended settings for all protective devices. Where devices are existing, highlight any changes from the existing setting to the proposed recommended setting.

O. Provide all information required to program/set multifunction solid state relays.

2.6 ARC FLASH HAZARD

A. Comply with IEEE 1584, NFPA 70, and NFPA 70E as applicable.

B. Utilize short circuit and protective device coordination results to provide arc flash hazard analysis. Perform calculations in accordance with IEEE 1584 or NFPA 70E with the method identified within the report.

C. Calculate the incident energy levels at each faulted bus for each mode of operation and for both maximum and minimum fault currents.

D. Include calculations at line side and load side of main breakers, where applicable.

E. Provide tabular report for all modes and conditions and include “worst case” summary. Use the “worst case” to generate the arc flash labels. Include:

1. Fault location.
2. Arcing fault magnitude.
3. Protective device clearing time.
4. Duration of the arc.
5. Arc flash boundary.
6. Working distance.
7. Incident energy.
8. Electrode configuration.

F. Highlight any available incident energy over 40 cal/cm² and provide recommendations to mitigate the hazard.

G. Arc Flash Labels:

1. Machine printed, 4-inch x 4-inch (nominal), thermal transfer, high adhesion polyester.
2. Provide UV resistant laminate for outdoor labels.

H. Arc Flash Label Information:

1. Equipment name.
2. Identifier LINE or LOAD where equipment has potential different energy levels.
3. Arc flash hazard information: arc flash boundary and incident energy in cal/cm².
4. Shock hazard information: limited approach and restricted approach boundaries.
5. Personal Protective Equipment (PPE) requirements.
6. Study Supplier, project number, and date.

I. Provide arc flash label sample with preliminary report.

J. Do not print labels until equipment is energized and protective devices set according to the approved final protective device coordination study.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the study.

1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Engineer's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.

B. Gather and tabulate the required input data to support the power system study.

C. Field data gathering for existing systems shall be under direct supervision and control of the engineer in charge of performing the study and shall be by the engineer or its representative

who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.

D. Data included, but are not limited to, the following:

1. Product data for overcurrent protective devices and existing settings.
2. Electrical power utility impedance at the service and upstream protective device data.
3. Power sources and ties.
4. For switchgear, switchboards, panelboards, and motor control centers, ampacity and SCCR in amperes RMS symmetrical.
5. For transformers, kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
6. For reactors, manufacturer and model designation, voltage rating, and impedance.
7. For circuit breakers, trip units, and fuses, manufacturer, and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
8. For generators, short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. For busways, manufacturer and model designation, current rating, impedance, lengths, and conductor material.
10. For motors, horsepower and NEMA MG 1 code letter designation.
11. Conductor sizes, lengths, number, conductor material, shield parameters for medium voltage cable, and conduit material (magnetic or nonmagnetic).
12. For relays, manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
13. Derating factors.

3.2 FIELD QUALITY CONTROL

A. Do all testing and adjustment prior to the energization of new equipment.

B. Test existing adjustable protective devices in accordance with NETA MTS.

C. Test new adjustable protective devices in accordance with NETA ATS.

D. Adjust existing and new protective devices according to approved coordination study.

E. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.

F. After successful testing and adjustment, install calibration sticker with Field Adjusting Agency name, employee initials, and date of calibration at each relay or protective device.

G. After energization, minor adjustments to settings may be required to commission the equipment.

H. Submit field report and list any changes made during field adjustment or commissioning for update for record submittal of study.

3.3 ARC FLASH LABELING

A. After the field adjustment of relays and protective devices, apply arc flash study labels.

B. Apply arc flash labels on the front covers of the following equipment:

1. Substations and distribution transformers.
2. Medium voltage switches.
3. Switchgear, switchboards, and panelboards.
4. Motor control centers.
5. Variable frequency controllers.
6. Disconnect switches.
7. Transfer switches.
8. 480V control panels.

C. Apply arc-flash labels at each section for large equipment such as switchgear and motor control centers.

D. Install LINE and LOAD arc-flash labels as applicable.

E. Remove any previous arc flash study labels as applicable and install new labels under the direction of the Power System Analysis Specialist.

END OF SECTION 260573

SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

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 transformer panel assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Source quality-control reports.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.

1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.

B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.

C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business (General Electric).
2. Eaton.
3. Square D; Schneider Electric USA.

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 TRANSFORMER PANEL ASSEMBLY (TPA)

A. Comply with UL 1062 for unit substations.

B. General Description: Unit assembly with combination of two winding dry type transformer and panel. Includes main primary circuit breaker and secondary panel section with main circuit breaker. Configuration, kVA, and voltage shown on Drawings. Also referred to on the Drawings as MPZ (Mini-Power-Zone).

1. Windings: Copper, epoxy-resin encapsulated.
2. Temperature Rise: 115 degrees C.
3. Taps: Full capacity, two 5 percent below.

C. Grounding: Include provisions for connection to grounding electrode system. Include copper equipment ground bar in panel distribution section.

D. Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

E. Enclosures:

1. Indoor: Standard enclosure type NEMA 3R, painted steel.
2. Outdoor: NEMA 3R, stainless steel.

F. Circuit Breakers and Panel Section:

1. Copper bus.
2. Plug-on type circuit breakers.
3. Main primary breaker sized per manufacturer's standard, minimum 18kA interrupting rating at 480V.
4. Secondary main breaker sized per manufacturer's standard, minimum 10kA interrupting rating at 240V.

2.3 IDENTIFICATION

A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each transformer, mounted with corrosion-resistant screws.

2.4 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.

1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
2. Ratio tests at rated voltage connections and at all tap connections.
3. Phase relation and polarity tests at rated voltage connections.
4. No load losses, and excitation current and rated voltage at rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation-Resistance Tests:

    a. High-voltage to ground.
    b. Low-voltage to ground.
    c. High-voltage to low-voltage.

9. Temperature tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and the grounding requirements in Section 260510 "Limited Electrical for Small Projects" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.

B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Construct concrete bases according to Section 033010 "Miscellaneous Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions.

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

D. Secure transformer to concrete base according to manufacturer's written instructions.

E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment in accordance with the National Electrical Code and as indicated on the Drawings.

B. 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.

C. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 IDENTIFICATION

A. Identify equipment by name designation and fed from source with nameplates.

B. Color code wiring.

C. Identify panel branch circuit numbers at TPA at circuit breakers and neutral terminals.

D. Provide as built typed panel directory at TPA.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Dry-Type Transformer Field Tests:

1. Visual and Mechanical Inspection.

    a. Inspect physical and mechanical condition.
    b. Inspect anchorage, alignment, and grounding.
    c. Verify that resilient mounts are free and that any shipping brackets have been removed.
    d. Verify the unit is clean.
    e. Perform specific inspections and mechanical tests recommended by manufacturer.
    f. Verify that as-left tap connections are as specified.

2. Electrical Tests:

    a. Measure resistance at each winding, tap, and bolted connection.
    b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5
    c. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform follow-up infrared scans of transformers, at 11 months after Substantial Completion.
3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.6 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.7 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213

SECTION 262416 - PANELBOARDS

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. Lighting and appliance branch-circuit panelboards.

B. Related Requirements:

1. Section 264313 “Surge Protection for Low-Voltage Electrical Power Circuits” for surge protective device performance requirements.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panelboards for installation according to NEMA PB 1.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

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

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

D. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location as indicated on Drawings. NEMA 4X shall be 316 stainless steel.

E. Phase, Neutral, and Ground Buses:

1. Material: Tin-plated copper.

a. Plating shall run entire length of bus.
b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

F. Conductor Connectors: Suitable for use with conductor material and sizes.

G. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity. SCCR as indicated on Drawings.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1 or Type 2 and in compliance with Section 264313 “Surge Protection for Low-Voltage Electrical Power Circuits”.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric; by ABB.
2. Eaton.
3. Square D; Schneider Electric USA.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.4 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

E. Install filler plates in unused spaces.

3.3 IDENTIFICATION

A. Identify field-installed conductors, create panelboard directory, and provide panelboard nameplate in accordance with Section 260510 “Limited Electrical for Small Projects”.

1. Install typed directory inside panelboard door. Handwritten directories are not acceptable.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections in accordance with NETA ATS.

B. Vacuum clean panel interior.

END OF SECTION 262416

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SECTION 262505 – 480V CONTROL PANELS

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 industrial control panels (pump control panels) with the following features:

1. Enclosure.
2. Main circuit breaker.
3. Motor controllers.
4. Control and monitoring devices.
5. Accessories.
6. Identification.

B. Related Requirements:

1. Division 26 for electrical work.
2. Division 40 for process automation requirements.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. GFCI: Ground-fault circuit interrupter.

C. MCCB: Molded-case circuit breaker.

D. MCP: Motor circuit protector.

E. NEC: National Electrical Code.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. UL: Underwriter’s Laboratories.

I. VFC: Variable frequency motor controller. See VFD.

J. VFD: Variable frequency drive. Used interchangeably with the term VFC.

1.4 ACTION SUBMITTALS

A. Product Data: For each control panel.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each control panel.

1. Include dimensioned plans, elevations, sections, and details.
2. Bill of materials with part numbers, cross-referenced to plans.
3. Nameplate schedule.
4. Conduit entrance locations and mounting details.
5. Power and control schematics.
6. Certification for compliance with UL 508A.
7. Identification per NEC 409.110.

1.5 INFORMATIONAL SUBMITTALS

A. Startup reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following if applicable:

1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
2. Manufacturer's written instructions for setting field-adjustable overload relays.
3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
5. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
6. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Control fuses: Equal to 10 percent of total quantity installed for each size and type, but no fewer than two of each size and type.
2. Power fuses: Equal to 10 percent of total quantity installed for each size and type, but no fewer than three of each size and type.
3. Corrosion Inhibitor: Equal to 100 percent of total number of control panels. (One spare per panel.)

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store control panels indoors in clean, dry space with uniform temperature to prevent condensation. Protect control panels from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.10 FIELD CONDITIONS

A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than 23 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet for electromagnetic and manual devices.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace control panels that fail in materials or workmanship within specified warranty period.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for control panels clearances between control panels and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

D. Comply with NEMA ICS 6: Industrial Control and Systems: Enclosures.

E. Comply with NFPA 70.

F. Comply with UL 508A.

G. Complete and fully functional control to manually or automatically operate the control system as specified herein and in other applicable sections of these specifications. Include manufacturer's recommended safety devices to protect operators. All control devices, unless specified otherwise, mounted in the Control Panel.

H. Control panel shall operate on a power supply of 480 volts, 3-phase, 60 hertz unless otherwise noted.

I. Control panel consists of a main circuit breaker, motor circuit protector (MCP) and motor controller for each motor, and a 120-volt control power transformer (fused on primary and secondary) along with other devices specified. Mount all control components in one common enclosure.

J. All electronic control equipment (i.e. controllers, isolators, signal boosters, transmitters, PLC's, etc.) shall be as specified in Division 40.

K. Control panels containing PLC's shall contain UPS or battery ride-through for the PLC in accordance with Division 40 specifications.

L. SCCR: Control panels with main breakers of 125 amps or less shall have SCCR of 18 kA, unless specifically noted elsewhere.

2.2 ENCLOSURES

A. Enclosures: Surface-mounted, dead-front cabinets rated for environmental conditions at installed location. Unless noted elsewhere, NEMA rating shall be NEMA 4X, Type 316 stainless steel, minimum 14 gauge, factory painted white.

B. Construction: The door shall be mounted via continuous stainless steel hinged 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.

C. Conduit Entrance: Bottom entry only. Large enclosures will not be allowed to site directly on housekeeping pads, include mounting legs if enclosure is too large for wall mounting.

D. All motor branch circuit breakers, motor starters and control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.

E. Operating handle for main circuit breaker: flange mounted.

F. Outdoor enclosures shall be provided with sun shields. Install sun shields on fronts, sides, and tops of enclosures subject to direct and extended sun exposure.

G. 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.

H. 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.

I. 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.

2.3 COMPONENTS

A. Comply with Collier County approved product list as shown on the Drawings.

B. Main Breaker: Thermal-magnetic air circuit breaker, Schneider Electric/Square D PowerPact Type B (125 amp frame, 18kAIC) or equal.

C. MCP: Molded case motor circuit protector with adjustable magnetic trip only, Schneider Electric/Square D “Mag-Gard” or equal.

D. Motor Controller:

1. Reduced Voltage Motor Starting: VFD**,** refer to VFD Article for requirements.

E. 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.

F. Overload reset buttons shall be mounted on dead front door.

G. Normally open and normally closed auxiliary motor overload contacts wired to terminal blocks shall be provided for each motor starter within the control panel.

H. SPD: Control panel shall be provided with a surge protective device (SPD) rated for 100kA per mode for the incoming power and in compliance with Section 264313. Mount SPD within control panel enclosure. Lead lengths shall not be longer than 12 inches from the main circuit breaker.

I. Control Power Transformer: 480-120V CPT, fused on primary and secondary sides, capacity as required.

2.4 CONTROL DEVICES AND ACCESSORIES

A. Control Operators and Indictors:

1. Heavy duty type, full size (30.5mm), NEMA 4X.
2. Each motor shall include Hand-Off-Auto selector switches to permit override of automatic control and manual actuation of shutdown.

B. Indicating Lights:

1. LED, full size (30.5mm), full voltage and push-to-test type.
2. Indicators shall be provided for individual motor run and an indicator for each failure condition.

C. Elapsed Time Meters (ETM):

1. Six digit, non-reset elapsed time meter to indicate the total running time of each motor in "hours" and "tenth of hours". Series T50 as manufactured by the ENM Company or equal.
2. Provide an ETM for each motor.

D. Relays:

1. Control relays shall be 10 amp rated contacts (minimum), 11 pin with mounting base, 3PDT (minimum), with LED indicators to show relay status, relays shall be manufactured by Potter Brumfield or equal.
2. Timing relays shall be solid state, with pin (octal) and bases, relays shall be T-series as manufactured by Diversified Electronics Inc. or equal.

E. A duplex GFCI utility receptacle (circuit breaker protected) providing 120 volts, 60 Hertz, single phase current shall be mounted on the side of the enclosure.

F. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by Divisions 40, 26 and as shown on Drawings.

G. 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.

H. 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.

I. 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.

J. Space heaters, with NC auxiliary contacts, to mitigate condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

2.5 VFD AND ACCESSORIES

A. VFD:

1. Allen Bradley Power Flex 753, six pulse drive, no exceptions.
2. Input Voltage: 480V, 3 phase.
3. Output Current: As indicated on Drawings.
4. EMC Filtered.
5. Control and interface to SCADA system via Ethernet cable using Ethernet/IP communications protocol.

B. DV/DT Output Filter:

1. Comprised of passive components only.
2. Limits peak voltage at motor terminals to 150 percent or less of VFD's DC bus voltage for motor leads of 1000 feet or shorter.
3. Maximum dV/dT waveform pulses at motor terminal of 200 volts per microsecond.
4. Insertion loss of 3 percent of rated voltage maximum.
5. ULlisted.
6. MTE Series A dV/dT Filter or equivalent.

C. Input Drive Isolation Transformer:

1. Separate enclosure, not mounted within pump control panel.
2. Dry type, two-winding with kVA and voltage ratings indicated on Drawings.
3. Designed specifically for drive isolation service.
4. Windings: Copper.
5. Temperature Rise: 80 degrees C.
6. Taps: Full capacity, two 2.5 percent above and four 2.5 percent below.
7. Grounding: Provide ground-bar kit installed on side of transformer enclosure.
8. Enclosure: NEMA 3R stainless steel. All stainless steel hardware.
9. Manufactured by Eaton; Schneider Electric; or General Electric (ABB).

2.6 WIRING

A. 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.

B. Wiring shall be stranded copper, minimum size #14 AWG (except for shielded instrumentation cable), with 600 Volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation.

C. Interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks.

D. Terminal blocks shall be 600 Volt heavy duty rated, tubular clamp type. Terminal strips shall be Allen Bradley catalog #1492-CA-1 or equal.

E. A copper ground bar with sufficient terminals for all field and panel ground connections shall be provided.

F. Signal wiring entering and exiting the control panel shall be provided with surge protection. Surge protection shall be as specified in Division 40.

G. An 8-inch (minimum) clear space within the enclosure shall be provided horizontally along the entire top and bottom of the control panel. A 4-inch (minimum) clear space within the enclosure shall be provided vertically along the entire sides of the control panel. No devices, terminals, etc. shall be installed within this space, which is provided for field conduit and wiring access only.

2.7 IDENTIFICATION

A. Control panel wiring shall be numbered at both ends with type written heat shrinkable wire markers.

B. 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.

C. 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.

D. Control panels shall be provided with two nameplates located on the exterior door. First nameplate shall identify the control panel name. Second nameplate shall identify the power source.

E. Where applicable provide a nameplate which reads as follows "CAUTION - THIS PANEL CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE." Letters shall be black on a high visibility yellow background.

F. Each terminal at terminal blocks shall be individually labeled.

G. 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. The following coding shall be used.

System	**Wire**	**Color**
Incoming line voltage	Phase conductors	Black
	Ground	Green
	Neutral (as required)	Gray
Internal control voltage	AC	Red
Internal control voltage	DC	Blue
External source	All	Yellow

2.8 FACTORY TESTS

A. Inspect and test control panel for correct operation. Test each circuit for continuity, short circuits, and ground faults.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Inspect anchorage, alignment, grounding, and clearances.

C. Compare equipment nameplate data for compliance with Drawings and Specifications.

D. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

E. Motor Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

F. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260510 "Limited Electrical for Small Projects."

3.2 STARTUP SERVICE

A. Complete startup checks according to manufacturer’s written instructions.

B. Verify motor running protection is appropriate for actual motors installed.

C. Test control panel with all field wiring connected. Set adjustable set points and time delays for proper operation of equipment. Adjust as required.

D. Perform infrared inspection of panel interior during periods of maximum possible loading. Remove all necessary covers prior to the inspection. Comply with the recommendations of NFPA 70B, "Testing and Test Methods" Chapter, "Infrared Inspection" Article.

E. Prepare test and inspection reports.

F. Install a set of legible “as built” control panel drawings, 11 x 17 inches or 8.5 x 11 inches, in storage pocket.

3.3 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain equipment.

END OF SECTION 262505

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

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. Type 2 surge protective devices.

B. Related Requirements:

1. Section 262416 "Panelboards" for integral SPDs installed by panelboard manufacturer.

1.3 DEFINITIONS

A. I nominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: Air of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. NRTL: Nationally recognized testing laboratory.

F. OCPD: Overcurrent protective device.

G. SCCR: Short-circuit current rating.

H. SPD: Surge protective device.

I. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.

J. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include electrical characteristics, specialties, and accessories for SPDs.
2. NRTL certification of compliance with UL 1449.

a. Tested values for VPRs.
b. I nominal ratings.
c. MCOV type designations.
d. OCPD requirements.
e. Manufacturer’s model number.
f. System voltage.
g. Modes of protection.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace SPDs that fail in materials or workmanship.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

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. ABB, Electrification Business.
2. Advanced Protection Technologies Inc. (APT).
3. Eaton.
4. Mersen USA.
5. Schneider Electric USA, Inc.

B. Source Limitations: Obtain devices from single source from single manufacturer.

C. Standards:

1. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2.

D. Product Options:

1. Include LED indicator lights for power and protection status. Lights visible without opening any cover.

E. Performance Criteria:

1. Match the voltage, phasing, and frequency of the power system.
2. SCCR equal to or exceed the equipment being protected by the SPD.
3. Protect again surges produced by a 1.2 / 50 µs and 8 / 20 µs combination waveform generator.
4. Include EMI/RFI noise filtration and comply with UL 1283.
5. Response time of one nanosecond or less for any individual component, self-restoring, and fully automatic.
6. Provide all modes of protection based on the system voltage.
7. Voltage protection ratings (VPRs) not exceeding the following:

System Voltage	Line-Neutral	Line-Ground	N-Ground	Line-Line
120 (2W+G)	700	700	700	n/a
240 (2W+G)	1200	1200	1200	n/a
120/240 (3W+G)	700	700	700	1200
120/208Y (4W+G)	700	700	700	1200
277/480Y (4W+G)	1200	1200	1200	2000
240Δ (3W+G)	n/a	1200	n/a	1200

8. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than the following kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.

   a. Service entrance equipment, switchgear, switchboards (480V): 300 kA.
   b. Distribution panelboards and motor control centers (480V): 200 kA.
   c. Panelboards and control panels (480V): 200 kA.
   d. Panelboards and load centers (240/208/120V): 100 kA.

9. I nominal Rating: 10 kA.

F. Enclosures:

1. Dry Indoor Enclosures: NEMA 250, Type 12.
2. Outdoor, Wet, Damp, Corrosive, and Process Area Enclosures: NEMA 250, Type 4X.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer’s written instructions.

C. Install leads between disconnects and SPDs in accordance with manufacturer’s written instructions.

1. Install leads as short as possible, not to exceed 24-inches.
2. Route leads to avoid sharp bends or kinks.
3. Where practicable with conductor size, gently twist leads.
4. Do not splice and extend SPD leads.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. SPDs that do not pass tests and inspections will be considered defective.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks in accordance with manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION 264313

SECTION 271523 - COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

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. 9/125 micrometer, single-mode, indoor-outdoor optical fiber cable (OS2).
2. Optical fiber cable connecting hardware, patch panels, and cross-connects.
3. Grounding.
4. Cabling identification products.

B. Related Requirements:

1. Section 262726 "Wiring Devices."
2. Section 270526 "Grounding and Bonding for Communications Systems."

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. RCDD: Registered Communications Distribution Designer.

1.4 OPTICAL FIBER HORIZONTAL CABLING DESCRIPTION

A. Optical fiber horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C and the equipment outlet, otherwise known as "Cabling Subsystem 1" in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. Maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration Drawings and printouts.
4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:

    a. Telecommunications rooms plans and elevations.
    b. Telecommunications pathways.
    c. Telecommunications system access points.
    d. Telecommunications grounding system.
    e. Telecommunications conductor drop locations.
    f. Typical telecommunications details.
    g. Mechanical, electrical, and plumbing systems.

C. Fiber optic cable testing plan.

1.6 CLOSEOUT SUBMITTALS

A. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

B. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Connecting Blocks: One of each type.
2. Jacks: Ten of each type.
3. Plugs: Ten of each type.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
2. Testing Supervisor: Currently certified by BICSI as a RCDD.

B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as a RCDD to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 9/125 MICROMETER, SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS2)

A. Description: Single mode, 9/125-micrometer, tight buffered, nonconductive optical fiber cable.

B. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.

C. Jacket:

1. Jacket Color: Yellow stripe along entire length of cable, and shall be marked “Collier County BCC IT” at three-foot intervals.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

D. Standards:

1. Comply with TIA-492CAAB for detailed specifications.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with ICEA S-104-696 for mechanical properties.

E. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
2. Plenum Rated, Nonconductive: Type OFNP in listed plenum communications raceway.
3. Plenum Rated, Nonconductive: Type OFNP or Type OFNR in metallic conduit.
4. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262; Type OFNP in listed plenum communications raceway; or Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit.
5. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
6. Plenum Rated, Conductive: Type OFCP or Type OFNP in listed plenum communications raceway.
7. Plenum Rated, Conductive: Type OFCP, Type OFNP, Type OFCR, or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

2.3 OPTICAL FIBER CABLE HARDWARE

A. Standards:

1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.
2. Comply with TIA-568-C.3.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, single-fiber cables in 36-inch lengths.

D. Connector Type: Type SC complying with TIA-604-10-B connectors.

E. Plugs and Plug Assemblies:

1. Male: Color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.

F. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.
4. Designed to snap-in to a patch panel or faceplate.

G. Faceplate:

1. Two-port, vertical single-gang faceplates designed to mount to single-gang wall boxes.
2. Eight-port, vertical double-gang faceplates designed to mount to double-gang wall boxes.
3. Plastic Faceplate: High-impact plastic.
4. Metal Faceplate: Stainless steel.
5. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.

a. Flush mounting jacks, positioning the cord at a 45-degree angle.

2.4 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.5 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.

C. Factory test preterminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.

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

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 1, NECA 301 and NECA/BICSI 568.

B. General Requirements for Optical Fiber Cabling Installation:

1. Comply with TIA-568-C.1 and TIA-568-C.3.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified by the manufacturer**.** Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, provide a 10-foot- long service loop on each end of cable.
10. Pulling Cable: Comply with manufacturer recommendations. Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

E. Group connecting hardware for cables into separate logical fields.

3.3 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.4 GROUNDING

A. Install grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.

B. Comply with TIA-607-B and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.5 IDENTIFICATION

A. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration including optional identification requirements of this standard.

B. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

C. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

D. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Link End-to-End Attenuation Tests:

1) Horizontal and Multimode Horizontal Link Measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
2) Attenuation test results for horizontal links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.

E. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

F. Remove and replace cabling where test results indicate that it does not comply with specified requirements.

G. End-to-end cabling will be considered defective if it does not pass tests and inspections.

H. Prepare test and inspection reports.

END OF SECTION 271523

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SECTION 312316

EXCAVATION - EARTH AND ROCK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for performing opencut excavations to the widths and depths necessary for constructing structures and pipelines, including excavation of any material necessary for any purpose pertinent to the construction of the Work.

B. Related Work Specified In Other Sections Includes:

1. Section 017416 – Site Clearing

2. Section 033100 – Concrete, Masonry, Mortar and Grout

3. Section 312319 – Groundwater Control for Open Cut Excavation

4. Section 312323 – Backfilling

5. Section 314000 – Shoring, Sheeting and Bracing

1.2 DEFINITIONS

A. Earth: "Earth" includes all materials which, in the opinion of the ENGINEER, do not require blasting, barring, wedging or special impact tools for their removal from their original beds, and removal of which can be completed using standard excavating equipment. Specifically excluded are all ledge and bedrock and boulders or pieces of masonry larger than one cubic yard in volume.

B. Rock: "Rock" includes all materials which, in the opinion of the ENGINEER, require blasting, barring, wedging and/or special impact tools such as jack hammers, sledges, chisels, or similar devices specifically designed for use in cutting or breaking rock for removal from their original beds and which have compressive strengths in their natural undisturbed state in excess of 300 psi. Boulders or masonry larger than one cubic yard in volume are classed as rock excavation.

1.3 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. Engage the services of a Professional Engineer who is registered in the State of Florida to design all cofferdam and sheeting and bracing systems which the CONTRACTOR feels necessary for the execution of his work. Submit to the ENGINEER a signed statement that he has been employed by the CONTRACTOR to design all sheeting and bracing systems. After the systems have been installed, furnish to the ENGINEER an additional signed statement that the cofferdams and sheeting and bracing systems have been installed in accordance with his design.

C. If a detour is required, submit a traffic control plan for approval to County Manager or designee and/or the Florida Department of Transportation as described in Section 015526.

1.4 SITE CONDITIONS

A. Geotechnical Investigation: A geotechnical investigation may have been prepared by the COUNTY and ENGINEER in preparing the Contract Documents.

1. The geotechnical investigation report may be examined for what ever value it may be considered to be worth. However, this information is not guaranteed as to its accuracy or completeness.

2. The geotechnical investigation report is not part of the Contract Documents.

B. Actual Conditions: Make any geotechnical investigations deemed necessary to determine actual site conditions.

C. Underground Utilities and Collier County Damage Prevention Policy:

1. This policy has been put in place to avoid damage to Collier County underground utilities. A minimum distance of five feet (5') horizontally and eighteen inches (18") vertically must be maintained away from Collier County utilities. Any and all variations from this order must be the Water or Wastewater Department.

2. Before commencement of any excavation at road crossings or any boring or any drilling, the contractor shall mark the proposed run alignment with white paint or flags. Subsequent to placement of the white markings, the existing underground utilities in the area affected by the work must be marked by Sunshine One Call after proper notification to them by either calling 811 in Florida or toll free at 1-800-432-4770. Visit www.callsunshine.com for more information. Before commencing excavation for the work, potholing of all potential conflicts must be performed.

3. All lines in conflict must be physically located by the contractor and verified by Collier County Locate Department personnel before performing work. Utilities under concrete or pavement may require soft dig vacuum locates which also is the contractor's responsibility to perform. All utilities will be field marked per Sunshine State One Call's statutes and guidelines. For line verification or any

other information concerning locates, please call the Locate Department at 239-252-5922 during normal business hours. For line verification or emergency locates after hours, call emergency numeric pager at 239-890-0809. **In the event the potholing and/or vacuum soft dig does not locate the marked utility, work must be stopped and the affected utility owner contacted.** Failure to comply with this policy and obtain required signature(s) may result in delay or denial of permit.

4. The contractor must comply with all provisions of Florida Statute 556, the Underground Facility Damage Prevention and Safety Act.

D. Quality and Quantity: Make any other investigations and determinations necessary to determine the quality and quantities of earth and rock and the methods to be used to excavate these materials.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL

A. Clearing: Clear opencut excavation sites of obstructions preparatory to excavation. Clearing in accordance with Section 017416, includes removal and disposal of vegetation, trees, stumps, roots and bushes, except those specified to be protected during trench excavation.

B. Banks: Shore or slope banks to the angle of repose to prevent slides or cave-ins in accordance with Section 314000.

C. Safety: Whenever an excavation site or trench is left unattended by the CONTRACTOR or when an area is not within 100 feet of observation by the CONTRACTOR, the excavation site or trench shall be filled and/or, at the County's Manager or designee discretion, protected by other means to prevent accidental or unauthorized entry. Include barricades and other protection devices requested by the ENGINEER or County Manager or designee, including temporary fencing, snow fencing, or temporary "structure" tape. Such safety items shall not relieve the CONTRACTOR of any site safety requirements or liabilities established by Federal, State and local laws and agencies, including OSHA, but is intended as additional safety measures to protect the general public.

D. Hazardous Materials: If encountered, take care of hazardous materials not specifically shown or noted in accordance with Section 015000.

E. During excavation and any site work, take storm water pollution prevention measures to ensure that water quality criteria are not violated in the receiving water body and all state and local regulatory requirements are met.

3.2 STRUCTURE EXCAVATION

A. Excavation Size: Provide excavations of sufficient size and only of sufficient size to permit the Work to be economically and properly constructed in the manner and of the size specified.

B. Excavation Shape: Shape and dimension the bottom of the excavation in earth or rock to the shape and dimensions of the underside of the structure or drainage blanket wherever the nature of the excavated material permits.

C. Compaction: Before placing foundation slabs, footings or backfill, proof roll the bottom of the excavations to detect soft spots.

1. For accessible areas, proof roll with a ten wheel tandem axle dump truck loaded to at least 15 tons or similarly loaded construction equipment.

2. For small areas, proof roll with a smooth-faced steel roller filled with water or sand, or compact with a mechanical tamper.

3. Make one complete coverage, with overlap, of the area.

4. Overexcavate soft zones and replace with compacted select fill.

3.3 TRENCH EXCAVATION

A. Preparation: Properly brace and protect trees, shrubs, poles and other structures which are to be preserved. Unless shown or specified otherwise, preserve all trees and large shrubs. Hold damage to the root structure to a minimum. Small shrubs may be preserved or replaced with equivalent specimens.

B. Adequate Space: Keep the width of trenches to a minimum, however provide adequate space for workers to place, joint and backfill the pipe properly.

1. The minimum width of the trench shall be equal to at least 3.5 feet or the outside diameter of the pipe at the joint plus 8-inches for unsheeted trench or 12 inches for sheeted trench, whichever is greater. Conform the trench walls to OSHA Regulations.

2. In sheeted trenches, measure the clear width of the trench at the level of the top of the pipe to the inside of the sheeting.

C. Depth:

1. Excavate trenches to a minimum depth of 8 inches, but not more than 12 inches, below the bottom of the pipe so that bedding material can be placed in the bottom of the trench and shaped to provide a continuous, firm bearing for pipe barrels and bells.

2. Standard trench grade shall be defined as the bottom surface of the utility to be constructed or placed within the trench. Trench grade for utilities in rock or other non-cushioning material shall be defined as additional undercuts backfilled with crushed stone compacted in 6-inch lifts, below the standard 8-inches minimum trench undercut. Backfill excavation below trench grade not ordered in writing by the ENGINEER with acceptable Class I, II or III embedment material to trench grade and compact to density equal to native soil.

D. Unstable or Unsuitable Materials: If unstable or unsuitable material is exposed at the level of the bottom of the trench excavation, excavate the material in accordance with the subsection headed "Authorized Additional Excavation".

1. Remove material for the full width of the trench and to the depth required to reach suitable foundation material.

2. When in the judgment of the ENGINEER the unstable or unsuitable material extends to an excessive depth, the ENGINEER may advise, in writing, the need for stabilization of the trench bottom with additional select fill material, crushed stone, washed shell, gravel mat or the need to provide firm support for the pipe or electrical duct by other suitable methods.

3. Crushed stone, washed shell and gravel shall be as specified in Section 312323.

4. Payment for such trench stabilization will be made under the appropriate Contract Items or where no such items exist, as a change in the Work.

E. Length of Excavation: Keep the open excavated trench preceding the pipe laying operation and the unfilled trench, with pipe in place, to a minimum length which causes the least disturbance. Provide ladders for a means of exit from the trench as required by applicable safety and health regulations.

F. Excavated Material: Neatly deposit excavated material to be used for backfill at the sides of the trenches where space is available. Where stockpiling of excavated material is required, obtain the sites to be used and maintain operations to provide for natural drainage and not present an unsightly appearance.

G. Water: Allow no water to rise in the trench excavation until sufficient backfill has been placed to prevent pipe flotation. Provide trench dewatering in accordance with Section 312319.

3.4 EXCAVATION FOR JACKING AND AUGERING

A. Jacking and Augering Requirements: Allow adequate length in jacking pits to provide room for the jacking frame, the jacking head, the reaction blocks, the jacks, auger rig, and the jacking pipe. Provide sufficient pit width to allow ample working space on each side of the jacking frame. Allow sufficient pit depth such that the invert of the pipe, when placed on the guide frame, will be at the elevation desired for the completed line. Tightly sheet the pit and keep it dry at all times.

3.5 ROCK EXCAVATION

A. Rock Excavation: Excavate rock within the boundary lines and grades as shown, specified or required.

1. Rock removed from the excavation becomes the property of the CONTRACTOR. Transport and dispose of excavated rock at an off site disposal location. Obtain the off site disposal location.

2. Remove all shattered rock and loose pieces.

B. Structure Depths: For cast-in-place structures, excavate the rock only to the bottom of the structure, foundation slab, or drainage blanket.

C. Trench Width: Maintain a minimum clear width of the trench at the level of the top of the pipe of the outside diameter of the pipe barrel plus 2 feet, unless otherwise approved.

D. Trench Depth: For trench excavation, in which pipelines are to be placed, excavate the rock to a minimum depth of 8 inches below the bottom of the pipe or duct encasement. Provide a cushion of sand or suitable crushed rock. Refill the excavated space with pipe bedding material in accordance with Section 312323. Include placing, compacting and shaping pipe bedding material in the appropriate Contract Items.

E. Manhole Depths: For manhole excavation, excavate the rock to a minimum depth of 8 inches below the bottom of the manhole base for pipelines 24 inches in diameter and larger and 6 inches below the bottom manhole base for pipelines less than 24 inches in diameter. Refill the excavated space with pipe bedding material in accordance with Section 312323. Include placing, compacting and shaping pipe bedding material for manhole bases in the appropriate Contract Items.

F. Over-excavated Space: Refill the excavated space in rock below structures, pipelines, conduits and manholes, which exceeds the specified depths with 2,500 psi concrete, crushed stone, washed shell, or other material as directed. Include refilling of over-excavated space in rock as part of the rock excavation.

G. Other Requirements: Follow, where applicable, the requirements of the subsections on "Trench Excavation" and "Structure Excavation".

H. Payment: No additional payment will be made for rock excavation.

3.6 FINISHED EXCAVATION

A. Finish: Provide a reasonably smooth finished surface for all excavations, which is uniformly compacted and free from irregular surface changes.

B. Finish Methods: Provide a degree of finish that is ordinarily obtainable from blade-grade operations and in accordance with Section 312323.

3.7 PROTECTION

A. Traffic and Erosion: Protect newly graded areas from traffic and from erosion.

B. Repair: Repair any settlement or washing away that may occur from any cause, prior to acceptance. Re-establish grades to the required elevations and slopes.

C. It shall be the CONTRACTOR's responsibility to acquaint himself with all existing conditions and to locate all structures and utilities along the proposed utility alignment in order to avoid conflicts. Where actual conflicts are unavoidable, coordinate work with the facility owner and perform work so as to cause as little interference as possible with the service rendered by the facility disturbed in accordance with Section 020500. Repair and/or replace facilities or structures damaged in the prosecution of the work immediately, in conformance with current standard practices of the industry, or according to the direction of the owner of such facility, at the CONTRACTOR's expense.

D. Other Requirements: Conduct all Work in accordance with the environmental protection requirements specified in Division 1.

3.8 AUTHORIZED ADDITIONAL EXCAVATION

A. Additional Excavation: Carry the excavation to such additional depth and width as authorized in writing, for the following reasons:

1. In case the materials encountered at the elevations shown are not suitable.

2. In case it is found desirable or necessary to go to an additional depth, or to an additional depth and width.

B. Refill Materials: Refill such excavated space with either authorized 2500 psi concrete or compacted select fill material, in compliance with the applicable provisions of Section 312323.

C. Compaction: Compact fill materials to avoid future settlement. As a minimum, backfill layers shall not exceed 6-inches in thickness for the full trench width and compaction shall equal 95% of maximum density, or 98% if under paved area of roadway, as determined by using ASTM D 1557. Perform compaction density tests at all such backfill areas with spacing not to exceed 100 feet apart and on each 6-inch compacted layer.

D. Payment: Additional earth excavations so authorized and concrete or select fill materials authorized for filling such additional excavation and compaction of select fill materials will be paid for under the appropriate Contract Items or where no such items exist, as a change in the Work.

3.9 UNAUTHORIZED EXCAVATION

A. Stability: Refill any excavation carried beyond or below the lines and grades shown, except as specified in the subsection headed "Authorized Additional Excavation", with such material and in such manner as may be approved in order to provide for the stability of the various structures.

B. Refill Materials: Refill spaces beneath all manholes, structures, pipelines, or conduits excavated without authority with 2500 psi concrete or compacted select fill material, as approved.

C. Payment: Refill for unauthorized excavation will not be measured and no payment will be made therefor.

3.10 SEGREGATION STORAGE AND DISPOSAL OF MATERIAL

A. Stockpiling Suitable Materials: Stockpile topsoil suitable for final grading and landscaping and excavated material suitable for backfilling or embankments separately on the site in approved locations.

B. Stockpile Locations: Store excavated and other material a sufficient distance away from the edge of any excavation to prevent its falling or sliding back into the excavation and to prevent collapse of the wall of the excavation. Provide not less than 2 feet clear space between the top of any stockpile and other material and the edge of any excavation.

C. Excess Materials: Be responsible for transport and disposal of surplus excavated material and excavated material unsuitable for backfilling or embankments at an off site disposal location secured by the CONTRACTOR.

3.11 REMOVAL OF WATER

A. Water Removal: At all times during the excavation period and until completion and acceptance of the WORK at final inspection, provide ample means and equipment with which to remove promptly and dispose of properly all water entering any excavation or other parts of the WORK.

B. Dry Excavations: Keep the excavation dry, in accordance with Section 312319.

C. Water Contact: Allow no water to rise over or come in contact with masonry and concrete until the concrete and mortar have attained a set and, in any event, not sooner than 12 hours after placing the masonry or concrete.

D. Discharge of Water: Dispose of water pumped or drained from the Work in a safe and suitable manner without damage to adjacent property or streets or to other work under construction.

E. Protection: Provide adequate protection for water discharged onto streets. Protect the street surface at the point of discharge.

F. Sanitary Sewers: Discharge no water into sanitary sewers.

G. Storm Sewers: Discharge no water containing settleable solids into storm sewers.

H. Repair: Promptly repair any and all damage caused by dewatering the Work.

END OF SECTION

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SECTION 312319

GROUNDWATER CONTROL FOR OPEN CUT EXCAVATION

PART 1 GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

A. This section provides for furnishing all permits, labor, materials, equipment, power and incidentals for performing all operations necessary to dewater, depressurize, drain and maintain excavations as described herein and as necessary for installation of pipeline and appurtenances. Included are installing, maintaining, operating and removing dewatering systems and other approved devices for the control of surface and groundwater during the construction of pipelines and appurtenances, open cut excavations, directional drilling. Included also are protecting work against rising waters and repair of any resulting damage.

1.2 CONTRACTOR'S RESPONSIBILITY

A. It is the sole responsibility of the CONTRACTOR to identify groundwater conditions and to provide any and all labor, material, equipment, techniques and methods to lower, control and handle the groundwater as necessary for his construction methods and to monitor the effectiveness of this installed system and its effect on adjacent facilities.

B. Operate, maintain and modify the system(s) as required to conform to these Specifications. Upon completion of the Construction, remove the system(s). The development, drilling and abandonment of all wells used in the dewatering system shall comply with regulations of the Florida Department of Environmental Protection and the governing Water Management District.

C. Assume sole responsibility for dewatering systems and for all loss or damage resulting from partial or complete failure of protective measures and any settlement or resultant damage caused by the dewatering operation.

1.3 PLANS AND OTHER DATA TO BE SUBMITTED

A. Prior to commencement of work, submit complete drawings, details and layouts showing the proposed dewatering plans in sufficient detail (i.e., general arrangements, procedures to be used, etc.) so as to allow the ENGINEER to evaluate the proposed dewatering systems. Include the following, as required by the CONTRACTOR's proposed operation:

1. Names of equipment suppliers.

2. Names of installation subcontractors.

3. Plan for dewatering at access shafts and control of surface drainage.

4. Plan for dewatering for cut-and-cover excavations, or otherwise controlling groundwater.

5. Eductor system layout and details.

6. Deep well locations and details.

7. Well point system layout and details.

8. Installation reports for eductors, deep wells and well points.

9. Water level readings from piezometers or observation wells, and method of maintenance.

10. As part of his request for approval of a dewatering system, demonstrate the adequacy of the proposed system and well point filler sand by means of a test installation.

PART 2 PRODUCTS

A. Select equipment including but not limited to pumps, eductors, well points and piping and other material desired.

PART 3 EXECUTION

3.1 DEWATERING EXCAVATIONS

A. Obtain all permits necessary for dewatering operations and file a copy of all such permits with the County Manager or designee and ENGINEER.

B. Furnish, install, operate and maintain all necessary equipment for dewatering the various parts of the Work and for maintaining free of water the excavations and such other parts of the Work as required for Construction operations. Dewatering system should provide for continuous operation including nights, weekends, holidays, etc. Provide appropriate backup if electrical power is primary energy source for dewatering system.

C. Continue dewatering in all required areas, until the involved work is completed, including the placing and compaction of backfill materials.

D. Provide a uniform diameter for each pipe drain run constructed for dewatering. Remove the pipe drain when it has served its purpose. If removal of the pipe is impractical, provide grout connections at 50-foot intervals, and fill the pipe with clay grout or cement and sand grout when the pipe has served its purpose.

3.2 DEWATERING TRENCH

A. Dewatering Excavation Plan: Develop an excavation dewatering plan that considers site ground and groundwater conditions, the type and arrangement of the equipment to be used and the proper method of groundwater disposal. Prepare the dewatering plan before beginning excavations below groundwater. Maintain one copy of the dewatering plan at the project site to be available for inspection while all dewatering operations are underway.

B. Do not lay any pipeline in a trench in the presence of water. Remove all water from the trench sufficiently ahead of the pipeline placing operation. The ENGINEER shall have full and final authority to require dewatering of the trench to ensure a dry, firm bed on which to place the pipeline. As a minimum, maintain water levels at least 6 inches below the bottom of the trench. Continue to dewater trench until trench backfilling operations have been completed.

1. If a dry trench bottom has not been obtained with usual methods of trench dewatering, then the order to excavate below grade and place sufficient select fill material, crushed stone, or 2500 psi concrete over the trench bottom may be given.

2. If all efforts fail to obtain a stable dry trench bottom, and it is determined that the trench bottom is unsuitable for pipe foundation, present an alternate system for stabilization to the Engineer of Record for approval by the County Manager or designee on a case-by-case basis.

C. Removal of water may be accomplished by pumping in connection with well point installation as the particular situation may warrant.

D. If the soils encountered at the trench grade are suitable for the passage of water, without destroying the sides or utility foundation of the trench, sumps may be provided at intervals at the side of the main trench excavation. Use pumps to lower the water level by taking their suction from said sumps.

3.3 REQUIREMENTS FOR EDUCTOR, WELL POINTS OR DEEP WELLS

A. Eductor, well points or deep wells, where used, must be furnished, installed and operated by a reputable CONTRACTOR regularly engaged in this business, and approved.

3.4 DURATION OF DRAINAGE

A. In areas where concrete is to be placed, carry out the foundation drainage so that the required lowering of the water table will be effected prior to placing reinforcing steel. Keep foundation beds free from water to the same levels for 3 days after placing concrete.

3.5 PROTECTION OF STRUCTURES

A. Provide adequate protection for all structures to avoid damage to concrete.

B. Operate construction equipment over completed concrete slabs or structures only with approval. Rubber tire equipment heavier than 5 tons and crawlers heavier than 7 tons will require adequate load spreading by sand fill or other means.

3.6 DISCHARGE OF WATER

A. Do not discharge pumped drainage water into the sanitary sewer system or inhibit pedestrian or vehicular traffic with the groundwater control system.

B. Discharge pumped drainage water into the storm sewer system or drainage ditch by direct means (i.e., discharge hose to inlet, burying header, etc.). Monitor the discharged water to determine that soil particles are not being removed.

C. Conform all discharge to current South Florida Water Management District and Collier County Department of Stormwater Management rules, regulations, procedures and regulatory permits and if discharged into receiving waters, shall not exceed 29 N.T.U.'s above background.

3.7 REPAIR OF DAMAGE

A. Assume full responsibility for all loss and damage due to flooding, rising water or seepage resulting from dewatering operations in any part of the work. Repair any damage to partially completed work from these or other causes, including the removal of slides, repair of foundation beds and performance of any other work necessitated by lack of adequate dewatering or drainage facilities.

END OF SECTION

SECTION 312323

BACKFILLING

PART 1 GENERAL

1.1 SUMMARY

A. General Requirements: Backfill all excavation to the original surface of the ground or to such other grades as may be shown or required. For areas to be covered by topsoil, leave or stop backfill (12) inches below the finished grade. Obtain approval for the time elapsing before backfilling against masonry structures. Remove from all backfill, any compressible, putrescible, or destructible rubbish and refuse and all lumber and braces from the excavated space before backfilling is started. Leave sheeting and bracing in place or remove as the work progresses.

B. Equipment Limitations: Do not permit construction equipment used to backfill to travel against and over cast-in-place concrete structures until the specified concrete strength has been obtained, as verified by concrete test cylinders. In special cases where conditions warrant, the above restriction may be modified providing the concrete has gained sufficient strength, as determined from test cylinders, to satisfy design requirements for the removal of forms and the application of load.

C. Related Work Specified In Other Sections Includes:

1. Section 017416 – Site Clearing

2. Section 312316 – Excavation – Earth and Rock

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM D 1557 - Standard Test Methods for Moisture-Density Relations of Soil and Soil-Aggregate Mixtures Using 10 lb Rammer and 18 in Drop

PART 2 PRODUCTS

2.1 BACKFILL MATERIAL - GENERAL

A. General: Refer to Utilities Standards and Procedures Ordinance Section 9.1.2 for laying and backfilling requirements. Backfill with sound materials, free from waste, organic matter, rubbish, boggy or other unsuitable materials. Acceptable backfill shall not contain rocks or stones larger than 2 inches in size.

B. General Materials Requirements: Conform materials used for backfilling to the requirements specified. Follow common fill requirements whenever drainage or select fill is not specified. Determine and obtain the approval of the appropriate test method where more than one compaction test method is specified.

C. Classification of Approved Embedment Materials: Embedment materials listed here include a number of processed materials plus the soil types defined according to the Unified Soil Classification System (USCS) in ASTM D2487. These materials are grouped into 5 broad categories according to their suitability for this application.

1. Class I: Angular, 0.25 inch to 1.5 inch (6 to 40 mm) graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed shells and crushed stone. (Note: The size range and resulting high void ratio of Class I material makes it suitable for use to dewater trenches during pipe installation. This permeable characteristic dictates that its use be limited to locations where pipe support will not be lost by migration of fine grained natural material from the trench walls and bottom or migration of other embedment materials into the Class I material. When such migration is possible, the material's minimum size range should be reduced to finer than 0.25 inch (6 mm) and the gradation properly designed to limit the size of the voids. An alternative to modifying the gradation is to use a geotextile fabric as a barrier to migration to fines.)

2. Class II: Coarse sands and gravels with maximum particle size of 1.5 inches (40 mm), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW and SP are included in this class. (Note: Sands and gravels, which are clean or borderline between clean and with fines, should be included. Coarse-grained soils with less than 12 percent, but more than 5 percent fines are neglected in ASTM D2487 and the USCS, but should be included. The gradation of Class II material influences its density and pipe support strength when loosely placed. The gradation of Class II material may be critical to the pipe support and stability of the foundation and embedment, if the material is imported and is not native to the trench excavation. A gradation other than well graded, such as uniformly graded or gap graded, may permit loss of support by migration into void spaces of a finer grained natural material from the trench wall and bottom. An alternative to modifying the gradation is to use a geotextile fabric as a barrier to migration of fines.)

3. Class III: Fine sand and clayey (clay filled) gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures. Soil Types GM, GC, SM and SC are included in this class.

4. Class IV: Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class. (Note: Use caution in the design and selection of the degree and method of compaction for Class IV soils because of the difficulty in properly controlling the moisture content under field conditions. Some Class IV soils with medium to high plasticity and with liquid limits greater than 50 percent (CH, MH, CH-MH) exhibit reduced strength when wet and should only be used for bedding, haunching and initial backfill in arid locations where the pipe embedment will not be saturated by groundwater, rainfall or exfiltration from the pipe. Class IV soils with low to medium plasticity and with liquid limits lower than 50 percent (CL, ML, CL-ML) also require careful consideration in design and installation to control moisture content, but need not be restricted in use to arid locations.)

5. Class V: This class includes the organic soils OL, OH and PT as well as soils containing frozen earth, debris, rocks larger than 1.5 inches (40 mm) in diameter and other foreign materials. Do not use these materials for bedding, haunching or backfill.

2.2 SELECT FILL

A. Materials for Select Fill: Use clean gravel, crushed stone, washed shell, or other granular or similar material as approved which can be readily and thoroughly compacted to 95 percent of the maximum dry density obtainable by ASTM D 1557.

1. Allowed Materials: Grade select fill between the following limits:

U.S. Standard Sieve	Percent Passing By Weight
2 inch	100
1-1/2 inch	90-100
1 inch	75-95
1/2 inch	45-70
#4	25-50
#10	15-40
#200	5-15

2. Unallowed Materials: Very fine sand, uniformly graded sands and gravels, sand and silt, soft earth, or other materials that have a tendency to flow under pressure when wet are unacceptable as select fill.

2.3 COMMON FILL

A. Materials for Common Fill: Material from on-site excavation may be used as common fill provided that it can be readily compacted to 90 percent of the maximum dry density obtainable by ASTM D 1557, and does not contain unsuitable material. Select fill may be used as common fill at no change in the Contract Price.

B. Granular Materials On-Site: Granular on-site material, which is fairly well graded between the following limits may be used as granular common fill:

U.S. Standard Sieve	Percent Passing by Weight
2 inch	100
#10	50-100
#60	20-90
#200	0-20

C. Cohesive Materials On-Site: Cohesive site material may be used as common fill.

1. The gradation requirements do not apply to cohesive common fill.

2. Use material having a liquid limit less than or equal to 40 and a plasticity index less than or equal to 20.

D. Material Approval: All material used as common fill is subject to approval. If there is insufficient on-site material, import whatever additional off-site material is required which conforms to the specifications and at no additional cost.

2.4 UTILITY PIPE BEDDING

A. Gradation for Small Piping: For pipe 18 inches or less in diameter, use pipe bedding of material 90 percent of which will be retained on a No. 8 sieve and 100 percent of which will pass a 1/2-inch sieve and be well graded between those limits.

B. Gradation for Large Piping: For pipe larger than 18 inches in diameter, use the same pipe bedding material as specified for smaller pipe or use a similar well graded material 90 percent of which will be retained on a No. 8 sieve and 100 percent of which will pass a 1-inch sieve.

C. Provide a minimum of six (6) inches bedding material under all gravity sewer piping. In areas where poor soil conditions or rock exist, provide a minimum of six (6) inches of pipe bedding material under water or force main pressure pipe.

PART 3 EXECUTION

3.1 PRECAST MANHOLE BEDDING

A. Bedding Compaction: Bed all precast manholes in well graded, compacted 12-inch layer of crushed stone. Compact bedding thickness no less than 6 inches for precast concrete manhole bases.

B. Concrete Work Mats: Cast cast-in-place manhole bases and other foundations for structures against a 2500 psi concrete work mat in clean and dry excavations.

C. Bedding Placement: Place select fill used for bedding beneath precast manhole bases, in uniform layers not greater than 9 inches in loose thickness. Thoroughly compact in place with suitable mechanical or pneumatic tools to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.

D. Use of Select Fill: Bed existing underground structures, tunnels, conduits and pipes crossing the excavation with compacted select fill material. Place bedding material under and around each existing underground structure, tunnel, conduit or pipe and extend underneath and on each side to a distance equal to the depth of the trench below the structure, tunnel, conduit or pipe.

3.2 PIPE BEDDING AND INITIAL BACKFILL

A. Placement: Place backfill for initial pipe backfill from top of bedding to 1 foot over top of pipes in uniform layers not greater than 8 inches in loose thickness. Tamp under pipe haunches and thoroughly compact in place the backfill with suitable mechanical or pneumatic tools to not less than 98 percent of the maximum dry density as determined by ASTM D 1557.

B. Foundation Bedding: Place bedding, to a depth specified by the County Manager or designee, as a foundation in wet, yielding or mucky locations. Construct foundation bedding by removal of the wet, yielding or mucky material and replacement with sufficient Class I material to correct soil instability.

C. Stone Placement: Do not place large stone fragments in the pipe bedding or backfill within 2 feet over or around pipelines, or nearer than 2 feet at any point from any casing pipe, conduit or concrete wall.

D. Machine Compaction: Machine Compaction of initial backfill is prohibited unless adequate cover as deemed by the County Manager or designee is provided. In no case shall adequate cover be less than 12 inches.

E. Unallowed Materials: Pipe bedding containing very fine sand, uniformly graded sands and gravels, sand and silt, soft earth, or other materials that have a tendency to flow under pressure when wet is unacceptable.

3.3 TRENCH BACKFILL

A. General: Backfill trenches from 1 foot over the top of the pipe, from the top of electrical duct bedding or as shown to the bottom of pavement base course, subgrade for lawns or lawn replacement, to the top of the existing ground surface or to such other grades as may be shown or required.

B. Materials: All backfill material shall be acceptable dry materials, and shall be free from cinders, ashes, refuse, vegetable or organic material, boulders, rocks, or stones, or other deleterious material which in the opinion of the County Manager or designee is unsuitable.

C. Depth of Placement - Place trench backfill in uniform layers not greater than 12 inches in loose thickness and that can be thoroughly compacted in place using suitable mechanical or pneumatic equipment to not less than 98 percent of the maximum dry density as determined by ASTM D 1557.

D. Depth of Placement - Undeveloped Areas: In nondeveloped areas and where select fill material or hand-placed backfill are not specified or required, place suitable job-excavated material or other approved backfill in lifts not exceeding 12 inches in loose thickness. Lifts of greater thickness may be permitted by the County Manager or designee if the CONTRACTOR demonstrates compliance with required densities. When the trench is full, consolidate the backfill by jetting, spading, or tamping to ensure complete filling of the excavation. Mound the top of the trench approximately 12 inches to allow for consolidation of backfill.

E. Compaction: Compact backfill as a percentage of the maximum density at optimum moisture content as determined by the standard proctor test, ASTM D698 as demonstrated in the following table:

Area	(Mod.) ASTM D1557
Around and 1’ (Min) above top of pipe	98
Remaining Trench	98
Pavement Sub-Grade and Shoulders (Last 3’ of Fill)	98
Base Material and Pavement	98
Adjacent to Structures (Areas not Paved)	98
Under Structures	98
Sub-Base	98

F. Density Tests: Density tests will be made at the request of the County Manager or designee. Deficiencies will be corrected at the expense of the CONTRACTOR.

G. Dropping of Material on Work: Do trench backfilling work in such a way as to prevent dropping material directly on top of any conduit or pipe through any great vertical distance.

H. Distribution of Large Materials: Break lumps up and distribute any stones, pieces of crushed rock or lumps which cannot be readily broken up, throughout the mass so that all interstices are solidly filled with fine material.

3.4 STRUCTURE BACKFILL

A. Use crushed stone underneath all structures, and adjacent to structures where pipes, connections and structural foundations are to be located within this fill. Use crushed stone beneath all pavements, walkways, and railroad tracks, and extend to the bottom of pavement base course or ballast.

1. Place backfill in uniform layers not greater than 8 inches in loose thickness and thoroughly compact in place with suitable approved mechanical or pneumatic equipment.

2. Compact backfill to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.

B. Use of Common Fill: Use common granular fill adjacent to structures in all areas not specified above. Select fill may be used in place of common granular fill at no additional cost.

1. Extend such backfill from the bottom of the excavation or top of bedding to the bottom of subgrade for lawns or lawn replacement, the top of previously existing ground surface or to such other grades as may be shown or required.

2. Place backfill in uniform layers not greater than 8 inches in loose thickness and thoroughly compact in place with suitable equipment, as specified above.

3. Compact backfill to not less than 90 percent of the maximum dry density as determined by ASTM D 1557.

3.5 COMPACTION EQUIPMENT

A. Equipment and Methods: Carry out all compaction with suitable approved equipment and methods.

1. Compact clay and other cohesive material with sheep's-foot rollers or similar equipment where practicable. Use hand held pneumatic tampers elsewhere for compaction of cohesive fill material.

2. Compact low cohesive soils with pneumatic-tire rollers or large vibratory equipment where practicable. Use small vibratory equipment elsewhere for compaction of cohesionless fill material.

3. Do not use heavy compaction equipment over pipelines or other structures, unless the depth of fill is sufficient to adequately distribute the load.

3.6 FINISH GRADING

A. Final Contours: Perform finish grading in accordance with the completed contour elevations and grades shown and blend into conformation with remaining natural ground surfaces.

1. Leave all finished grading surfaces smooth and firm to drain.

2. Bring finish grades to elevations within plus or minus 0.10 foot of elevations or contours shown.

B. Surface Drainage: Perform grading outside of building or structure lines in a manner to prevent accumulation of water within the area. Where necessary or where shown, extend finish grading to ensure that water will be carried to drainage ditches, and the site area left smooth and free from depressions holding water.

3.7 RESPONSIBILITY FOR AFTERSETTLEMENT

A. Aftersettlement Responsibility: Take responsibility for correcting any depression which may develop in backfilled areas from settlement within one year after the work is fully completed. Provide, as needed, backfill material, pavement base replacement, permanent pavement, sidewalk, curb and driveway repair or replacement, and lawn replacement, and perform the necessary reconditioning and restoration work to bring such depressed areas to proper grade as approved.

3.8 INSPECTION AND TESTING OF BACKFILLING

A. Sampling and Testing: Provide sampling, testing, and laboratory methods in accordance with the appropriate ASTM Standard Specification. Subject all backfill to these tests.

B. Correction of Work: Correct any areas of unsatisfactory compaction by removal and replacement, or by scarifying, aerating or sprinkling as needed and recompaction in place prior to placement of a new lift.

C. Testing Schedule:

1. Compaction Schedule

2. Optimum Moisture Content (Proctor Test)

END OF SECTION

SECTION 323113

CHAIN LINK FENCING AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for providing vinyl coated galvanized steel chain link fencing and gates.

B. Related Work Specified in Other Sections Includes:

1. Section 033100 – Concrete, Masonry, Mortar and Grout

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM 1043 - Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework

2. ASME B36.10M - Welded and seamless wrought steel pipe

3. FS RR-F-191 - Fencing, Wire and Post, Metal

1.3 DESIGN

A. General: Provide fencing of the chain-link type and six (6) feet high with six (6) feet of diamond mesh woven wire fabric. Locate the fence as shown.

B. Fabric, Supports and Fittings: Provide steel fabric, supports and fittings except as specified.

C. Fabric, Supports and Fittings: Provide green or black color coated steel fabric, supports and fittings. Coat the framework, posts and hardware except hinges and latches to match the fabric with thermoplastic or thermoset resins and provide oven-baked materials to a minimum dry coating of seven mils. Color coat all accessories except hinges and latches to match the fence. Provide aluminum hinges and latches.

D. Pipe Sizes and Weights: Provide pipe sizes and weights meeting the requirements of ASME B 36.10, Table 2 and ASTM A 53, Table 1. All pipe sizes listed are nominal, unless otherwise indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers are listed in the County Approved Product List, Appendix F. Other manufacturers of equivalent products may be submitted.

2.2 FABRIC

A. Provide fabric that is a one piece woven 2-inch mesh chain link of 6-gauge steel wire with a minimum breakload of 1800 lbs/ft. and which is interwoven to form a continuous fabric with no splices and is coated after weaving. Provide the top selvage knuckled for fabric 60 inches high and under, and the bottom selvage twisted and barbed for fabric over 60 inches high. Clean the fabric of all grease and foreign matter before coating and shipping. Stretch the fabric tightly approximately three inches above grade level and attach the fabric to the terminal or gateposts using beveled tension bands and tension bars.

1. Provide galvanized fabric that is fusion coated with a minimum seven-mil coating of polyvinyl chloride (PVC) applied over a thermoset plastic bonding agent. Conform the PVC to Federal Specification RR-F-191.

2. Vinyl coat all cut ends.

3. Conform aluminum fabric to Fed. Spec. RR-F-191.

2.3 TENSION WIRE

A. For the tension wire for the fence bottom use minimum 6-gauge galvanized coil spring steel fusion color coated as specified for the fabric.

2.4 TOP AND BRACE RAILS

A. General: Furnish the top rail in approximately 20-foot lengths with couplings approximately 6 inches long for each joint. Provide one coupling in each 5 with an expansion spring. Provide the rail continuous from end-to-end for each run of fence. Provide brace rails at all terminal posts, locate the rails midway between the top and bottom of the fabric and extend from the terminal post to the first adjacent line post. Securely fasten rails at both ends. Provide top and brace rails that are galvanized steel fusion color coated as specified for framework in Subsection 1.03 C.

B. Pipe Type: 1-1/4-inch, Schedule 40 pipe or a 1.625- by 1.25-inch roll-formed section with minimum bending strength of 192 pounds on 10-foot span.

2.5 POSTS

A. General: Provide all posts that are coated as specified for vinyl-coated framework, posts and hardware in Subsection 1.03 C.

B. Pipe Posts: Provide pipe posts as follows:

1. For end, corner and pull posts use 2-1/2-inch, Schedule 40 pipe

2. For line posts use 2-inch, Schedule 40 pipe

3. For gate posts use the following pipes for different leaves:

   a. For leaves up to 6 feet wide, use 2-1/2-inch Schedule 40 pipe

   b. For leaves over 6 feet to 12 feet wide, use 3-1/2-inch Schedule 40 pipe

   c. For leaves over 12 feet to 18 feet wide, use 6-inch Schedule 40 pipe

C. Bending Strength: Provide materials with the minimum bending strength based on a 6-foot cantilever for rolled formed or tube posts as follows:

		Galvanized Steel
1. End, Corner and Pull Posts:		
	2.875" O.D. roll formed or	444
	2-1/2-inch square tube	547
	2-1/2-inch square, heavy wall extrusion	
2. Line Posts:		
	For fences 8 feet maximum height 1.875- by 1.625-inch C-Section	245
	For fences over 8 feet high 2.25- by 1.703-inch C-Section	347
3. Gate Posts:		
	For leaves up to 6 feet wide (2.875-inch O.D. roll formed or	444
	2-1/2-inch square tube	645

2.6 GATES

A. General: For the perimeter construction of gates with leaves up to 6 feet wide, use 1-1/2-inch Schedule 40 pipe or 1-1/2-inch square steel tube, and for gates with leaves greater than 6 feet wide, use 2-inch Schedule 40 pipe or 2-inch square steel tube.

B. Braces: Provide the gates with sufficient horizontal and vertical members and bracing to ensure structural stability to prevent sagging and to provide for the attachment of fabric, hardware and accessories. Provide gates with diagonal cross bracing consisting of 3/8-inch diameter adjustable length truss rods where necessary to provide frame rigidity without sag or twist.

C. Cantilever Sliding Gates: Furnish cantilever overhang as follows:

Gate Leaf Size	Overhang
6'-0" to 10'-0"	6'-6"
11'-0" to 14'-0"	7'-6"
15'-0" to 22'-0"	10'-0"
12'-0" to 30'-0"	12'-0"

1. For gates leaf sizes 23'-0" to 30'-0", add one additional 2-inch square lateral support rail welded adjacent to the top horizontal rail. Make the bottom rail of 2" x 4" tubing weighing 1.71 pounds per foot.

2. Provide all cantilever overhang frames having 3/8-inch (galvanized steel) (aluminum) brace rods.

3. Provide the enclosed track made of a combined track and rail aluminum extrusion having a total weight of 3.72 pounds per foot and designed to withstand a reaction load of 2,000 pounds.

4. Provide each gate leaf with two swivel type zinc die cast trucks having four sealed lubricant ball-bearing wheels, 2-inch in diameter by 9/16-inch in width, with two side rolling wheels to insure alignment of the truck in the track. Hold trucks to post brackets by 7/8-inch diameter ball bolts with 1/2-inch shank. Design truck assemblies to take the same reaction load as the track.

5. Install gates on 8.625-inch OD Schedule 40 (galvanized)) posts. Use three posts for single slide gate and four posts for double slide gate.

6. Provide guide wheel assemblies for each supporting post. Provide each assembly consisting of two rubber wheels 4 inches in diameter attached to a post so that the bottom horizontal member will roll between the wheels which can be adjusted to maintain gate frames plumb and in proper alignment.

D. Gate Accessories: Equip gates with hinges, latches, center stops, hasps, holdbacks, and padlocks. Provide hinges, latches, center stops, hasps, and holdbacks that are aluminum. Provide double gates with a center drop bar and gate holdbacks.

E. Latches: Provide gate latches that are positive locking, pivoting type with the padlocking arrangement accessible from either side of the gate.

F. Hinges: Hang all gates on offset hinges to permit swinging the gate through a 180-degree arc to lie, when not obstructed, along and parallel to the line of the fence.

2.7 ATTACHMENTS

A. General: Provide all attachments fabricated of coated to match the fabric as specified for framework, posts and hardware in Subsection 1.03, except provide aluminum hinges and latches.

B. Tension Bars: Provide 3/16-inch by 3/4-inch galvanized carbon steel tension bars attached to the terminal posts by means of beveled edge bands.

C. Truss Rods: Provide 3/8-inch diameter galvanized carbon steel truss rods. Securely mount truss rods between the line post end of the brace rail and the base of the terminal post.

D. Post Tops: Provide post tops of galvanized pressed steel or malleable iron to form weathertight caps for post or tube posts. Make provisions for installation or passage of the top rail.

E. Brace and Tension Bands: Provide galvanized steel brace bands and tension bands, of the "unclimbable" beveled edge type with 3/8-inch diameter square shouldered aluminum carriage bolts, nonremovable from outside of the fence.

F. Rail Couplings: Provide rail couplings of the outside sleeve type, not less than six inches long, self-centering, which allows for expansion and contraction. Provide aluminum galvanized steel rail couplings.

G. Fabric Ties: Provide 9-gauge galvanized steel fabric ties.

H. Hog Rings: Provide 9-gauge wire, aluminum alloy, Type 6061-T6 hog rings.

I. Extension Arms: Provide galvanized pressed steel extension arms for supporting the barbed wire where used. Design the arms with an adequate cross section to withstand without failure or permanent deflection a perpendicular force of 250 pounds applied at the end of the arm when the arm is securely attached to the post. Construct extension arms to be slanted out.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Install all fencing and accessories according to the manufacturer's recommendations. Do not begin installation and erection before final grading is completed, unless otherwise approved.

B. Excavation: Drill or hand excavate (using post hole digger) holes for posts to the diameter and spacing indicated, in firm, undisturbed or compacted soil.

1. If not indicated, excavate holes for each post to the minimum diameter recommended by the fence manufacturer, but not less than four times the largest cross-section of the post.

2. Unless otherwise indicated excavate the hole depths approximately 3 inches lower than the post bottom, with the bottom of posts set not less than 36 inches below the finished grade surface.

C. Tension Wire: Attach the tension wire to the bottom of the fabric by hog rings spaced at 24-inch intervals and to terminal posts by brace bands.

D. Posts: Set posts plumb in concrete encasement at not more than 10-foot centers in the line of the fence with the tops properly aligned. Extend concrete encasement for line posts a minimum of three feet below finish grade with a minimum diameter of ten inches. Extend concrete encasement for terminal, corner and gate posts 40 inches below finished grade, except gate posts for leaves greater than 6 feet, for which extend the encasement 54 inches below grade. Provide the minimum diameter of encasement for terminal, corner and gateposts to be sufficient to provide not less than four inches between any part of the post and the face of the concrete and in no case provide the diameter to be less than 12 inches. Set line posts 32 inches into the concrete and set all other posts 36 inches, except gate posts for leaves greater than 6 feet wide, which are to be set 48 inches into the concrete. Slope the top exposed surface of the concrete to shed water and provide a neat appearance.

1. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold posts in position during placement and finishing operations.

a. Unless otherwise indicated, extend the concrete footing 2 inches above grade and trowel to a crown to shed water.

2. Where aluminum is in contact with concrete, coat the aluminum.

E. Fabric Ties: Space fabric ties approximately 12 inches apart on the line posts and 12 inches apart on the rails. (For clips used with C-section posts, use galvanized 11-gauge steel wire.)

F. Fabric: Leave approximately 3 inches between finished grade and the bottom selvage, unless otherwise indicated. Pull the fabric taut and tie to posts, rails, and tension wires. Install the fabric on the security side of the fence, and anchor the fabric to the framework so that the fabric remains in tension after the pulling force is released.

G. Fasteners: Install nuts for tensions bands and hardware bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent nut removal.

END OF SECTION

NO TEXT FOR THIS PAGE

SECTION 329200

RESTORATION BY SODDING OR SEEDING

PART 1 GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

A. The work in this section consists of furnishing all labor, material and equipment to restore all areas disturbed during construction to match preconstruction conditions. Establish a stand of grass within the areas disturbed by furnishing and placing grass sod where required, or by seeding and mulching areas not requiring sod.

1.2 REFERENCE DOCUMENTS

A. Use materials conforming to the requirements of Florida Department of Transportation Standard Specifications for Road and Bridge Construction as follows:

1. Section 570 – Grassing (by Seeding)

2. Section 575 – Sodding

3. Section 981 – Grassing and Sodding Materials

4. Section 982 – Commercial Fertilizer

5. Section 983 – Water for Grassing

1.3 SUBMITTALS

A. Submit certifications and identification labels for all sodding supplied in accordance with General Conditions.

PART 2 PRODUCTS

2.1 SODDING

A. Types: Sod may be of either St. Augustine or Argentine Bahia grass or as that disturbed, as established prior to construction. Use well matted sod with roots. When replacing sod in areas that are already sodded, use sod of the same type as the existing sod.

B. Provide sod as required in accordance with Florida Department of Transportation Specifications 575 and 981. Furnish sod equal to and similar in type as that disturbed. Place and water in accordance with FDOT Specifications Section 575.

C. Use sod in commercial-size rectangles, preferably 12-inch by 24-inch or larger, except where 6-inch strip sodding is called for.

D. Use sod that is sufficiently thick to secure a dense stand of live grass. Use sod that is live, fresh and uninjured at the time of planting, having a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling. It shall be reasonably free of weeds and other grasses. Plant sod as soon as possible after being dug, and shade and keep moist from the time it is dug until it is planted.

E. Handle sod in a manner to prevent breaking or other damage. Do not handle by dumping from trucks or other vehicles. Use care at all times to retain the native soil on the roots of each sod roll during stripping and handling. Sod that has been damaged by handling during delivery, storage or installation will be rejected.

F. Swales: Place sod to the proper grade and cross section in all flow areas to ensure the design flow of water in the ditch. In excavating for the placement of sod, provide a minimum of 3 inches of undercut.

2.2 FERTILIZER

A. Supply chemical fertilizer in suitable bags with the net weight certification of the shipment. Fertilizer shall be 12-8-8 and comply with Section 982 of the FDOT Standard Specification for Road and Bridge Construction.

B. The numerical designations for fertilizer indicate the minimum percentages (respectively) of (1) total nitrogen, (2) available phosphoric acid and (3) water soluble potash, contained in the fertilizer.

C. The chemical designation of the fertilizer shall be 12-8-8, with at least 50 percent of the nitrogen from a nonwater-soluble organic source. The nitrogen source may be a unreaformaldehyde source provided it is not derived from a waste product of the plastic industry.

2.3 EQUIPMENT

A. Spread fertilizer uniformly at the specified rate.

2.4 NETTING

A. See County Approved Product List, Appendix F.

2.5 SEEDING

A. Seed all unpaved areas disturbed during construction that do not require sod. Complete all seeding in conformance with FDOT Specifications Sections 570 and 981. Mulch and fertilize the grassed areas shall be mulched and fertilized in accordance with FDOT Specifications.

B. Provide mulch material free of weeds. Mulch shall be oat straw or rye, Pangola, peanut, Coastal Bermuda, or Bahia grass hay.

C. All seeds must have been tested within 6 months of planting. Submit a seed bag tag with final payment requests from each type or mixture of seed used.

2.6 TOPSOIL

A. Topsoil stockpiled during excavation may be used. If additional topsoil is required to replace topsoil removed during construction, it shall be obtained off site at no additional cost to the COUNTY. Topsoil shall be fertile, natural surface soil, capable of producing all trees, plants, and grassing specified herein.

2.7 MULCH

A. Furnish small grain straw mulch. Apply mulch at a rate of 1.5 tons per acre, corresponding to a depth not less than 1-inch or more than 3-inches according to texture and moisture content of mulch material. Apply asphalt emulsion at a rate of 150 gallons per ton of straw to anchor the straw applied.

2.8 WATER

A. It is the CONTRACTOR'S responsibility to supply all water to the site, as required during seeding and sodding operations and through the maintenance period and until the work is accepted. Make whatever arrangements may be necessary to ensure an adequate supply of water to meet the needs for the work. Furnish all necessary hose, equipment, attachments, and accessories for the adequate irrigation of lawns and planted areas as may be required. Water shall be suitable for irrigation and free from ingredients harmful to plant life.

2.9 SOIL IMPROVEMENTS

A. Apply lime at the rate of 1 to 1.5 tons per acre. Apply 10-10-10 commercial fertilizer at the rate of 800 pounds per acre and work well into the top inch of topsoil.

PART 3 EXECUTION

3.1 SOD BED PREPARATION

A. Clear areas to be sodded and/or seeded of all rough grass, weeds, and debris, and bring soil to an even grade.

B. Thoroughly till soil to a minimum 4-inch depth.

C. Bring area to proper grade, free of sticks, stones, or other foreign matter over 1-inch in diameter or dimension. The surface shall conform to finish grade, less the thickness of sod, free of water-retaining depressions, the soil friable and of uniformly firm texture.

3.2 INSPECTION

A. Verify that soil preparation and related preceding work has been completed.

B. Do not start work until conditions are satisfactory.

3.3 SOD HANDLING AND INSTALLATION

A. During delivery, prior to planting, and during the planting of sod areas, protect the sod panels at all times from excessive drying and unnecessary exposure of the roots to the sun. Stack sod during construction and planting so as not to be damaged by sweating or excessive heat and moisture.

B. After completion of soil conditioning as specified above, lay sod panels tightly together so as to make a solid sodded lawn area. On mounds and other slopes, the long dimension of the sod shall be laid perpendicular to the slope. Immediately following sod laying, roll the lawn areas with a lawn roller customarily used for such purposes, and then thoroughly water.

C. Place sod at all areas where sod existed prior to construction, on slopes of 3 horizontal to 1 vertical (3:1) or greater, in areas where erosion of soils will occur, and as directed by the ENGINEER. On areas where the sod may slide, due to height and slope, the ENGINEER may direct that the sod be pegged, with pegs driven through the sod blocks into firm earth, at suitable intervals.

3.4 USE OF SOD ON ROADWAY PROJECTS

A. In accordance with the FDOT District One Standard Practice, establish permanent green grass at the completion of roadway construction and maintenance work. The following shall apply to all restoration involving State or County roadways:

1. Use sod in lieu of seed and mulch on all roadways with urban (raised curb) typical sections.

2. One inch water per week shall be required for a minimum of four (4) consecutive weeks for the purpose of establishing sod. This can be waived during construction, if and only if there is a minimum of one inch of rain per week on all sod on the project.

3. Placed sod on slopes 1:3 or greater. Stake sod on slopes 1:2 or greater.

4. On all curves with superelevation, place sod from the edge of pavement to the toe of slope on the downhill side(s) for the entire length of the superelevated roadway. On multi-lane divided rural facilities, place sod in the median and on the inside of the curve in the superelevated areas. This does not apply to reverse crowns.

5. Use sod for all projects with less than 10,000 square yards grass area.

6. On tangent sections and on outside of curves, use sod between the edge of pavement and a point 4 feet beyond the shoulder break point.

7. The entire width of sod should not exceed 15 feet from the edge of pavement.

8. Sod is to be used to eliminate narrow seed and mulch areas. Sod areas less than 6 feet in width.

9. Place sod around drainage structures as per the standard Indexes and extend to the edge of pavement.

3.5 SOD MAINTENANCE

A. The sod shall produce a dense, well-established growth. Repair and re-sod all eroded or bare spots until project acceptance. Repair to sodding shall be accomplished as in the original work.

B. Perform sufficient watering to maintain adequate moisture for optimum development of the seeded and sodded areas, and no less than 1.5 inches of water per week for at least 2 weeks. Thereafter, apply water for a minimum of 60 days as needed until the sod takes root and starts to grow or until final acceptance, whichever is latest.

3.6 GUARANTEE

A. Guarantee a live and vigorous stand of permanent grass at the time of acceptance of the work consisting of 80 percent minimum coverage for seeded grass areas with no bare spots greater than 5 square feet.

3.7 CLEANING

A. Remove debris and excess materials from the project site.

END OF SECTION

SECTION 330503

POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for providing buried PVC pipe, fittings and appurtenances.

1. Provide PVC pipe and fittings complete with all necessary jointing facilities and materials, specials, adapters and other appurtenances required for installation in and completion of the pipelines to be constructed.

2. Provide plain end or rubber gaskets (push-on or mechanical joint) of the types, sizes and classes shown or specified.

B. Related Work Specified In Other Sections Includes:

1. Section 022501 – Leakage Tests

2. Section 025400 – Disinfection

3. Section 330504 – Ductile Iron Pipe and Fittings

4. Section 330518 – Laying and Jointing Buried Pipelines

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM D3034 - Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings

2. ASTM F679 - Polyvinyl Chloride (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings

3. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. through 60 In., for Water Distribution

4. AWWA C907 - Polyvinyl Chloride (PVC) Pressure Fittings for Water - 4 In. through 8 In.

5. ASTM D2321 - Underground Installation of Flexible Thermoplastic Sewer Pipe

6. ASTM F477 - Elastomeric Seals (Gaskets) For Joining Plastic Pipe

7. ANSI A21.10 - Ductile-Iron and Gray-Iron Fittings 3 inches through 48 inches, for Water and Other Liquids

8. ANSI A21.11 - Rubber-Gasket Joints for Ductile-Iron and Gray Iron Pressure Pipe and Fittings

9. Uni-Bell B-11

1.3 SYSTEM DESCRIPTION

A. Gravity Sewer Pipe - PVC pipe shall be of the integral wall bell and spigot joint type, which meets or exceeds all requirements set forth in ASTM D3034, latest revision. Minimum wall thickness shall conform to ASTM SDR 26. PVC pipes used for gravity sewers shall be green in color. Fittings shall be made of PVC plastic as defined by ASTM SDR 26 1784, latest revision. Flexible gasketed joints shall be compression type conforming to ASTM D3201, latest revision. Elastomeric joint gaskets shall conform to ASTM F477, latest revision. At all conflict crossings using 4"-12" substitute C900 PVC, Class 305, DR 14 and for PVC pipe 14" and larger use C900 PVC, Class 235, DR 18.

B. Force Main Pipe – PVC pipe meeting the latest revision of AWWA C900 shall be provided. For installation of 4" – 12" pipe, the pressure class shall be 235 with a DR of 18. For installation of 14" – 24" pipe, use pressure class 165, DR 25, meeting or exceeding the requirements of Uni-Bell B-11. PVC pipes used for force mains shall be green in color. Outside diameters shall be equivalent to ductile iron pipe of the same nominal size. Joints between successive lengths of straight PVC pipe shall be compression type using a single elastomeric gasket, per ASTM C-3139 and F477. Fittings for C900 pipe shall be C900 rated PVC. Joint restraint devices shall be provided for horizontal or vertical alignment changes using uni-flange type collars, epoxy coated, with high strength, and low alloy hardware (see County Approved Product List, Appendix F). PVC pipe direct buried beneath roadways, parking lots or parking lot entrances shall meet AWWA Specification C900, latest revision. All 4" to 12" pipe in such locations shall be a minimum of Class 305, DR 14, and all 14" to 24" pipe shall be a minimum of Class 235, DR 18. Pressure Class 250 ductile iron pipe may be used instead of PVC in these locations if approved by the County Manager or designee.

C. Potable, Raw and Non-Potable Irrigation Water Main Pipe - PVC shall conform to AWWA Specification C900, latest revision. All 4" to 12" pipe shall be a minimum of Class 235, DR 18 and all 14" to 24" pipe shall be a minimum of Class 165, DR 25 and shall meet or exceed Uni-Bell B-11. All potable water pipe shall bear the seal of the National Sanitation Foundation (NSF) for potable water pipe. All pipe shall be marked with the manufacturer's name, nominal size, type of plastic and pressure rating. All PVC pipe used for potable water lines shall be predominately

blue in color. Underground PVC pipes used for potable water lines shall be solid-wall blue pipe, will have a co-extruded blue external skin, or will be white or black pipe with blue stripes incorporated into, or applied to, the pipe wall. PVC pipes used for raw water shall be white in color. PVC pipes used for non-potable irrigation, reclaimed or reuse water shall be purple in color. Pipe O.D. shall be equivalent to cast iron pipe of the same nominal size. PVC pipe direct buried beneath roadways, parking lots or parking lot entrances shall meet AWWA Specification C900, latest revision. All 4" to 12" pipe in such locations shall be a minimum of Class 305, DR 14, and all 14" to 24" pipe shall be a minimum of Class 235, DR 18. Pressure Class 250 ductile iron pipe may be used instead of PVC in these locations if approved by the County Manager or designee.

D. Provide pipe of the various sizes and classes as specified in the schedule or shown. Restrain all pressure pipe joints.

E. Construct concrete encasements only with written permission from the Water Director.

1.4 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. Submit the following shop drawings:

1. Pipe joints, fittings, sleeves and cleanouts. Where special designs or fittings are required, show the work in large detail and completely describe and dimension all items.

2. Fully dimensioned drawings of piping layouts, including fittings, couplings, sleeves, cleanouts, valves, supports and anchors. Label pipe size, materials, type, and class on drawings and include the limits of each reach of restrained joints. Provide cross sections showing elevations of cleanouts, pipes, fittings, sleeves, and valves.

3. Catalog data for pipe, joints, fittings, sleeves, harnessing and cleanouts.

C. Quality Control: Submit certificate of compliance for pipe, fittings, gaskets, coatings, specials, sleeves and cleanouts in accordance with this Section.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all pipe, fittings and appurtenances as specified in Division 1 and Section 330518.

PART 2 PRODUCTS

2.1 MATERIALS

A. PVC Pipes and Fabricated Fittings: PVC pipe and fabricated fittings shall be made from virgin PVC resin that has been compounded to provide physical and chemical properties that equal or exceed cell class 12454-B as defined in ASTM D1784, and shall qualify for a hydrostatic design basis of 4,000 psi (27.58 MPa) at 73.4°F (23°C) per the requirements of PPI TR-3.

B. Fittings for Pressure Pipe: Provide all fittings meeting the requirements of Sections 330504.

C. Joints and Fittings for Gravity Sewer Pipe: Provide all fittings meeting the requirements of ASTM D 3034 and ASTM F 679. Provide joints that are a molded integral part of the pipe section. Do not use joints or couplings furnished loose. Provide joints with elastomeric gasket joints.

D. Joints for Pressure Pipe: Provide pipe with bell ends in accordance with AWWA C900. Provide joints with elastomeric gasket joints.

E. Elastomeric Gasket Joints: Provide elastomeric gasket joints in accordance with ASTM F 477.

F. Rubber Gasket Joints: Provide mechanical joints meeting the requirements of ANSI A21.11.

G. Color: Provide pipe made of 100 percent of the color specified. Provide green sewer or force main pipe. Provide blue potable water pipe. Provide white raw water pipe. Provide purple non-potable irrigation, reclaimed or reuse water pipe.

H. Pipe Marking: Provide mark on each pipe at internals of 5 feet or less to designate compliance with applicable ASTM or AWWA specification.

I. Temporary Bulkheads: Provide temporary bulkheads at the ends of sections where adjoining pipelines have not been completed and are not ready to connect.

1. Remove all temporary bulkheads when they are no longer needed.

J. Date of Manufacturer: Provide pipe and fitting manufactured no earlier than 12 month period proceeding the date of the Agreement.

K. Wall Thickness for Pressure Pipe:

1. 4 through 12 inches diameter – provide AWWA-C900 DR 14, Class 305 for pressure pipe installed under pavement.

2. 14 through 24 inches diameter – provide AWWA-C905 DR 18, Class 235 for pressure pipe installed under pavement.

L. Restraining Devices: Joint restraining devices (see County Approved Product List, Appendix F) shall be placed at all bends, tees, plugs, reducers, and other fittings to provide lateral support, and shall conform to the Collier County Standard Details. Concrete thrust blocks shall only be utilized if approved by Collier County Utilities.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all buried PVC pipe and fittings in accordance with the manufacturer's recommendations, approved shop drawings, as specified in Division 1, and Section 330518. For horizontal directional drilling of Fusible PVC, see Section 330502 for casing and execution requirements.

3.2 LEAKAGE TESTING

A. Cleaning: Flush clean and test all pipes after installation.

B. Testing: Test pipes for leaks and repair or tighten as required.

C. Procedures: Conduct tests in accordance with Section 022501.

3.3 DISINFECTION

A. General: Disinfect all pipelines that are to carry potable water before they are placed in service as specified in Section 025400.

3.4 SCHEDULES

A. Refer to the Schedules contained in Section 330518 Laying and Jointing Buried Pipelines for information on the piping that is to be constructed using the pipe materials and methods specified herein.

END OF SECTION

NO TEXT FOR THIS PAGE

SECTION 330518

LAYING AND JOINTING BURIED PIPELINES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Installation of all underground pipelines. Provide pipeline materials, coatings and linings as specified and pipe of the types, sizes and classes shown or specified.

1. Use proper and suitable tools and appliances for the safe and convenient cutting, handling, and laying of the pipe and fittings.

2. Use suitable fittings where shown and at connections or where grade or alignment changes require offsets greater than those recommended and approved.

3. Lay all underground pipelines not supported on piles or concrete cradle in select fill bedding material.

4. Close off all lines with bulkheads when pipe laying is not in progress.

B. Related Work Specified in Other Sections Includes:

1. Section 022501 – Leakage Tests

2. Section 025400 – Disinfection

3. Section 312316 – Excavation - Earth and Rock

4. Section 312319 – Groundwater Control for Open Excavation

5. Section 312323 – Backfilling

6. Section 330502 – High Density Polyethylene (HDPE) Pipe and Fittings

7. Section 330503 - Polyvinyl Chloride (PVC) Pipe and Fittings

8. Section 330504 - Ductile Iron Pipe (DIP) and Fittings

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM D 2774 - Practice for Underground Installation of Thermoplastic Pressure Piping

2. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances

3. ASTM A 307 - Specification for Carbon Steel Bolts and Studs, 60000 psi Tensile

4. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, C25, 125, 250, 800

5. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges

6. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

7. AWWA C115/A21.15 - Flanged Ductile-Iron Pipe With Threaded Flanges

8. Uni-Bell - Handbook of PVC Pipe

9. Collier County - Utilities Standards and Procedures Ordinance

1.3 DELIVERY, STORAGE AND HANDLING

A. General: Deliver, store and handle all products and materials as specified in Division 1 and as follows:

B. Transportation and Delivery: Take every precaution to prevent injury to the pipe during transportation and delivery to the site.

C. Loading and Unloading: Take extreme care in loading and unloading the pipe and fittings.

1. Work slowly with skids or suitable power equipment, and keep pipe under perfect control at all times.

2. Under no condition is the pipe to be dropped, bumped, dragged, pushed, or moved in any way that will cause damage to the pipe or coating.

D. Sling: When handling the pipe with a crane, use a suitable sling around the pipe.

1. Under no condition pass the sling through the pipe. Interior of pipe is to be kept free of dirt and foreign matter at all times.

2. Use a nylon canvas type sling or other material designed to prevent damage to the pipe and coating.

3. When handling reinforced concrete pipe or uncoated steel or ductile iron pipe, steel cables, chain or like slings are acceptable.

E. Damaged Piping: If in the process of transportation, handling, or laying, any pipe or fitting is damaged, replace or repair such pipe or pipes.

F. Blocking and Stakes: Provide suitable blocking and stakes installed to prevent pipe from rolling.

1. Obtain approval for the type of blocking and stakes, and the method of installation.

G. Storage for Gaskets: Store gaskets for pipe joints in a cool place and protect gaskets from light, sunlight, heat, oil, or grease until installed. Store gaskets in a sealed container (such as a vented drum). When long-term storage with exposure to direct sunlight is unavoidable, PVC pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excessive heat accumulation (Uni-Bell PVC Handbook).

1. Do not use any gaskets showing signs of cracking, weathering or other deterioration.

2. Do not use gasket material stored in excess of six months without approval.

1.4 FIELD CONDITIONS

A. Repair of Sanitary Sewers and Services: Rebed, in compacted select fill material, sanitary sewers which cross over the new pipe or which cross under the new pipe with less than 12 inches clear vertical separation. Compact the bedding to densities required for new pipeline construction and extend bedding below the sewer to undisturbed earth. Reconstruct sewers damaged by pipeline construction.

1. Furnish and install all materials and do all work necessary for the reconstruction or repairs of sanitary sewers and services.

2. Provide pipe for reconstruction of sanitary sewers and services meeting the appropriate specification requirements.

3. Provide pipe of the same size as the existing sewer or when the same size is not available, use the next larger size of pipe. Obtain approval of joints made between new pipe and existing pipe.

PART 2 PRODUCTS

A. The materials allowed for buried sewer pipes are PVC, HDPE or Ductile Iron Pipe.

PART 3 EXECUTION

3.1 PREPARATION

A. Dry Trench Bottoms: Lay pipe only in dry trenches having a stable bottom.

1. Where groundwater is encountered, make every effort to obtain a dry trench bottom in accordance with Section 312319.

2. Perform trench excavation and backfill in accordance with Sections 312316 and 312323.

3.2 INSTALLATION

A. General: Install all piping in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1. Where pipe joint deflections are used, do not exceed 80 percent of the maximum deflection limits shown in AWWA C600. Gravity systems shall contain no joint deflection.

1. Arrange miscellaneous pipelines, which are shown in diagram form on the Plans, clear of other pipelines and equipment.

2. Gravity systems shall not contain vertical dips greater than one and a half inches (1.5”).

B. Code Requirements: Provide pipeline installations complying with AWWA C600 for iron pipe, AWWA Manual M11 for steel pipe, ASTM D 2774 for thermoplastic pressure piping, and as modified or supplemented by the Specifications.

C. Pipe Laying - General:

1. Thoroughly inspect all pipe for damage and cleanliness. If found to be defective, tag, remove and replace pipe with satisfactory pipe or fittings at no additional charge to COUNTY.

2. Generally, lay all pipe with bells pointing ahead.

3. Carefully place all pipe, pipe fittings, valves and hydrants into trench by means of a derrick, ropes or other suitable tools or equipment in such a manner as to prevent damage and check for alignment and grade.

4. Make adjustments to bring pipe to line and grade by scraping away or filling in select fill material under the body of the pipe.

5. Wedging or blocking up the pipe barrel is not permitted.

6. Bring the faces of the spigot ends and the bells of pipes into fair contact and firmly and completely shove the pipe home.

7. As the work progresses, clean the interior of pipelines of all dirt and superfluous materials of every description.

8. Keep all lines absolutely clean during construction.

9. Lay pipelines accurately to line and grade.

10. During suspension of work for any reason at any time, a suitable stopper shall be placed in the end of the pipe last laid to prevent mud or other material from entering the pipe.

D. Pipe Laying - Trenches:

1. Carefully lay all pipelines in trench excavations piece by piece using suitable tools or equipment on select fill bedding (refer to Utilities Standards and Procedures Ordinance, Section 9.1.2), concrete cradle or other foundations as shown, specified or ordered in writing. Prevent damage to materials, protective coatings and linings.

2. Do not dump or drop pipe or pipe materials into trench.

3. Properly secure the pipe against movement and make the pipe joints in the excavation as required.

4. Carefully grade and compact pipe bedding.

5. Bell Holes:

a. Cut out bell holes for each joint as required to permit the joint to be properly made and allow the barrel of the pipe to have full bearing throughout its length.

b. Thoroughly tamp bell holes full of select fill material following the making of each joint to provide adequate support to the pipe throughout its entire length.

E. Other Foundations: Install pipelines laid on other types of foundations as specified for such other foundations or as ordered in writing.

F. Field Cuts of Pipelines: For shorter than standard pipe lengths, make field cuts in a manner producing a cut square and perpendicular to the pipe axis. Remove any sharp, rough edges which otherwise might injure the gasket.

G. Procedure for sealing cut ends and repairing field damaged areas of polyethylene lined pipe and fittings is as follows:

1. Remove burrs caused by field cutting of ends or handling damage and smooth out edge of polyethylene lining if made rough by field cutting or handling damage.

2. Remove oil or lubricant used during field cutting operations.

3. Areas of loose lining associated with field cutting operation must be removed and exposed metal cleaned by sanding or scraping. For larger areas, remove loose lining and dirt, then roughen bare pipe surface by scratching or gouging with a small chisel to provide an anchor pattern for the epoxy. It is recommended that the polyethylene lining be stripped back by chiseling, cutting, or scraping about 1 inch to 2 inches into well adhered lined area before patching. This ensures that all areas of undercutting have been removed. Be sure to roughen an overlap of 1 inch to 2 inches of polyethylene lining in area to be epoxy coated. This roughening should be done with a rough grade emery paper (40 grit), rasp, or small chisel. Avoid honing, buffing, or wire brushing since these tend to make surface to be repaired too smooth for good adhesion.

4. With area to be sealed or repaired clean and suitably roughened, apply a thick coat of a two-part coal tar epoxy (see County Approved Product List, Appendix F). The heavy coat of epoxy must be worked into the scratched surface by brushing. Mixing and application procedure for the epoxy must follow the epoxy manufacturer's instructions.

5. It is important that the entire freshly cut, exposed metal surface of the cut pipe be coated. To ensure proper sealing, overlap at least 1 inch of the roughened polyethylene lining with this two-part epoxy system.

H. Ductile Iron Pipe Mechanical Joints:

1. Assembly: In making up mechanical joints, center the spigot in the bell.

   a. With a wire brush just prior to assembly of the joint thoroughly brush 8 inches outside of spigot and inside of bell with which the rubber gasket comes in contact. Remove all oil, grit, tar (other than standard coating) and other foreign matter from joint.

   b. Brush lubricant over the gasket just prior to installation. (Note: There is only one rubber gasket size for each diameter of pipe.)

   c. Press the gasket into place within the bell and move the gland into position, bolts inserted, and the nuts tightened finger tight.

   d. Tighten the nuts with a torque wrench so that the gland is brought up toward the pipe evenly. Torque wrenches shall be set as specified in AWWA C111. Spanner type wrenches not longer than specified in

AWWA C111 may be used with the permission of County Manager or designee.

e. Tighten all nuts 180 degrees apart alternately in order to produce equal pressure on all parts of the gland.

2. Torques: Apply the following range of bolt torques:

Size Inches	Range of Torque - ft. lbs
5/8	40 - 60
3/4	60 - 90
1	70 - 100
1-1/4	90 - 120

3. Remaking of Joints: If effective sealing is not obtained at the maximum torque listed above, disassemble and reassemble the joint after thorough cleaning.

I. Ductile Iron Pipe Rubber Gasket Joints:

1. Assembly: In making up the rubber gasket joint, brush the gasket seat in the socket thoroughly with a wire brush and wipe the gasket with a cloth.

a. Place the gasket in the socket with the large round end entering first so that the groove fits over the bead in the seat.

b. Apply a thin film of lubricant (AWWA C600) to the inside surface of the gasket that will come in contact with the entering pipe.

c. Brush the plain end of the pipe to be entered thoroughly with a wire brush and place it in alignment with the bell of the pipe to which it is to be joined.

d. Exert sufficient force on the entering pipe so that its plain end is moved past the gasket until it makes contact with the base of the socket to make the joint.

2. Positioning: Before proceeding with backfilling, feel completely around the joint using a feeler gauge to confirm that the gasket is in its proper position.

a. If the gasket can be felt out of position, withdraw the pipe and examine the gasket for cuts or breaks.

b. If the gasket has been damaged, replace it with a new one before re-installing the pipe.

3. Optional Mechanical Joints: Use mechanical joint fittings that meet the requirements of Section 330504 with the rubber gasket joint pipe when specified or when rubber gasket fittings are not available.

J. Temporary Bulkheads: Provide temporary bulkheads at the ends of sections where adjoining pipelines have not been completed, and in connections built into pipelines where adjoining pipelines or structures have not been completed and are not ready to be connected.

1. Remove bulkheads encountered in connecting sewers or structures included in this Contract, or in pipelines or structures previously built, when they are no longer needed or when ordered.

K. Temporary Blow-Off Assembly: Dead-end water lines shall be temporarily ended with a blow-off as shown in Collier County Standard Details. After full bore flush replace with a fire hydrant meeting the requirements of Section 331619.

L. Sleeve Type Couplings: For sleeve type couplings, equally tighten diametrically opposite bolts on the connection so that the gaskets will be brought up evenly all around the pipe.

1. Torque Wrenches: Do the final tightening with torque wrenches set for the torque recommended by the coupling manufacturer.

M. Concrete Encasement: Concrete encasement shall be constructed in accordance with Collier County Standard Details when:

1. A potable water main crosses at a depth that provides less than 18 inches clear distance from sewer lines in which case a Deviation Form request should be completed. Encase the sewer main unless specifically approved by Collier County Utilities. Encasement shall extend a minimum 10 feet on each side of the point of crossing. Pressure test both pipelines to 150 psi after the concrete has properly cured.

2. A water main running parallel to a sewer line provides less than 10 feet separation from sewer lines, in which case a Deviation Form Request needs to be completed. Encase the sewer main unless specifically approved by Collier County Utilities.

3. The ENGINEER has ordered the line encased. NO POTABLE WATER MAIN SHALL BE ENCASED IN CONCRETE UNLESS SPECIFICALLY AUTHORIZED BY THE COUNTY MANAGER OR DESIGNEE.

The points of beginning and ending of pipe encasement shall be not more than 6 inches from a pipe joint to protect the pipe from cracking due to uneven settlement of its foundation or the effects of superimposed live loads.

N. Valve Box Setting: Install valve boxes vertical and concentric with the valve stem.

1. Adjust valve-box to final grade at the time designated by the County Manager or designee.

2. Build a collar, as shown in the standard details, 18 inches by 18 inches by 6 inches or 24 inch diameter round by 6 inches flush to grade of top of box. Similar collar shall be poured flush with grade and top of unpaved areas.

3. Satisfactorily reset any valve box that is moved from its original position, preventing the operation of the valve.

4. Replace any valve box that has been damaged.

O. Identification:

1. Metallized Warning Tape: For DIP and PVC pipe (other than gravity sewer pipe and laterals) to be installed, 3-inch detectable marking tape, of appropriate color and appropriate warning statement, shall be placed along the entire pipe length. In all cases, marking tape shall be installed two feet (2') below grade or one-half the pipe's bury, whichever is less, during backfill operations (refer to Utilities Standards Manual Section 1 – 1.1 and 2.2.1). All PVC pipe, PVC fittings, and identification tape shall be color-coded per Collier County Standards. HDPE pipe installed by horizontal directional drilling will not be required to be marked with metalized warning tape.

2. Electronic Markers (see County Approved Product List, Appendix F): Install electronic markers twenty-four inches (24") below final grade, above pipe, at all bends or changes in alignment and every two hundred and fifty feet (250') along the pipe between bends.

P. Separation From Other Pipe Systems:

1. Parallel Water and Sewer or Non-Potable Lines: Sanitary sewer lines, storm sewers or force mains shall be separated from water mains by a minimum clear vertical distance of 18 inches and a horizontal distance of 10 feet. Non-potable, reclaimed or reuse water mains shall be separated from water mains, gravity sewers or force mains by a minimum clear vertical distance of 18 inches and a horizontal distance of 5 feet center to center or 3 feet outside to outside. When this standard cannot be maintained, the sewer line shall be concrete encased for a distance of 10 feet each way from the water line and any other conduit, with a minimum vertical clearance of 12 inches being provided at all times. See Section 1 - Design Criteria, Subsection 1.2.3.

2. Crossing Water and Sewer or Non-Potable Lines: Water mains crossing over a sewer or non-potable water line shall be (bottom of water main to top of sewer) separated by at least 18 inches unless local conditions or barriers

prevent an 18 inch vertical separation. All crossings with vertical clearance less than 18 inches shall be made using sewer pipe thickness Class 200 AWWA C900 PVC pipe, and water pipe of Class 51 Ductile iron pipe, for a distance of 10 feet on each side of the crossing. The gravity sewer pipe in these locations shall be backfilled with USCS Class I bedding stone to a height of 6 inches above the crown of the pipe. When water mains cross under a sewer, both mains shall be constructed of C900 Class 200 PVC pipe with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing with no intermediate joints. Additionally, a section of water main pipe shall be centered at the point of crossing. See Section 1 – Design Criteria, Subsection 1.3.

Q. Aerial Crossings:

1. Pipes spanning elevated pier crossings shall be flanged ductile iron Pressure Class 350 pipe conforming to AWWA C115, C150 & C151. Pipe spanning on piers spaced further apart than normal pipe length of 18 or 20 ft. shall be multiple length pipe with interior flanged joints with a rubber gasket pipe (see County Approved Product List, Appendix F). The pipe wall thickness and flanged joints shall be designed to safely span the elevated piers under working pressure without exceeding the allowable stresses and conform to AWWA C150. Limit pipe deflection at center of span with pipe full of water to 1/720 of span length. Provide expansion joints for between above ground and below ground wastewater lines.

2. Flanges shall conform to AWWA C150 and C115. All bolts and nuts used in aerial crossings shall be 304 stainless steel. Gaskets shall be full faced or recessed "O-Ring" type to prevent leaks in pipe under stress in the aerial crossing.

3. Outside surface of all pipe, flanges or spool pieces shall be shop coated with zinc primer, High Build Epoxy protective coat and a finish coat of polyurethane high gloss. Color shall be Federal Safety Blue for potable water mains and Pantone Purple 522 C for non-potable irrigation water mains.

4. Install operating valves or other flow regulating devices on each shoreline or at a safe distance from each shoreline to prevent discharge in the event the line is damaged.

5. Install supports for all joints in pipes utilized for aerial crossings and to prevent overturning and settlement. Expansion jointing is specified between above ground and below ground sewers and force mains.

3.3 FIELD QUALITY CONTROL

A. Testing: Test pipelines in accordance with Section 022501.

1. Test valves in place, as far as practicable, and correct any defects in valves or connections.

2. Gravity Sewer Lines: Test in accordance with Section 022501

B. Inspection: Clean, inspect, and examine each piece of pipe and each fitting and special for defects before it is installed.

1. Cut away any lumps or projections on the face of the spigot end or the shoulder.

2. Do not use any cracked, broken, or defective pieces in the work.

3. If any defective piece should be discovered after having been installed, remove and replace this piece with a sound piece in a satisfactory manner at no increase in Contract Amount.

3.4 CLEANING

A. General: Thoroughly clean all pipe before it is laid and keep it clean until it is accepted in the completed work.

B. Removal of Materials: Exercise special care to avoid leaving bits of wood, dirt, and other foreign particles in the pipe. If any particles are discovered before the final acceptance of the work, remove and clean the pipe.

3.5 DISINFECTION

A. General: Disinfect all pipelines that are to carry potable water in accordance with Section 025400.

END OF SECTION

NO TEXT FOR THIS PAGE

SECTION 330520

PIPE REMOVAL AND ABANDONMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Removal and abandonment of piping and appurtenances, wholly or in part, as required to complete Work as shown on the Drawings and specified in this Section.

B. Related Work Specified in other Sections Includes:

1. Section 020500 – Connection to Existing Systems

2. Section 033100 – Concrete, Masonry Mortar and Grout

3. Section 312316 – Excavation – Earth and Rock

4. Section 312323 – Backfilling

1.2 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. Submit the following:

1. Proposed methods for pipe removal and abandonment;
2. Equipment proposed to be used to do pipe removal and abandonment work;
3. Resume of pipe grouting subcontractor;
4. Pipe removal and abandonment schedule/sequence.

C. If a detour is required, submit a traffic control plan for approval to County Manager or designee and/or the Florida Department of Transportation as described in Section 015526.

1.3 SITE CONDITIONS

A. General

1. Prior to any work, a proper and approved maintenance of traffic plan (MOT) shall be submitted to the engineer and the County.

2. Execute pipe removal and abandonment so that there is no injury to persons or damage to adjacent buildings, structures, equipment, materials, piping, wiring, pavement, fences, trees, guardrails, and other adjacent improvements. Execute demolition and abandonment so that access to facilities that are in operation and to residences and businesses is free and safe.

3. Execute pipe removal and abandonment so that interference to vehicular traffic and personnel traffic does not exceed scheduled interference. Do not place rubble,

excavation, piping, or other materials removed on roadways, drives, or sidewalks that are to remain in service.

PART 2 - PRODUCTS

2.1 TEMPORARY MATERIALS

A. Provide temporary fencing, barricades, barriers, piping, valves, pumps, power and controls, and water necessary to meet the requirements of this Section.

B. Temporary fencing, barricades, barriers, and enclosures shall be suitable to the purpose intended.

2.2 REPAIR AND REPLACEMENT MATERIALS

For repair or replacement of existing facilities or improvements to remain, use materials identical to, or equal to, materials used in existing work when new.

PART 3 – EXECUTION

3.1 GENERAL

A. Conduct pipe removal and abandonment as shown and specified in the Contract Documents.

B. Conduct pipe removal and abandonment so that existing equipment, piping, wiring, structures, and other improvements to remain are not damaged. Repair or replace equipment, piping, wiring, structures, and other improvements damaged at no additional cost to the County.

C. Do not remove equipment, piping, wiring, structures, or other improvements not shown or specified to be removed. If equipment, piping, wiring, structures, or other improvements not shown or specified to be removed is removed, replace equipment, piping, wiring, structures, or other improvements at no additional cost to the County.

3.2 DISCONNECTIONS

A. Prior to starting pipe removal or abandonment, check underground and exposed existing utilities, piping, and equipment within the limits of pipe removal or abandonment. Prior to starting, check underground and exposed existing utilities, piping connected to and associated with existing pipe to be removed or abandoned. Verify the following:

1. Piping is inactive (abandoned);
2. Other utilities which may be in conflict have been permanently or temporarily disconnected, if required:

B. Do not proceed with salvage or demolition if piping is active or utilities have not been disconnected.

3.3 ABANDONMENT

A. The Contractor shall, as described on the Drawings and as may be directed by the County, abandon in place the following existing utility improvements:

1. All water mains, reuse water mains and raw water mains that are designated to be abandoned shall be filled with grout. Refer to Section 033100 – Concrete, Masonry Mortar and Grout.

2. All sewer lines, force mains, laterals and services that are designated to be abandoned shall be flushed clean and filled with grout. Prior to grout fill, sewer lines, force mains, laterals and services to be abandoned shall be flushed clean to remove wastewater and solids. Contractor is responsible for securing and providing flushing water, collection of flush water/wastewater, and disposal. The cleaning of these piping systems shall comply with all local and DEP requirements.

3. Sewer manholes designated to be abandoned shall have the top two feet removed. The remainder of each manhole shall be abandoned and filled with grout or flowable fill. The excavation or pit shall be backfilled with select fill and compacted in accordance with Section 312323 – Backfilling and the trenching details on the Drawings.

B. Appurtenances: All water hydrants, ARV valves and other appurtenances on abandoned lines shall be removed to the main and the fitting at the main shall be capped or plugged. All valves shall have the valve box, pad and operator removed, with the valve left in the open position unless specifically noted otherwise.

C. Preparation:

1. The County shall be notified at least 72 hours in advance of grouting operations.

2. Bulkheads shall be spaced at intervals of not more than 1,000 feet. If the line to be abandoned is longer, bulkheads shall be inserted in the pipe to maintain the required maximum spacing between bulkheads.

3. Temporary vents shall be installed in the line to be filled at a maximum spacing of 150 ft. The vents shall be capable of being capped to allow further grouting operations.

D. Equipment:

1. The materials shall be mixed or delivered in equipment of sufficient size and capacity to provide the desired amount of grout material for each stage in a single operation. The equipment shall be capable of mixing the grout at densities required for the approved procedure and shall also be capable of changing density as dictated by field conditions any time during the grouting operation.

2. Mixers and Pumps - The grout shall be delivered to the injection point at a steady pressure with a non-pulsating centrifugal or triplex pump. Means shall be provided to increase or decrease the water-cement ratio. The system shall mix the grout to a homogeneous consistency. Means of accurately measuring grout component quantities, pumping pressures, and volumes pumped shall be provided.

3. Pressure Gauges - CONTRACTOR shall provide one pressure gauge at the point of injection and one pressure gauge at the grout pump. Grouting shall not proceed without appropriate calibrated gauges in place and in working order. Pressure gauges shall be equipped with diaphragm seals, have a working range between 1.5 to 2.0 times the design grout pressure, and have an accuracy within 0.5 percent of full range. Pressure gauges shall be instrument oil filled and attached to a saddle-type diaphragm seal to prevent clogging with grout.

E. Grouting:

Once grouting operations begin, grouting shall proceed uninterrupted from bulkhead to bulkhead. Grout placement shall not be terminated until both of the following conditions have been met, unless otherwise approved by the County: a) The estimated volume of grout to fill the line has been injected; and, b) grout has been expelled from the furthest vent or bulkhead. Bulkheads and temporary vents shall not be removed until the grout has set.

F. Testing and Sampling:

1. Take four test specimens for each 50 cubic yards of grout or for each four hours of placing.

2. Test in accordance with ASTM C109 except:

   a. The specimens shall be 3 inch by 6 inch cylinders covered after casting to prevent damage and loss of moisture. Moist cure specimens for a period up to 7 days prior to a 28-day compressive strength test.

   b. Do not oven dry specimens that are load tested. Specimens may be tested at any age to monitor compressive strength. The material may require special handling and testing techniques.

G. The CONTRACTOR may remove the pipe in accordance with the Paragraph 3.04 in lieu of abandonment if acceptable to the County. Such removal, however, will be paid at the same price for pipe abandonment.

H. All work under this Section shall comply with City, County, State and Federal regulations.

3.4 REMOVAL AND DISPOSAL

A. The Contractor shall, as described on the Drawings and as may be directed by the County, remove the following existing utility improvements:

1. All water mains, reuse water mains and raw water mains that are designated to be removed.

2. All sewer lines, sewer manholes, force mains, laterals and services that are designated to be removed shall be flushed clean with water prior to removal. Contractor is responsible for securing and providing flushing water, collection of flush water/wastewater, and disposal. The cleaning of these piping systems shall comply with all local and DEP requirements.

B. The pipe removal and disposal shall include all valves, fittings and appurtenances.

3.5 SALVAGE OF EQUIPMENT, PIPING, AND MATERIALS

A. Remove items identified on the drawings or specified to remain the property of the County. Do not damage equipment, piping, and materials to be salvaged.

B. Following removal or equipment, piping, and materials to be salvaged, place equipment, piping, and materials in a location within the County limits as designated by the County.

3.6 REPAIRS

Repair structural elements, equipment, piping, conduit, and other improvements to remain that are damaged during demolition. Use workers specifically qualified in trade, or trades, involved to repair damaged work.

3.7 DISPOSAL

A. Remove and dispose of all equipment, piping, and materials from the jobsite not specifically designated to be retained by the County.

B. Contractor shall not accumulate or store debris from demolition on the project site.

C. The disposal of the piping, manholes and appurtenances shall be in accordance with County, State and Federal laws.

3.8 BACKFILLING

A. Backfill excavations, trenches, and pits resulting from abandonment and removal according to Section 312323 – Backfilling.

B. Backfill of the pipe trenches shall be according to the County details for pipe trench backfill. Pipe trenches for removed pipes that were within 3 horizontal feet of the edge of pavement shall be backfilled according to the detail for the type of roadway.

3.9 CLEANUP AND CLOSURE

A. Following pipe abandonment or removal, clean-up areas where other work is to be done as specified in this Section, or Sections applicable to work to be done.

B. Following pipe abandonment or removal, clean-up areas where no other work is to be done under this Contract. Remove debris and rubbish, temporary facilities, and equipment. Level surface irregularities to eliminate depressions. Leave work in a neat and presentable condition.

C. In locations where a pipe to be abandoned or removed connects to a pipe that remains in service, the Contractor shall install a suitable cap or plug on the end of the active pipe.

END OF SECTION

NO TEXT FOR THIS PAGE

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. Sleeve-type couplings.
2. Dismantling joint.

B. Related Requirements:

1. Section 400507 “Hangers and Supports for Process Piping”: Hangers, anchors, sleeves, and sealing of piping to adjacent structures.
2. Section 400519 “Ductile Iron Process Pipe”: Ductile-iron piping materials and appurtenances.
3. Section 400551 “Common Requirements for Process Valves”: Common product requirements for valves for placement by this Section.

1.3 DEFINITIONS

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

B. 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.

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.

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 and ASME 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 ASME BPVC-IX and AWS D1.1/D1.1M.
4. American Iron and Steel (AIS): Submit certification indicating compliance with requirements.

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 ASME BPVC-IX and AWS D1.1/D1.1M for welding materials and procedures.

C. Perform Work according to ASME B31.3, ASME B31.9 and applicable codes for installation of piping systems.

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 and ASME qualified within previous 12 months for employed weld types.

D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Florida.

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. Manufacturer's Warranty: Manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SLEEVE-TYPE COUPLINGS

A. Manufacturers: Provide one of the following or equal:

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

B. Description:

1. Comply with AWWA C213, C219.
2. Middle Ring: Steel or ductile iron.
3. Followers: Steel or ductile iron.
4. Gaskets:

a. Material: Buna-N or EPDM compatible with service conditions.
b. Comply with ASTM D2000.

5. Bolts: Type 304 stainless steel.

C. Finishes:

1. Factory fusion bonded epoxy coated.

2.2 DISMANTLING JOINTS

1. Manufacturers: Provide the following manufactured product or equal:

a. ROMAC, Model DJ400.

2. Design Pressure Rating: 150 psi.
3. Manufacturer to provide size and number of harnessing rods to meet design pressure rating.

2.3 FINISHES

A. Prepare piping appurtenances for field finishes as recommended by the manufacturer.

2.4 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.

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. Coating: Finish piping appurtenances as recommended by manufacturer for service conditions.

B. Restrained Joints: Per manufacturers recommendation.

C. Disinfection: Disinfect potable water piping per local code and ordinances.

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. Delegate pipe support design to a pipe support design engineer hired by Contractor. Where Drawings show support types and/or locations, they shall be analyzed for adequacy to support loads and stresses calculated by pipe support designer, modified if required, installed generally where shown, and integrated with pipe support system design provided by Contractor.

B. Related Requirements:

1. Section 033010 “Miscellaneous Cast-in-Place Concrete.”
2. Section 036000 “Grouting.”
3. Section 400506 “Couplings, Adapters, and Specials for Process Piping.”
4. 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 systems, hoses, tubes, fittings, joints, valves, and similar appurtenances.

D. Supports or Pipe Supports: 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 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.

B. Shop Drawings: Submit scaled piping layouts for each system. Indicate flow stream, pipe sizes, materials, schedules, linings, critical dimensions between pipes, equipment, and building features. Indicate by schedule pipe hanger/support type and locations. Provide detail of each type of hangers, supports, anchors, and guides.

1.6 DELEGATED DESIGN SUBMITTALS

A. Support System Design:

1. Engage services of an independent registered professional engineer licensed in State of Florida ordinarily engaged in 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 piping material, pipe joints, valves, and piping appurtenances proposed for use.

    a. Proposed support system engineer shall have at least 5 years of experience in analysis and design of similar systems, including the use of commercial and custom pipe supports and in the use of commercial pipe stress software programs.
    b. 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/.

2. 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 Engineer for review. Submittal needs to be stamped by a professional engineer registered in State of Florida.
    e. All aspects of the analysis and design to comply with the provisions of ANSI B31.3 and the referenced standards.

3. 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.

1.7 INFORMATIONAL SUBMITTALS

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

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

C. Welders' Certificate: Submit welders' certification of compliance with ASME Section IX and AWS D1.1, verifying qualification within previous 12 months.

D. 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. Supports and hangers shall be crated, delivered, and uncrated to protect against any damage.

B. 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 AWS D1.1 for welding hanger and support attachments to building structure.

1.10 QUALIFICATIONS

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

B. Fabricator: Company specializing in fabricating products specified in this Section with minimum five years' documented experience.

C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Florida.

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.

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. Any structural steel members required to brace any piping from excessive dislocation shall conform to the applicable requirements of Section 055000 “Metal Fabrications” and shall be furnished and installed under this Section.

C. 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.

D. 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.

E. 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 on Drawings or as specified.
3. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless specifically directed or authorized by 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.

F. 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.

G. Restraints, flexible connections, expansion items, and related items as included in other specifications (especially Sections 400506 and other individual pipe sections) and shown on Drawings.

2.2 PERFORMANCE REQUIREMENTS/DESIGN CRITERIA

A. 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.

B. Contractor to provide approved piping, valves, fittings, etc. to the support system designer.

C. 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.

D. Support spacing shall be per ASME 31.9.

E. 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.

F. 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. For Support of Metallic Pipe:

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 inches, 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: provide corrosion protection between dissimilar metals.

B. For Support of Non-Metallic Pipe:

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.

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-inches and smaller diameter shall not exceed 5 feet.

B. Copper Piping:

1. Supports for copper pipe shall be copper plated or shall have a 1/16-inch plastic coating.
2. Support spacing for copper piping and tubing 2 inch and smaller diameter shall not exceed 5 feet and greater than 2-inch diameter shall not exceed 8 feet.
3. Where pipe supports come in contact with copper piping, provide protection from galvanic corrosion by: wrapping pipe with 1/16-inch-thick neoprene sheet material and galvanized protection shield; isolators similar to Cooper B-Line B3195CT; or copper-plated or PVC-coated hangers and supports.

C. Non-Metallic Piping:

1. 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 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 inch 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. 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.

D. 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.

E. Support vertical pipes 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. Secure vertical pipes passing through pipe sleeves 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.

1. DO NOTE USE ADHESIVE ANCHOR BOLTS ON ANY PIPE SUPPORT HUNG FROM A ROOF OR CEILING, unless specifically noted otherwise.

B. Post-installed anchors in concrete shall have current published ICC-ES Evaluation Report indicating the anchor is approved for installation in cracked concrete.

C. 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. 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, OK.
c. Wej-it by Wej-it Expansion Products, Inc., Broomfield, CO.

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 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. Base strength of the rod 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 Size for Metallic Rod Hangers:

	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

1. Note *: For pipe diameters less than 14 inch, if using pipe roller, use 2 hanger rods with minimum diameter noted below for pipe's diameter.

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; Cooper B-Line; Gulf State Manufacturing; or Unistrut Northeast, Cambridge, Massachusetts.

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 inches 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 WALL SUPPORTED SINGLE AND MULTIPLE PIPES

A. Single or multiple pipes located adjacent to walls, columns, or other structural members shall be supported using welded steel wall brackets, where use of steel is allowed, as manufactured by Carpenter and Patterson, Figure No. 69, 84, or 139.

B. Where noted, multiple pipes may be supported on C-channel with steel brackets similar to Unistrut pipe clamps; with pipe anchor chairs; or equal.

C. Individual pipes, up to 8-inch diameter, where noted, may use MSS Type 8 pipe clamps as noted on Drawings.

D. Securely fasten all members to wall, column, etc., using double-expansion shields or other method as approved by Engineer. Provide additional wall bearing plates as required.

2.11 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 Engineer.

B. Concrete Supports: Where indicated, securely fasten pipe bends to concrete supports with suitable metal bands as required and approved by Engineer. Isolate piping from poured concrete with a neoprene insert.

2.12 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. 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 inches 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 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 one of the following or equal:

1. Carpenter & Patterson, Figure No. 128.
2. Anvil, Figure 261.
3. Cooper B-Line, Figure B3373.

E. Copper-clad or PVC-coated clamps shall be used on copper pipes. Insulation shall be removed from insulated pipes prior to installing riser clamps. Insulation shall not be damaged by clamp installation.

2.13 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 inches and smaller, framework shall be as manufactured by one of the following or equal:

    a. Unistrut Corporation.
    b. Power-Strut (or Ackinstrut where fiberglass systems are specified).
    c. Multi-Strut by Carpenter-Paterson.

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. 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. Design of each individual framing system shall be the responsibility of 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 2.4, SUPPORT AND RESTRAINT SYSTEMS.

B. Supports not otherwise described in this Section shall be fabricated or constructed from standard structural stainless steel or steel shapes in accordance with applicable provisions of Section 055000 “Metal Fabrications,” or 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 Engineer.

C. Additional Pipe Support Situations:

1. Supporting Multiple Chemical and Related Piping:

a. Location: As indicated on Drawings or otherwise required, especially adjacent to chemical pumps.
b. Use: Framework support.
c. Materials: FRP, with proper local stress protection.

2.14 SHOP FACTORY FINISHING

A. Per manufacturer's recommendations.

2.15 ACCESSORIES

A. Insulation Shield: Install on insulated non-steel piping. Oversize the rollers and supports, as required. Manufacturers: Provide one of the following or equal:

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: Provide one of the following or equal:

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: Provide one of the following or equal:

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 inches 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 recessed into and grouted flush with slab.

D. Pipe Hangers and Supports:

1. Install according to: ASME 31.9.
2. Support horizontal piping as indicated on Shop Drawings, depending upon pipe size.
3. Install hangers with minimum 1/2-inch space between finished covering and adjacent Work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment.
6. Support horizontal cast iron pipe adjacent to each hub, with 5 feet 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. Provide copper-plated hangers and supports for copper piping.
11. Design hangers for pipe movement without disengagement of supported pipe.
12. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
13. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
14. Provide welded steel brackets where piping is to be run adjacent to building walls or columns.
15. Use beam clamps where piping is to be suspended from building steel.
16. Insulated Piping: Provide two bolted clamps designed to accommodate insulated piping.

17. Use offset clamps where pipes are indicated as offset from wall surfaces.
18. 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.
19. 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.
20. Repair mounting surfaces to original condition after attachments are made.
21. Brace horizontal pipe movements by both longitudinal and lateral sway bracing.
22. 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 of concrete, minimum 3-1/2 inch thick and extending 6 inches beyond supported equipment. Comply with Section 033100 “Cast-in-Place Concrete.”

F. Prime Coat:

1. Prime coat exposed steel hangers and supports.
2. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.3 FIELD QUALITY CONTROL

A. Test pipe support systems 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 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. Report shall bear the stamp of a professional engineer registered in State of Florida and shall be subject to the review of Engineer.

3.4 ATTACHMENT SCHEDULE

A. Pipe Hanger Spacing:

1. Pipe Material: ABS.

a. Maximum Hanger Spacing: 4 feet.
b. 3/8 inch.

2. Pipe Material: Aluminum.

    a. Maximum Hanger Spacing: 10 feet.
    b. 1/2 inch.

3. Pipe Material: Cast iron.

    a. Maximum Hanger Spacing: 5 feet.
    b. 5/8 inch.

4. Pipe Material: Cast iron, with 10-foot length of pipe.

    a. Maximum Hanger Spacing: 10 feet.
    b. 5/8 inch.

5. Pipe Material: CPVC.

    a. Size: 1 inch and smaller.
    b. Maximum Hanger Spacing: 3 feet.
    c. 1/2 inch.

6. Pipe Material: CPVC.

    a. Size: 1-1/4 inches and larger.
    b. Maximum Hanger Spacing: 4 feet.
    c. 1/2 inch.

7. Pipe Material: Copper tube.

    a. Size: 1-1/4 inches and smaller.
    b. Maximum Hanger Spacing: 6 feet.
    c. 1/2 inch.

8. Pipe Material: Copper tube.

    a. Size: 1-1/2 inches and larger.
    b. Maximum Hanger Spacing: 10 feet.
    c. 1/2 inch.

9. Pipe Material: Fiberglass.

    a. Maximum Hanger Spacing: 4 feet.
    b. 1/2 inch.

10. Pipe Material: Glass.

    a. Maximum Hanger Spacing: 8 feet.
    b. 1/2 inch.

11. Pipe Material: Polybutylene.

    a. Maximum Hanger Spacing: 2.7 feet.
    b. 3/8 inch.

12. Pipe Material: Polypropylene.

    a. Maximum Hanger Spacing: 4 feet.
    b. 3/8 inch.

13. Pipe Material: PVC.

    a. Maximum Hanger Spacing: 4 feet.
    b. 3/8 inch.

14. Pipe Material: Steel.

    a. Size: 3 inches and smaller.
    b. Maximum Hanger Spacing: 12 feet.
    c. 1/2 inch.

15. Pipe Material: Steel.

    a. Size: 4 inches and larger.
    b. Maximum Hanger Spacing: 12 feet.
    c. 5/8 inch.

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.

B. Related Requirements:

1. Section 400506 “Couplings, Adapters, and Specials for Process Piping”: Piping appurtenances.
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.
4. Section 400553 “Identification for Process Piping.”

1.3 COORDINATION

A. Section 013100 “Project Management and Coordination”: Requirements for coordination.

1.4 PREINSTALLATION MEETINGS

A. Section 013100 “Project Management and Coordination”: Requirements for preinstallation meeting.

1.5 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information regarding pipe and fittings.

B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, and materials lists.

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 or factory 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 centerline] 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.).

1.9 QUALIFICATIONS

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

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 C115, C150, C151.
2. Thickness Class**:** As indicated on Drawings.
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 AWWA C110, ductile iron AWWA C153, ductile iron.

2. Pressure Rating: As indicated on Drawings.
3. Mechanical Joints:

    a. Comply with AWWA C110 and AWWA C111.
    b. Glands: Ductile or Gray iron with asphaltic coating.
    c. Push-on Joints: Comply with AWWA C111.

4. Restrained Joints: Comply with AWWA C111.
5. Flanged Fittings: Comply with AWWA C110 ASME B16.1 Class 125 or Class 250B 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 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 equal.
8. Flanged Coupling Adaptors: Smith-Blair Type 913, or equivalent products of Klamflex Pipe Couplings (PTY) LTD, Robar Industries LTD, or equal.
9. Dismantling joints: ROMAC DJ400 or equal.

C. Cement-Mortar Lining:

1. Comply with AWWA C104.
2. Thickness: Standard.

D. Exterior Coating:

1. Exposed Service: As specified by manufacturer.
2. If required, coatings "hold-backs" 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 Engineer. If, in the opinion of Engineer coating damage is beyond repair, pipe to be replaced at expense of 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. Gaskets:

1. Full face type or ring 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.

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 or commercial sand blasting; SSPC SP 6.
2. Touch up shop-primed surfaces with primer as specified by the manufacturer.
3. Solvent-clean surfaces that are not shop primed.

3.3 INSTALLATION

A. Buried Service Piping:

1. Place bedding material at trench bottom.
2. Level fill materials in continuous layers not exceeding 6 inch compacted depth.
3. Compact to 95 percent of maximum density.
4. Backfill: Around sides and to top of pipe with cover fill, tamp in place, and compact to 95 percent of maximum density.
5. Install ductile iron piping and fittings: in accordance with requirements of the manufacturer and according to AWWA C600 or as otherwise provided herein.
6. As soon as the excavation is complete to normal grade of the bottom of the trench:

a. Place, compact, and grade bedding to provide firm, uniform, and continuous support for the pipe.
b. Excavate bell holes so that only the barrel of the pipe bears upon the bedding. Blocking under the pipe will not be permitted.
c. Place bedding evenly on each side of the pipe to mid-diameter and use hand tools to force the bedding under the haunches of the pipe and into the bell holes
d. Place bedding shall to 12 inch above the top of the pipe.
e. Place backfill above the bedding; placing the initial 3 feet of backfill above the bedding in 1-foot compacted layers.
f. Do not operate directly over the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe.

7. Close ends of the pipe with watertight plugs when installation is not in progress. Prevent deflection, using joints or fittings as required when crossing other utilities.
8. Cut pipes by machine only, leaving a smooth cut at right angles to the axis of the pipe. Bevel pipe to conform to bevels.
9. Check pipe to ensure proper connection with adjoining pipe. Match inverts and grade.
10. Do not drive pipe to grade with excessive force that could damage the pipe. Take all steps to prevent from floating in the trench.
11. When moveable trench bracing such as trench boxes, moveable sheeting, shoring, or plates are used to support the sides of the trench, prevent moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill.
12. Do not extend trench boxes, moveable sheeting, shoring or plates to extend below top of the pipe.
13. Repair or replace defective pipe.

B. 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.
6. Do not use equipment flanges for support; support pipe separately.

C. 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.

D. Make taps to ductile iron piping only with service saddle, tapping boss of a fitting or valve body, or equipment casting.

E. Install piping with sufficient slopes for venting or draining 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 pipe guides as specified in Section 400507 “Hangers and Supports for Process Piping”, to compensate for pipe expansion due to temperature differences.

H. Disinfection: Disinfect potable water piping per local ordinances and codes.

I. Dielectric Fittings: Provide between dissimilar metals.

J. 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 Engineer. Seal Field cut ends approved epoxy coating in accordance with manufacturer's instructions.

K. Finish primed surfaces according to manufacturer’s recommendation.

3.4 TOLERANCES

A. Deflection at joints not to exceed that recommended by the pipe manufacturer.

B. 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.
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. 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. 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 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

Exhibits A and B are included on following pages.

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 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.

B. Related Requirements:

1. Section 400507 “Hangers and Supports for Process Piping” for product and execution requirements for valve supports specified by this Section.
2. Section 400557 “Actuators for Process Valves and Gates.”
3. Section 400563 “Ball Valves.”
4. Section 400564 “Butterfly Valves.”
5. Section 400565.33 “Rubber Flapper Check Valves.”
6. Section 400578.19 “Combination Air Valves for Water Service.”

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. Color palate 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 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.

1.6 QUALITY ASSURANCE

A. Maintain clearances as indicated on Shop Drawings.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Mate valves to actuators at manufacturer's 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. Provide the services of a qualified and factory-trained service representative of the manufacturer to provide installation inspection and check out, and operational and maintenance instruction, for each type of the following equipment for the following durations:

Equipment	Valve Sizes	Installation Inspection	O and M Instruction
480 volt electric actuators	N/A	4 hr.	4 hr.

G. Obtain Manufacturer's Certification of Proper Installation for Specified valves and valve assemblies.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing valves and actuators with minimum five years' documented experience.

B. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Florida.

1.8 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.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to materials ordering or any fabrication.
2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace valves and actuators that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

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. As indicated in valve schedule.
3. Labeling (valve tags):

a. Fiberglass reinforced plastic, ASTM D709, 70 mil thick, 2 1/2-inch diameter or 2 1/2-inch by 1 1/4-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 Type 316 stainless-steel grommets at each end, center of hole 3/8-inch from tag edge.
e. Cable and Splice Hardware: 3/32-inch Type 316 stainless steel.

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 VALVE ACTUATORS

A. Provide actuators in accordance with the valve schedule included herein**.**

B. Provide mechanical position indicators for power actuated and gearbox actuated valves.

C. Comply with AWWA C541 (Pneumatic and Hydraulic actuators) and C542 (Electric Motor Actuators) as applicable.

D. Provide chain actuators for shutoff valves mounted greater than 7 feet above operating floor level.

E. Gear and Power actuators as specified in Section 400557 “Actuators for Process Valves and Gates.”

2.3 FINISHES

A. Valve Coating: Comply with AWWA C550.

B. Factory finishes are included in individual valve Sections.

C. Exposed Valves: As specified by the manufacturer.

D. Stainless Body Valves: Do not coat.

E. Do not coat flange faces of valves unless otherwise specified.

2.4 SOURCE QUALITY CONTROL

A. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

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 option of 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 manufacturer's 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 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 brackets, extension rods, guides, various types of operators, and appurtenances as indicated. Before properly setting these items, check drawings and figures which have a direct bearing on their location.

L. Inspect 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 operating mechanisms for proper functioning. Check 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 gate or 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 “Process Interconnections” for piping materials applying to various system types.

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 presence of Engineer to show the valve operates smoothly from full open to full close and without leakage.
c. Cycle valves equipped with electric, pneumatic, or hydraulic actuators 5 times from full open to full closed in presence of Engineer to exhibit operation without vibration, jamming, leakage, or overheating.
d. Operate pressure control and pressure relief valves in presence of 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 pipe lines 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 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 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. Labels.
6. Lockout devices.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods for valves.

1.3 ACTION 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, or 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 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials: Furnish two containers of spray-on adhesive.

B. Tools: Furnish special crimpers and other devices required for Owner to reinstall tags.

1.6 QUALITY ASSURANCE

A. Piping Color Scheme and Lettering Size: Comply with ASME A13.1.

B. Comply with recommended water treatment plant color coding from the latest version of Ten State Standards unless otherwise requested by Owner.

1.7 QUALIFICATIONS

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

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:

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. Brimar Industries, Inc.; Pipemarker.com.
4. Seton Identification Products.

B. Description: Laminated three-layer plastic with engraved black 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 black 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 valve number and information on valve schedule coded in a system provided by Owner.

B. Metal Tags:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Kolbi Pipe Marker Co.
d. Marking Services, Inc.
e. Brimar Industries, Inc.; Pipemarker.com.
f. R&R Identification Co.
g. Seton Identification Products.

2. Description:

a. Brass or 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 valve number and information on valve schedule coded in a system provided by Owner.

C. Information Tags:

1. Manufacturers:

a. Brady ID.
b. Seton Identification Products.

2. Description:

a. Clear plastic with printed text DANGER, CAUTION, WARNING, or Gas Pictogram per ASMA A13.1 as applicable.
b. Minimum Tag Size: 3-1/4 inches by 5-5/8 inches.
c. Furnish grommet and self-locking nylon ties.

3. Tag Chart: Typewritten, letter-size list of applied tags and location, in anodized aluminum frame.

2.3 STENCILS

A. Manufacturers:

1. Kolbi Pipe Marker Co.
2. Marking Services, Inc.
3. Brimar Industries, Inc.; Pipemarker.com.
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-inch to 1-1/4-inch	1/2-inch
1-1/2-inch to 2-inch	3/4-inch
2-1/2-inch to 6-inch	1-1/2-inch
8-inch to 10-inch	2-1/2-inch
Over 10-inch	3-inch

C. Stencil Paint:

1. Description: Semigloss acrylic 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 Paragraph 2.3, B.
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. Brimar Industries, Inc.; Pipemarker.com.
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 Paragraph 2.3, B.
c. Color shall be white or black depending on background color.

C. Plastic Underground Pipe Markers:

1. Manufacturers:

a. Kolbi Pipe Marker Co.
b. Marking Services, Inc.
c. Brimar Industries, Inc.; Pipemarker.com.
d. Rhino Marking and Protection System.
e. Seton Identification Products.

2. Description:

a. Brightly colored, continuously printed plastic ribbon tape.
b. Minimum Size: 6 inches wide by 4 mils thick.
c. Manufactured for direct burial service.
d. Letter sizes per Paragraph 2.3, B.

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 inches by 0.75 inches.
3. Adhesive backed, with printed identification.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers:

a. Brady ID.
b. Master Lock Company, LLC.

2. Description:

a. Material: Anodized aluminum.
b. Furnish hasp with erasable label surface.
c. Minimum Size: 7-1/4 inches by 3 inches.

B. Valve Lockout Devices:

1. Manufacturers:

a. Brady ID.
b. Master Lock Company, LLC.

2. Description:

a. Material: Steel.
b. Furnish device to restrict access to valve operator and to accept lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. According to manufacturer instructions.

B. Apply stencil painting as specified in Section 099000 “Painting.”

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 400557 - ACTUATORS FOR PROCESS VALVES AND GATES

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: Following types of actuators for linear, multi-turn, and quarter turn valves and gates:

1. Manual actuators.
2. Electric motor actuators.

B. Related Requirements:

1. Section 400507 “Hangers and Supports for Process Piping” for hangers, anchors, sleeves, and sealing of piping to adjacent structures.
2. Section 400551 “Common Requirements for Process Valves” for common product requirements for valves for placement by this Section.
3. Section 400564 “Butterfly Valves.”

1.3 DEFINITION

A. Where the term “valve” alone is used in this Section, it applies to both valves and gates as the corresponding text context dictates.

1.4 COORDINATION

A. Section 400551 “Common Requirements for Process Valves” for valve schedule requirements.

B. Coordinate Work of this Section with installation of valves, gates, and accessories.

1.5 SUBMITTALS

A. Product Data: Manufacturer information for actuator with model number and size indicated.

B. Shop Drawings:

1. Parts list, materials, sizes, position indicators, limit switches, actuator mounting, wiring diagrams, control system schematics with external interfaces on assembly drawings.
2. Actuator Shop Drawings with respective valve submittal.

C. Manufacturer's Certificate: Products meet or exceed specified requirements.

D. Manufacturer Instructions: Special procedures and placement requirements.

E. Source Quality-Control Submittals: Results of factory or shop tests and inspections and provide required certifications.

F. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

G. Qualifications Statements:

1. Qualifications for manufacturer and installer.
2. Manufacturer's approval of installer.

H. American Iron and Steel (AIS): Certification of compliance with requirements

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Documentation of actual locations and types of actuators.

1.7 QUALITY ASSURANCE

A. Valve Actuators in NEC Class I, Group C and D, Division 1 or 2 Hazardous Locations: Comply with NFPA 70.

B. Minimum NEMA Enclosure Classification:

1. Non-submergence Installations: NEMA 4X.
2. Submergence Installations: NEMA 6P/IP68.

C. Maintain a copy of each standard affecting Work of this Section on Site.

D. Single Source Requirements:

1. Furnish electric motor actuators in the scope of the project by the same manufacturer. Coordinate this requirement with actuated valves and gates included in scope of vender furnished equipment.
2. Furnish actuators, floor stands, stem guides, stems, extensions, and accessories for slide gate assemblies by slide gate manufacturer.

E. Mate actuators to equipment at equipment manufacturers or integrators facility.

1. Test assembled product. Certify ready for installation prior to shipment to job site.
2. For extremely large assemblies requiring disassembly for installation, the actuator may be disassembled for shipment and remounted in the field.

1.8 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.

1.9 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.

1.10 EXISTING CONDITIONS

A. Field Measurements:

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

1.11 WARRANTY

A. Manufacturer’s Special Warranty: Submit standard written warranty against manufacturing defects for manual and electric-motor actuators.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to valve and gate schedule for actuator type, accessories, and sizing information.

B. Provide clockwise closed actuation unless otherwise noted on the valve and gate schedule.

C. Supply chain actuators for manual valves located 7 feet or higher above finished floor.

2.2 ACCESSORIES

A. Floor Stands:

1. Materials:

   a. Stand: Cast iron.
   b. Stem Bushing: Sintered bronze.
   c. Position Indicator: Bronze.

2. Height to input shaft or handwheel: 36 inch.
3. Base Mounting Requirements:

   a. Concrete Floor Mounting: Type 316 stainless-steel anchor bolts.
   b. Face of Basin or Offset Mounting: Heavily reinforced, adjustable wall bracket with required anchor hardware using Type 316 stainless-steel.

4. Actuator Mounting Requirements:

   a. Manual Actuator: Cast iron handwheel on top of floor stand with dual ball type thrust bearings, grease fitting on bearing bowl, hardened machined alloy bronze lift nut (for rising stem). Where manual effort is greater than 40 lb. rim pull with 2 feet diameter wheel, provide geared actuator with a handwheel or crank.

      1) Handwheel casting to include the word “OPEN” and an arrow indicating the direction of operation.

   b. Gearbox or Direct Powered Actuator: Through bolt holes matched to actuator or gearbox bolting pattern.

5. Non-rising stem position indicator: Mechanical indicator connected to and driven by stem extension and cast position marks on floor stand with the word “OPEN” cast at the top of the travel, and a field mounted aluminum “CLOSED” tag supplied with drive rivets, installed based on number of valve turns.
6. Rising Stem Position Indicator: Permanent markings on transparent stem covers.

B. Stem Covers: Fracture-resistant clear polycarbonate stem covers for rising stems. Closed top with adhesive type position indicator markings.

C. Extension Stems and Stem Guides:

1. Extension stems and couplings to actuate recessed, buried, below slab valves and gates via operating nut or floor stand mounted actuator.
2. Stem Extensions and Stem Couplings: Alloy steel, hardware of Type 316 stainless-steel unless specified otherwise in the respective slide gate specification.
3. Stem and Stem Couplings: Rated for five times the maximum input torque capacity of the actuator.
4. Adjustable, Cast Iron Wall Bracket Type Stem Guides: Include two-piece bronze UHMW bushing.
5. Spacing: 10 feet spacing or at spacing calculated by manufacturer to prevent buckling with a safety factor of 2 based on design thrust, shaft material and shaft size.

D. Torque Tubes:

1. Supply where shown on Drawings or Valve and Gate Schedule.
2. Supported by/mated to valve bonnet/yoke.
3. Sized by supplier for the required actuator torque.
4. Drilled specifically for valve and actuator bolt pattern.
5. Internal extension keyed or shaped specifically to mate to valve shaft and fabricated of Type 316 stainless steel.
6. Internal extension designed for axial adjustment for mating purposes.

E. Chain Wheels:

1. Supply for manual valves 3 inch diameter or larger mounted 7 feet and greater above operating floor level.
2. Type: Sprocket rim with chain and floating chain guide.
3. Chain Wheel and Guides Materials: Cast iron with hot-dip galvanized chain.
4. Chain Length: Extend to 5-1/2 feet above operating floor level.
5. Chain Storage: Include where chains may interfere with personnel egress; made with high-strength thermoplastic polymer in safety orange color.
    a. Basis-of-Design: Trumbull, Model ‘Chain Up’ as manufactured by Trumball Manufacturing, Inc., or equal.
6. Chain Wall Hooks: Include where feasible to prevent chain from impeding personnel egress.

2.3 MANUAL ACTUATORS

A. Operating Nuts:

1. 2 inch cast iron AWWA design.
    a. Painted Carbon Steel Tee Handle Operator: 2 inch AWWA nut socket end extension length for nut actuated valves where nuts are recessed in valve boxes.
    b. Tee Extension Length: Determine based on nut height as shown on Drawings with handle height approximately 3 feet above operating surface.
2. Operating Nuts Recessed on Concrete: Cast iron floor box with cover and tee handle operator with 2 inch AWWA nut socket end.
3. Nut Operated Non-Rising Stem Buried Valves: Cast iron bonnet skirts, extension pipes valve box and cover. Stem extensions with AWWA nut end to elevation shown on the Drawings or scheduled.
4. Two tee handles for every ten buried or encased non-rising stem application with 2 inch AWWA operating nut.

B. Gear-Assisted Manual Valve Actuators:

1. Provide:
    a. For manually actuated valves and gates larger than 8 inch nominal diameter and for ball and plug valves 6 inch and larger.
    b. With power actuators where torque requirements dictate.

2. Comply with AWWA C504.
3. Handwheel Diameter: 8 inch.
4. Maximum Handwheel Pull: 40 lbs. maximum.
5. Housings: Cast or ductile iron.
6. Worm or helical gear type.
7. Gears: Hardened steel, machine cut and mated.
8. Bearings: Permanently lubricated bronze.
9. Input and Output Shafts: Sealed with greased, waterproof machine shaft seals.
10. Filled with waterproof grease and designed for submerged service where scheduled.
11. Handwheel: Removable.
    a. Diameter: 8 inch up to 12 inch valve size.
    b. Diameter: 12 inch diameter up to 16 inch valve size.
    c. Diameter: 18 inch diameter for larger than 16 inch valve size.
    d. Maximum Diameter: 24 inch diameter.
12. Include mechanical top mounted valve position indication, opening direction, and adjustable stops.

C. Direct Manual Slide Gate Actuators:

1. Small Gates not Requiring Gear Reduction to Achieve Rim Pull Requirements: Yoke or floor stand mounted handwheel with dual ball type thrust bearings, grease fitting on bearing bowl, hardened machined alloy bronze lift nut.

D. Gear-Assisted Manual Slide Gate Actuators:

1. Provide manually actuated slide gates where direct mount actuators cannot meet rim pull requirements and design safety factors.
2. Include power actuators where torque requirements dictate.
3. Comply with AWWA C504.
4. Yoke mount for self-contained gates and floor stand mount for non-self-contained gates.
5. Accessories specified hereinabove where pertinent to the application.
6. Handwheel or crank style operator with maximum rim or crank pull of 40 lbs.
    a. Crank operators of cast iron construction with revolving brass grip.
    b. Handwheel casting to include the word “OPEN” and an arrow indicating the direction of operation.
7. Gear Boxes:
    a. Bevel or parallel shaft as required by installation geometry.
    b. Fully enclosed cast or ductile iron housings.
    c. Suitable for pedestal or yoke (bench) mounting.
    d. Mechanical seals on input shafting.
    e. Shafting fully supported with anti-friction ball or roller bearings throughout.
    f. Precision machined high strength bronze lift nuts.
    g. Precision cut steel gears.
    h. Input Shafts: Type 316 stainless steel.
    i. AWWA drive nut for removable crank, wheel, or portable power operator to be 2 inches
    j. Single or compound reduction as required to achieve rim pull requirements.
    k. No damage to gearbox components with 100 lbs. rim pull.

l. Coordinate with gate stem design such that catastrophic failure occurs at stem nut prior to stem buckling.

8. Tandem gear drives where indicated on Gate Schedule. Tandem drives include parallel gear boxes, Type 316 stainless-steel interconnecting shafting, and flexible couplings furnished by the manufacturer.

2.4 ELECTRIC MOTOR ACTUATORS

A. General:

1. Where specified on the Valve and Gate Schedule.
2. Comply with AWWA C542.
3. Actuators for Valves 3 inches and Smaller: 120 Volt, 1 Phase, 60 Hertz power supply.
4. Actuators for Valves Larger than 3 inches: 480 Volt, 3 Phase, 60 Hz power supply.

B. 120 Volt Power Actuators:

1. Actuators to have reversing motor, reduction gearing, local position indicator, position limit switches, provision for manual override, 100 to 1000 in-lbs torque range and motor thermal and electronic control protection.
2. Enclosure:
   a. Cast aluminum or steel alloy.
   b. Powder coated or fusion bonded epoxy finish.
   c. NEMA 4X.
3. Power Train:
   a. Self-locking planetary epicyclical gear design.
   b. Hardened steel or Hardened bronze alloy gears with bronze bearings.
   c. Housing Penetrations: Seal with mechanical seals.
   d. Housing: Equip with space heaters.
   e. Mounting System: ISO 5211.
4. Actuator for Open/Close/Jog Reversing Service: Proportional/modulating service where required in the equipment specifications or Instrumentation Drawings.
5. Motors:
   a. Design for valve actuation service.
   b. Insulation: Class F.
   c. Split phase capacitor protection.
   d. Duty Cycle: 40 percent at 100 degrees F for open/close duty, and 100 percent for modulating duty.
   e. 90-Degree Travel Time: 10 to 20 seconds depending on actuator size.
   f. Actuator Switches: Have two SPDT 15 Amp rated switches for remote open/close valve position indication.

6. Products: Subject to compliance with requirements, provide one of the following or equal:

    a. Series 92 as manufactured by Asahi/America.
    b. P Series as manufactured by Promation Engineering, Inc.

C. 480 Volt Power Actuators:

1. General: 2 phase 60 hz supply rated, self-contained, totally enclosed with motor, integral reversing starters, local controls, reduction gearing, limit switch gearing, limit switches, control power transformer, torque switches, bored and keyed drive sleeve for non-rising stems, declutch lever, auxiliary handwheel, and local position indication.
2. Separately seal motor and control compartments with space heaters in limit switch, motor, and control compartments.
3. Suitable for indoor and outdoor use, fully functional in ambient temperature range from 40 to 140 degrees F at 100 percent relative humidity.
4. Size to guarantee full travel, seating and unseating torque or thrust as specified by the valve or gate manufacturer.
5. Size to provide torque required to operate valve or gate at 90 percent of nominal voltage.
6. Design Travel Rate:

    a. As indicated on valve and gate schedule, and if not so indicated:

        1) Gate Valves and Slide Gates: 12 inches per minute.
        2) Globe Valves: 4 inches per minute.
        3) Quarter Turn Valves: 30 seconds per 1 foot of throat diameter.

7. Enclosure: Cast iron construction, 0-ring sealed, watertight to NEMA 4X/6 and submersible to IP 68-8, 26 feet for 96 hours per EN 60529.

    a. Operate successfully a minimum of 10 full cycles under submersion.
    b. Where required on Valve and Gate Schedule, certified explosion proof for Class I, Division 1 and 2, Groups B, C, and D.
    c. External Fasteners: Type 316 stainless steel.
    d. Include anti-condensation heater, suitable for continuous operation with alarm output to indicate heater failure.

8. Motors:

    a. High-starting torque; low stall torque, low inertia, designed and built by actuator manufacturer.
    b. Embed thermistor in each motor winding for thermal protection.
    c. Insulation: Class F, with a duty rating of at least 15 minutes at 40 degrees F ambient temperature.
    d. Electrical disconnection by means of plug and socket. Allow motor removal without loss of lubricant.
    e. Hardware to ensure motor runs with correct rotation for required direction of valve travel regardless of power supply connection sequence.

9. Motor Protection:

    a. De-energize without damage in the event of a stall condition when attempting to move a jammed valve.
    b. De-energize in the event of an over-torque condition.
    c. Imbed a minimum of three thermal devices in motor windings to de-energize the motor in case of overheating.
    d. Lost phase protection algorithm.

10. Gear Train:

    a. Grease filled, O-ring sealed in cast or ductile iron gear case.
    b. Suitable for operation in any orientation.
    c. Hardened, machine cut steel gears, and precision machined alloy bronze worm gear.
    d. Reduction gearboxes as specified in Paragraph "Gear-Assisted Manual Valve Actuators."

11. Manual Operation:

    a. Handwheel which does not rotate during motor operation.
    b. Output contact with declutch mechanism to indicate manual operation.
    c. Utilize actuator worm shaft/worm wheel to maintain self-locking gearing and to facilitate changeover from motor to manual operation when the actuator is under load. Do not use designs that bypass actuator worm gear or break valve load at worm gear.
    d. Automatic return from manual to motor operation upon starting motor.
    e. Manual operation capable with seized motor.

12. Position and Torque Calibration:

    a. Sensing by absolute encoder using hall effect sensors. Incremental encoders requiring batteries to retain settings upon loss of power are not acceptable. Settings stored in permanent non-volatile memory.
    b. Torque and travel adjustment parameters:

        1) Position Setting Range: 1 to 500 turns, with resolution of 2.81 degrees and accuracy to 5.0 degrees of actuator output.
        2) Torque Setting: 40 to 100 percent of rated torque.

    c. Torque switch bypass for the torque sensing system to inhibit torque switch trip during unseating or during starting in mid-travel against high inertia loads.

13. Wiring and Terminals:

    a. Tropical grade insulated stranded cable of appropriate size for the control and 3-phase power.
    b. Include a removable plug and socket head for termination of all external wiring. Include actuators without plug and socket terminal connections having power and control disconnect switches for ease of maintenance and safety.

14. Controls:
    a. Microprocessor: Based with mechanically and electronically interlocked reversing contactors for Open/Close duty and solid-state contactors for modulating duty.
    b. Local/Off /Remote Selector Switch and Open/Stop/Close Pushbuttons: Mount on actuator face with red and green indication lights for open/close and amber for fault.
    c. Remote On/Off Service: Actuator to accept one remote signal to open and a second remote signal to close.
    d. Modulating Service: When in remote mode, actuator to accept a 4 to 20 mA DC position control signal and position valve 0 to 100 percent of travel in proportion to control signal.
    e. Monitoring Relays: Remotely indicate fault signal for indication of power failure, phase failure, thermal switch tripped, torque switch tripped between travel stops, and Local-Off-Remote selector switch position.
    f. Gear Actuated Position Transmitter: On modulating duty actuator that is a two-wire device, produce 4 to 20 mA DC signal proportional to 0 to 100 percent travel.
    g. Transmitter: Have easily accessible zero and span adjustment potentiometers.
    h. DC Power Supply: Integral with operator and powered from 110-volt AC internal transformer. Positioner board to provide repeatable accuracy to 0.25 percent of span and have separate trim pots for zero, span, and dead band adjustment.

15. Position Indication: Continuous mechanical dial indication of valve and gate position in step with the actuator at all times in both the hand wheel and motor operation. For modulating applications, graduations on mechanical dial position indicator to be 0 to 100 percent scale.
16. Limit Switches:
    a. Adjustable type to trip at any point between fully opened and fully closed.
    b. Mid-travel Switches: Provide as noted.
    c. Do not allow set position to be lost if over travel occurs in either manual or electric modes of operation.
    d. Two independent and fully adjustable rotary type position limit switches each with 15 Amp DPDT contacts for remote open/close position indication.

17. Torque Switches: Actuator with adjustable torque switches and be responsive to load encountered in either direction of travel.
18. Terminal Compartment:
    a. Separate from the inner electrical components of actuator with a watertight seal.
    b. Three threaded cable entries.
    c. Stud-type Terminals: Embed in a terminal block of high tracking-resistance compound.
    d. Three-phase Power Terminals: Shroud from control terminals by means of an insulating cover.

19. Remote Control Stations:
    a. Where indicated, remote control stations for actuators located below the operating floor or located more than 7 feet above the operating floor.

b. Include a Local/Off/Remote selector switch, Open/Stop/Close pushbuttons and Open/Close indicating lights.

1) Local/Off/Remote selector to include padlock mount for the Off position.

c. Include auxiliary contacts for remote indication of switch position.

20. Manufacturers: Provide products by one of the following or equal.

a. IQ/IQM as manufactured by Rotork, Plc.
b. Limitorque MX as manufactured by Flowserve Corporation.
c. EIM TEC2000 as manufactured by Allied Valve, Inc.
d. AUMA SA/SAR as manufactured by AUMA Riester GmbH & Co. KG.

2.5 SOURCE QUALITY CONTROL

A. Factory Testing:

1. Shop inspect and test completed assemblies.
2. Factory performance test each actuator and supply individual test certificates. Submit test certificates prior to shipment of valve actuators. Test equipment to simulate a typical valve and gate load, and record the following parameters:

a. No load current.
b. Current at maximum torque setting.
c. Stall current.
d. Torque at maximum torque setting.
e. Stall torque.
f. Test voltage and frequency.
g. Flash test voltage.
h. Actuator output speed.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

A. Install products plumb, square, and true according to manufacturer’s published installation instructions.

B. Securely mount actuators using brackets or hardware specifically designed for attachment to valves/gates.

C. Extend chain actuators to 5-1/2 feet above operating floor level.

3.3 FIELD QUALITY CONTROL

A. After installation, inspect for proper supports and interferences according to manufacturer's requirements and Section 400551.

3.4 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Perform adjustments during normal occupancy hours.

3.5 DEMONSTRATIONS

A. Videotape one demonstration of a typical actuator and one demonstration of a non-typical actuator as agreed upon by service representative and Owner. Give single videotape with both demonstrations to Owner as part of closeout submittals.

END OF SECTION 400557

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. Two-Piece Brass Body 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.

C. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 TWO-PIECE BRASS BODY BALL VALVES 3-INCH AND SMALLER

A. Manufacturers:

1. Apollo Valve.
2. Milwaukee Valve.
3. NIBCO Inc.

B. Description:

1. Standard: MSS SP-110.
2. SWP Rating: 150 psi (1035 kPa).
3. CWP Ratings for Valves NPS 1/4 to NPS 2 (DN 8 to DN 50): 600 psi (4140 kPa).
4. CWP Ratings for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 400 psi (3447 kPa).
5. Body Design: Two-piece.
6. Body Material: Forged brass.
7. Ends: Threaded or soldered joint.
8. Seats: PTFE.
9. Stem Material: Type 316 stainless steel.
10. Stem Extension Sleeve Material: Aluminum to extend operating handle past pipe insulation.
11. Ball Material: Type 316 stainless steel.
12. Port: Full.
13. Packing Material: PTFE.
14. Operator: Steel lever with zinc plating and vinyl grip.

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 EXAMINATION

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 400564 - BUTTERFLY 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. AWWA butterfly valves.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods related to valves commonly used for process systems.
2. Section 400557 “Actuators for Process Valves and Gates.”

C. Van Stone flanges shall not be used 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.

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.

C. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 AWWA BUTTERFLY VALVES

A. Manufacturers:

1. DeZurik.
2. Val-Matic.
3. M&H.
4. Kennedy.
5. Pratt.

B. Description:

1. Comply with AWWA C504, Class 150B. Flanged end connections per ASME B16.1.
2. Minimum Working Pressure: 150 psig.
3. Maximum Process Fluid Temperature: 90 deg. F.
4. Body Style: Short body flanged.
5. Shaft: One or two piece, mechanically secured to disc, capable for mechanical separation from disc without damage to shaft or disc.
6. Bearings: Self-lubricating.
7. Shaft Seals/Packing:

    a. Self-compensating V-type- primary means.
    b. Multiple O-rings for up to 24-inch.
    c. Pull down seals using a square braid of graphite fiber for over 24-inch.
    d. Retained by bolted retainer plate or gland, clips not acceptable.
    e. Retained by stuffing box with follower gland for over 24-inch.
    f. Replacement without removal of valve from line.
    g. Adjustment without disturbing actuator assembly for over 24-inch.

8. Seats:

    a. Mounting: On body or disc.
    b. For body mounted seats, supply machined metal seating edges on disc. Seats mechanically retained and adjustable with common tools for valves larger than 24-inch.
    c. For disc mounted seats, fasten with a segmented or one-piece machined metal retaining ring, and self-locking bolts or set screws, fully adjustable with common tools. Machined metal seat ring installed in the valve body.
    d. Type: Resilient and replaceable. Field adjustable and replaceable.

C. Actuator:

1. Per Section 400557 “Actuators for Process Valves”
2. Handwheel for manual valves or Electrically actuated as indicated on Drawings.
3. Gear Actuators for Manual Valves: Comply with AWWA C504.

D. Materials:

1. Body: Cast iron, ASTM A126 or Ductile iron, ASTM A536.
2. Stem: ASTM A276, Type 316 stainless steel.
3. Disc: Ductile iron, ASTM A536.
4. Seats:

    a. Elastomer: EPDM or Buna-N.
    b. Retaining Ring: ASTM A276, Type 316 stainless steel.
    c. Seat Ring: ASTM A276, Type 316 stainless steel.

5. Bearings:

    a. Sleeve: Nylatron.
    b. Thrust: Bronze ASTM 763, Alloy C99500.

6. Connecting Hardware: ASTM A276, Type 316 stainless steel.

E. Finishes:

1. As specified in Section 400551 “Common Requirements for Process Valves.”
2. Manufacturers standard fusion bonded epoxy.
3. NSF 61 compliant for potable water service valves.

2.2 SOURCE QUALITY CONTROL

A. As specified in Section 400551 “Common Requirements for Process Valves.”

B. Testing: Test butterfly valves according to AWWA C504.

C. Submit an affidavit of compliance stating that the valves have been manufactured and tested in accordance with AWWA C504 and specifically list all exceptions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. As specified in Section 400551 “Common Requirements for Process Valves”: Submittal requirements for compliance with this Section.

3.2 INSTALLATION

A. As specified in Section 400551 “Common Requirements for Process Valves.”

B. According to manufacturer’s instructions.

C. Van Stone flanges shall not be used with industrial butterfly valves, or other piping system components having an elastomer liner that is used as a gasket.

END OF SECTION 400564

SECTION 400565.33 – RUBBER FLAPPER 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:

1. Rubber flapper 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” for valve schedules.

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. Product Data: Submit manufacturer's catalog information, indicating materials of construction and compliance with indicated standards.

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

C. Source Quality-Control Submittals: Indicate results of factory tests and inspections and provide required certifications.

1.5 INFORMATIONAL SUBMITTALS

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

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

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:

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.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace rubber flapper check valves that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 RUBBER FLAPPER CHECK VALVES 3-INCH AND LARGER - Tag Type RFCV

A. Manufacturers:

1. Crispin RF Series.
2. DeZurik APCO CRF 100.
3. Val-Matic Series 500.

B. Description:

1. Comply with AWWA C508.
2. Size: 3 inches and larger.
3. Type: Swing, rubber encapsulated metal disc, movement provided via flexing of reinforced rubber tab.
4. Seat: resilient, integral with rubber disc encapsulation.
5. Working Pressure:150 psig.
6. Maximum Fluid Temperature: 104 deg. F.
7. Accessories:

    a. Spring assist.

8. Mounting: Horizontal.
9. End Connections: Flanged, ASME B16.1.

C. Materials:

1. Body and Cover: Cast iron, ASTM A126 Ductile iron, or ASTM A536 lined ductile iron.
2. Disc: Steel encapsulated with reinforced EPDM rubber.
3. Seat: integral to disc encapsulation.
4. Cover hardware: Type 316 stainless steel.
5. Closure spring: Type 316 stainless steel.
6. Dampener: Type 316 stainless steel.
7. Connecting Hardware: Type 304 stainless steel.

D. Controls:

1. Bracket and Hardware: Type 316 stainless steel.

E. 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 recommended by Manufacturer.
2. Solvent-clean surfaces that are not shop primed.
3. Clean surfaces to remove loose rust, mill scale, and other foreign substances by commercial sand blasting; SSPC SP 6.

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 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 400565.33

SECTION 400578.19 - COMBINATION AIR VALVES FOR WATER SERVICE

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: Combination air valves for water treatment facilities.

B. Related Requirements:

1. Section 400507 “Hangers and Supports for Process Piping”: Anchors and supports.
2. Section 400551 “Common Requirements for Process Valves”: Typical product and installation requirements for valves specified in this Section.

1.3 COORDINATION

A. Coordinate Work of this Section with installation of process piping.

1.4 PREINSTALLATION MEETINGS

A. Section 400551 “Common Requirements for Process Valves.”

1.5 ACTION SUBMITTALS

A. Product Data: Submit manufacturer catalog information.

B. Shop Drawings: Indicate materials, dimensions, weights, and end connections in assembly drawings.

1.6 INFORMATIONAL SUBMITTALS

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

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

C. Source Quality-Control Submittals: Indicate results of factory tests and inspections and provide required certifications.

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

E. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

F. Qualifications Statements:

1. Submit qualifications for manufacturer and installer.
2. Submit manufacturer's approval of installer.
3. American Iron and Steel (AIS): Submit certification indicating compliance with AIS requirements.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of combination air valves.

1.8 QUALITY ASSURANCE

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

B. Manufacturer Quality Management System: Certified to ISO 9001.

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.

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. Manufacturer's Warranty: Manufacturer agrees to repair or replace combination air valves that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMBINATION AIR VALVES FOR WATER SERVICE – Tag Type CAV

A. Manufacturers: Provide products from following or County approved equal:

1. ARI.

B. Basis of Design:

1. Upstream of Well Check Valve:

a. Model: D-040PTO2; 2-inch threaded, reinforced nylon body, combination ARV for water; 3 - 250 psi.
b. Total Quantity: 3.

2. Downstream of Well Check Valve:

a. Model: D-060CHFNST02; 2-inch threaded, ductile iron body, combination ARV for water, with non-slam, surge dampening/slam preventing; 3 - 285 psi.
b. Total Quantity: 3.

C. Description:

1. Type:

a. Fully automatic, float operated.
b. Body: Single.

2. Comply with AWWA C512.
3. Size: As indicated on Drawings.
4. Suitable for potable or raw water service.
5. Pressure Rating: 150 psig.
6. Maximum Operating Temperature: Water to 104 deg. F.

7. Combination air valves shall perform the functions of an air/vacuum valve (exhaust large quantities of air on start-up, admits air on shut-down) and air release valves (release air continuously during operation) to maintain system efficiency and prevent pipeline surges.

D. Materials:

1. Body: Reinforced Nylon.
2. Drainage Cover: Type 316 stainless steel.
3. Float: Type 316 stainless steel.
4. Seat: Type 316 stainless steel.
5. Sealing Disc: E.P.D.M.
6. Internal Trim: Type 316 stainless steel.
7. Hardware: Type 316 stainless steel.

E. End Connections:

1. Size 4 Inches and Smaller: Threaded, NPT.
2. Size Larger than 4 Inches: Flanged, ASME B16.1 or B16.5.

F. Accessories:

1. Backwash accessories, including inlet shutoff valve, blowoff valve, rubber supply hose, and quick-disconnect couplings.
2. Epoxy lining for ASTM A125, Class B, cast iron body.
3. Throttling device on outlet.

2.2 FINISHES

A. Prepare piping appurtenances for field finishes per manufacturer's recommendations.

B. Provide shop inspection and testing of completed assembly.

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.

3.2 PREPARATION

A. 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. Install according to manufacturer’s installation instructions.

3.4 FIELD QUALITY CONTROL

A. Inspect for interferences and proper supports.

B. Testing:

1. As specified in Section 400551 “Common Requirements for Process Valves.”
2. Demonstrate operation without undue noise or vibration.

C. 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.
3. Repair damaged coatings with material equal to original coating.

D. Submit installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 CLEANING

A. Keep interior of air release valves clean as installation progresses.

3.6 DEMONSTRATION

A. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 400578.19

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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, PCSS will also serve as Applications Engineer System Supplier (AESS).

1. The Owner shall be providing configuration and development of HMI screens for this project.

C. 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.

D. Equipment and installations shall satisfy applicable Federal, State, and local codes. Refer to Electrical Drawings for area classifications for Class and Division ratings.

E. 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.

F. Related Requirements:
1. Section 4063XX "Sections for Control System Equipment."
2. Section 4066XX "Sections for Network and Communication Equipment."
3. Section 4067XX "Sections for Control System Equipment Panels and Racks."
4. Section 406866 "Configuration of Controller Software."
5. Section 407000 "Instrumentation for Process Systems."
6. Section 4071XX "Sections for flow measurement."
7. Section 4072XX "Sections for level measurement."
8. Section 4073XX "Sections for pressure, strain, and force measurement."

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.

C. Maintenance of Plant Operations (MOPO): A construction plan which prevents or limits process disruptions during construction.

D. Leadership in Energy and Environmental Design (LEED): A green building certification indicating that a building was designed and constructed to be environmentally responsible and use resources efficiently.

E. Section 4062XX “Sections for Computer System Hardware”: The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 PREINSTALLATION MEETINGS

A. 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.

B. 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 and AESS. The meeting will last up to 4 hours.

C. Attendance at MOPO workshop.

D. Bi-Weekly on-site or conference call coordination meetings with Engineer, Contractor, Vendors, and AESS as required prior to any field start-up or activity testing begins.

E. Schedule mandatory coordination meetings. Hold meetings at Owner's designated location and include attendance by Owner, Engineer, Contractor, PCSS's Project Engineer, and AESS 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 meeting for a minimum of one week before 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. For non-listed PCSS', 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. 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. 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-508 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. Preliminary list of PLC hardware, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to beginning development of system programming. The review and approval of software and hardware systems as part of this Project Plan stage does not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of manufacturer or model of these systems after the submittal is approved is not allowed without Engineer's approval.

c. 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.

d. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, control system architecture and I/O wiring diagrams

2. Define Exceptions to Specifications or Drawings in a Deviation List consisting of a paragraph-by-paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that an evaluation may be made by Engineer. Specifically state if no exceptions are taken to Specifications or Drawings. If there is no statement by PCSS, then it is acknowledged that no exceptions are taken.

3. PCSS must coordinate their work with General Contractor's overall schedule. PCSS schedule incorporates all PCSS milestones including but not limited to the following:

   a. Schedule for all subsequent project submittals. Include the time required for Contractor's submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
   b. Proposed dates for all project coordination meetings.
   c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
   d. Software purchasing and configuration (following approval of related submittals).
   e. Shipment of instrument and control system equipment.
   f. Installation of instrument and control system equipment.
   g. Testing: Schedule for all testing.
   h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and HMI server/workstation provided under this Contract.
   i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.
   j. Listing of all major graphics and PLC programs intended to be created or modified for this project. Indicate if graphic or program is new or existing.

4. Component and Wiring Identification and Tagging Plan:

   a. Components provided by PCSS require a tag, label, or nameplate. Review specifications and provide a table indicating the tagging and labeling scheme used by the PCSS:

1) Instruments.
2) Network Rack Components.
3) Panel Hardware.

b. 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. Input/Output (I/O) List Submittal:

1. Submit, within 60 days after Notice to Proceed, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.
2. Base I/O list on P&ID's, Drawings, the design I/O list (if included), and requirements in Specifications. Submit the I/O list in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.
3. Reflect all active and spare I/O points on the I/O list. Add points to accommodate spare I/O's as required in the specifications.
4. Arrange the I/O list so that each control panel has a dedicated worksheet, which includes the following information:

a. TAG NUMBER(S): As indicated on Drawings, the identifier assigned to a device that performs a function in the control system. As part of this information, break out the tag loop number to allow for sorting by loop.
b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
c. PHYSICAL LOCATION: Control Panel designation of where the I/O point is wired to.
d. PHYSICAL POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
e. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.
f. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points is "1."
g. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
h. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
i. P&ID - P&ID or Drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.
j. LOGICAL POINT ADDRESS: I/O address of each point.
k. EXISTING or NEW I/O POINT: Indicate if point is existing (E) or new (N).
l. CONDITION OF EXISTING SIGNAL: Condition of existing I/O signals to be noted as functional (F) if working properly or if not functioning (NF) with issue described.

5. Sort the I/O list in order by:

    a. Physical location.
    b. I/O Type.
    c. Loop Number.
    d. Device Tag.

6. Once I/O list is approved, PLC I/O addresses are not be modified without approval by Engineer.
7. For I/O layout requirements, refer to Section 406343 “Programmable Logic Controllers.”

F. Field Instruments Submittal:

1. Refer to the Instruments section for submittal requirements.

G. Control System Architecture, Computer Equipment Rack, Hardware and Software Packages Submittal:

1. For each hardware and software packages component specified in the sections above, submit a cover page that lists date, specification number, product name, manufacturer, model number, location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001 (updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
2. 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, and networked peripherals such as power monitors, security cameras, etc. PCSS is required to provide unique network architecture drawings for the following networks:

    a. SCADA.
    b. Instrumentation.
    c. Electrical.

3. Develop the system architecture drawings 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 linetype 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 that 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. Communication cables shall 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 at a later date.
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 inch x 17 inch 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.

H. Panel Layout Drawings and Wiring Diagrams Submittal:

1. Panel Layout Drawings: Submit Drawings for all panels specified. Draw to scale panel assembly and elevation drawings and detail all equipment in or on the panel. Use 11 inch x 17 inch 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. For every outdoor control panel, heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Include on calculations the recommended type of equipment required for both heating and cooling.

j. Submit evidence that all control panels are constructed in conformance with UL 508 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.

2. 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. ISA Loop Wiring Diagrams: Not required.

I. Controller Program Submittal:

1. Refer to Section 406866 “Configuration of Controller Software” for specific submittal requirements.

J. Testing Plan Submittals:

1. Refer to Section 406121.20 “Process Control System Testing” for specific testing submittal requirements.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For all PCSS supplied hardware to include in operation and maintenance manuals.

1. 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. Instrument and Equipment Lists:

1) Develop the following lists in Microsoft Excel format:

a) An instrument list or spreadsheet for all instruments supplied including tag number, description, specification section and paragraph number, manufacturer, model number, calibrated range, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

b) 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 ISA-TR20.00.01-2001(updated in 2004-2006) data sheets for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001(updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
2) 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.
3) Provide the record documentation of the system audit and completed test forms with sign-offs as specified in Section 406121.20 “Process Control System Testing.”
4) 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 and in Adobe Acrobat format. Provide drawings using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
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. Operations and Maintenance Data - Software Maintenance Manual:

1. Include these manuals as part of "Final System Documentation."
2. Software Listings and Databases: Submit hard copies of the same information required in the "Controller Program Submittal" except include files updated to reflect the as-built system. Include PDF versions of these files on the DVDs specified below.
3. PID Loop Tuning Parameters: Submit annotated chart recorder traces or computer system trend screen printouts showing tuned control loop response to plus and minus 40 percent of full span step changes of loop setpoint for each individual loop. For cascade loops, submit charts showing response of the secondary loop with secondary setpoint on manual

and also response of the entire cascade control loop in automatic mode. Include a description of tuning methodology used.

4. Supply hardcopies of configuration information for the HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract.
5. Machine Readable Documentation: Provide two sets of as-built software documentation on DVDs or USB thumb drives in original electronic format for all PLC, HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract. Incorporate all changes made during or after testing, start-up, and commissioning.
6. Include final version of the system standards and conventions manual reflecting as-programmed conditions.
7. System Configuration Section:

    a. Include a printout (or screen capture) of all configuration screens for every device requiring PCSS configuration. This includes, but is not limited to, PLC processors, EtherNet/IP and any other communication modules.

C. Operations and Maintenance Data - Operators' Manual:

1. Provide Operator's Manuals prior to final acceptance of the system.
2. Separately bind and include in the manual all information necessary for the operator to monitor and control the plant from the control system. Write the manuals in non-technical terms and organize for quick access to each detailed description of the operator's procedure. Include the following information:

    a. A comprehensive table of contents of the manual.
    b. A simple overview of the entire system indicating the function and purpose of major control system components described by area or building.
    c. A detailed description of the operation of the HMI and OIT including all appropriate displays. Including a screenshot of each HMI and OIT display screen and annotating each function in text is an acceptable format for presenting this information.
    d. Step-by-step procedures for starting up or shutting down critical component of the control system such as server or a control panel.
    e. Login / logout procedures for the operator interface system(s).
    f. Complete, step-by-step procedures for printing reports and entering manual data.
    g. Complete, step-by-step procedures for performing system or selected file backup and restoration including archiving historical data. Include recommended archiving schedule for historical data and/or frequency system performs an automatic back-up with a listing of all applications that are backed up or need to be backed up.
    h. Operational description for operating HMI computer equipment and peripherals including printers, CD-ROMs, removable bulk storage devices, UPS, etc. Include in the description procedures for typical maintenance and troubleshooting tasks.
    i. A complete glossary of terms and definition of acronyms.
    j. List of personnel to be contacted for warranty and emergency services, including name, address, telephone number, pager or cell phone number, fax number, and email address.

3. 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.

1.7 MAINTENANCE MATERIAL SUBMITTAL

A. Furnish extra materials from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Refer to individual specification sections in Division 40 for spare equipment requirements and provide one comprehensive spare parts submittal for project.

B. Pack all spare parts in individual cartons and label with indelible markings clearly indicating components inside. Supply with the required spare parts complete ordering information paperwork including manufacturer's contact information (address and phone number), part name, part number, equipment name and tag number(s) for which the part is to be used (if applicable). Deliver and store the spare parts in a location directed by the Owner or Engineer.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: PCSS to hold a valid UL-508 certification for their panel fabrication facility.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

C. Responsible for the technical supervision of the installation by providing on-site supervision to the installers of the various components.

D. Process Control System Supplier (PCSS) shall be a “systems integrator” regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a “systems integrator” 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 includes, 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 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.

F. Listed suppliers will not be required to submit a qualifications proposal (see "Informational Submittals"). Contractors interested in listing an equal to the above listed suppliers to submit PCSS' qualifications for review and approval as specified herein.

G. Select a PCSS from one of the following:

1. Carollo, Contact: Joe Hanlon, Phone: 727-460-2550.
2. McKim & Creed, Contact: Robert Garland, Phone: 941-379-3404.
3. Tetra Tech, Contact: Danny Nelson, Phone: 239-438-2108.
4. Revere Control Systems, Contact: Ben Matthews, Phone: 863- 337-3001.
5. Jacobs, Contact: Bill Gramer, Phone: 239-860-4922.

H. Select a fiber optic cable provider/installer from one of the following:

1. Aztek Communication Technologies, Phone: 239-659-0017
2. IT Solutions, Inc. Phone: 239-354-7755

I. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section.

1.9 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 ambient.
2. Equipment in indoor locations operate between 50 to 95 degrees F degrees ambient minimum.
3. Storage temperatures range from 32 to 122 degrees F degrees ambient minimum.
4. Furnish additional cooling or heating if required by the equipment specified herein.
5. Relative Humidity. Air-conditioned area equipment operate 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.

1.10 WARRANTY

A. Warranty Period: One year from Date of Final Completion unless noted otherwise in individual specification Sections.

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 utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1 - 5 VDC (volts direct current).
3. Outputs of equipment that are not of the standard signals as outlined, 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. 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. 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.

B. Provide sunshades for equipment mounted outdoors in direct sunlight. Include sunshades standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North to minimize the impact of glare and ultraviolet exposure on digital readouts.

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, and AESS as required during active construction period.

3.6 PCSS MAINTENANCE SERVICE

A. Provide a written proposal for a maintenance contract executed by the PCSS to the Owner for on-site preventive maintenance services related to the Instrumentation and Control system. Do not include the cost of this maintenance contract in the Contract Price.

B. Visits to the sites to correct deficiencies under warranty are not included in this preventive maintenance service contract.

END OF SECTION 406100

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SECTION 406121.20 - 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 Applications Engineering services are performed by Contractor.

1. Furnish labor, materials, equipment, and incidentals required to complete testing of provided devices and systems.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): Entity responsible for providing materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Applications Engineering System Supplier (AESS): Entity who provides programming, configuration, and related services for the control system equipment provided by the PCSS.

C. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.

D. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

E. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

F. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

G. 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 4061000 “Process Control and Enterprise Management Systems General Provisions.”

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 and Automatic Control Strategy signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.

1) Example forms are shown in the Appendices.
2) Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
3) Submit testing forms prior to start of testing.

1. Testing Procedures:

a. Submit detailed procedures proposed to be followed for each of the tests specified herein. Test procedures serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified. At a minimum, provide the following test procedures:

1) Network and Communications Testing.
2) I/O Testing.
3) UPS.
4) Control panel power, indictors, and hardwired logic tests.

b. Structure documents in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.
c. Indicate in test procedures all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.
d. Structure test procedures in a cause and effect manner where the inputs are indicated, and the outputs are recorded.
e. Include in test procedures the demonstration and validation under normal operating conditions and under various failure scenarios as specified in Contract Documents.
f. Do not start testing until all Testing Submittals have been approved.

C. Test Documentation:

1. Upon completion of each required test, document the test by submitting a copy of the signed off Testing Status forms. Testing is not to be considered complete until the signed-

off forms have been submitted and approved. Submittals of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

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 are 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.”

1.8 COST OF TRAVEL

A. Scheduled tests will only be attended once by Engineer /Owner. If test is not successful, all subsequent tests will be performed at Contractor's expense. Reimburse Owner for all costs, including labor and expenses, invoiced by Engineer and incurred by Owner for subsequent retests.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING - GENERAL

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Track results of all 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. Factory Testing:

a. Unwitnessed Factory Test (UFT).
b. Witnessed Factory Test (WFT).

2. Field Testing:

    a. Operational Readiness Test (ORT).
    b. Functional Demonstration Test (FDT).
    c. 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 Owner.

F. Do not ship equipment to jobsite until Engineer or Owner has received all Factory Testing results and approved the system as ready for shipment.

G. Engineer reserves the right to test or re-test any functions.

H. Correction of Deficiencies:

1. Correct deficiencies in workmanship and/or items not meeting specified testing requirements to meet specification requirements at no additional cost to Owner.
2. Repeat testing, as specified herein, after correction of deficiencies is made until specified requirements are met.

3.2 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)

A. Purpose of UFT is for PCSS to check system prior to Engineer and/or Owner attending factory testing. This type of testing is part of any quality firm's internal QA/QC procedures.

B. Temporary network connections are required to confirm the network configuration. Temporary wiring of primary elements, final control elements, and field-mounted transmitters is not required.

C. Hardware to be tested includes all control system devices shown on System Architecture drawings and provided by PCSS.

D. Perform these tests, but not be limited to the following. Address each of these tests in the Test Procedure submittal.

1. All panels and enclosures provided to undergo a thorough inspection to verify integrity of cabinet enclosures, frame structures, paint work and finish, etc. Review panel drawings to ensure they accurately reflect panel layout and wiring.
2. Perform a system audit to verify all components have been staged for test and have been documented properly with correct model numbers, serial numbers, etc. Prove documentation of audit at factory test and submit as part of O&M Manual Documentation:

    a. For each workstation and server, list of all software installed (including the operating system), with software revision number, software improvement modules

or patches installed, license number and owner registration information, warranty period, vendor and local distributor names and contacts.

b. For each microprocessor-based component connected to control communication backbone in system (PLCs, managed switches, protocol converters, communication cards on final field devices, radios, etc.), list firmware revision, vendor and local distributor information, and system, warranty information, configuration parameters (e.g., communication settings, fail position settings, etc.)

3. Perform panel wire pull tests to ensure all wiring has been connected with appropriate torque to prevent wires from coming loose.
4. Test UPS to verify UPS switch power correctly while keeping all UPS powered loads online. Perform testing of UPS to determine if they have been sized correctly to maintain specified run time during field testing.
5. Perform a 100 percent I/O point checkout to verify proper operation of input/output points from panel terminations to HMI and OIT nodes. At a minimum, I/O checkout consists of four steps.

    a. Jumper discrete input signals at field terminal blocks in control panels to verify proper status in HMI and OIT nodes.
    b. Connect analog input signals to a signal generator at field terminal blocks in control panels to verify proper status in HMI and OIT nodes and verify signals are at zero percent, 50 percent, and 100 percent of full scale.
    c. Test discrete output signals by switching equipment to manual control at HMI and OIT nodes and turning the output on or other means to turn the output on. Then verify the output is on by connecting a digital multimeter to measure continuity at terminations, thus verifying command from PLC has properly executed contact closure.
    d. Test analog output signals by switching the equipment to manual control at HMI and OIT nodes and turning output on or other means to turn the output on. Then verify output by utilizing a digital multimeter to measure current or voltage generated at termination points.

6. Verify all control strategies using simulation or other means to verify logic performs as expected. Verify faults and logical failure conditions for control strategies such instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out of range testing (over and under scale) for analog inputs, and all other strategies specified in control strategy document.
7. For each hardware enclosure, include with inspection, but not be limited to, cabinet enclosures, frame structure, paint work and finish, dimensions, and hardware operability (i.e., fans, door hinges, keylocks, etc.).
8. For each subpanel, include with inspection, but not be limited to, I/O subsystem physical layout, power supply sizing and mounting, cable routing, wire runs across hinges properly installed, fans and blowers unobstructed and mounted to maximize air flow, power conditioning correctly installed, and overall layout and installation of components meets manufacturer's recommendations and standard industry accepted practices.
9. All other control panel circuitry.

10. Perform the following systems tests:

    a. Demonstrate ability to share data between operator workstations and servers.
    b. Demonstrate ability of each workstation to print reports on all designated report printers.
    c. Demonstrate ability for each workstation to read and write designated files from servers and other workstations on the network.
    d. Demonstrate operability of all back-up and mass storage equipment.
    e. Demonstrate communication failure and recovering self-healing ring testing.
    f. Demonstrate total power failure and recovery. Remove the UPS for this test.
    g. Demonstrate capabilities of the historical server.
    h. Demonstrate failover capabilities of the redundant HMI servers.
    i. Demonstrate failover capabilities of the redundant PLCs.

E. Upon successful completion of UFT, PCSS to submit a record copy of test results as specified in PART 1. As part of this test results submittal, notify Engineer and Owner in writing that system is ready for WFT. No other notice of Factory test will be accepted. Engineer and/or Owner to schedule a test date within 30 days of receipt of this submittal.

3.3 FACTORY TESTING - WITNESSED FACTORY TEST (WFT)

A. Purpose of WFT is to allow Engineer or Owner representatives to witness functionality, performance, and stability of entire hardware and software system as a complete integrated system. WFT to be run by PCSS and conducted at PCSS's facility.

B. Required Documents for Test:

1. Clean set of approved panel drawings and wiring diagrams.
2. Set of Contract Documents: Drawings and Specifications.
3. All design-change related documentation.
4. Master copy of the PCSS developed factory testing signoff forms.
5. Testing procedures.

C. Operate the system continuously throughout WFT without failure, except where initiated per established test procedures. Unanticipated failures may, at Owner or Engineer's option, result in overall WFT being deemed unsuccessful. Correct and re-test all deficiencies identified during these tests prior to completing WFT or shipment of panels to jobsite as determined by Owner/Engineer.

D. Perform these tests during the WFT, but not be limited to, the following:

1. A repeat of all tests specified in the UFT.

E. Daily schedule during these tests to be as follows:

1. Morning meeting to review the day's test schedule.
2. Scheduled tests and sign-offs.

3. End of day meeting to review day's test results and to review or revise next day's test schedule.
4. Unstructured testing period by witnesses.

F. Upon successful completion of WFT, PCSS to submit a record copy of test results as specified in PART 1.

3.4 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 determines if equipment is ready for operation.

B. This test to take place prior to FDT and startup. Prior to starting this test, install relevant process equipment and mechanically test instruments installed, control panels installed, and field wiring complete.

C. Required Documents for Test:

1. Master copy of the PCSS developed field testing sign-off forms.
2. Testing procedures.
3. Calibration forms.

D. These inspections, calibrations, and tests do not require witnessing. However, Engineer may review and spot-check testing process periodically. All deficiencies found to be corrected by PCSS prior to commencement of Functional Demonstration Test.

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 tests as part of ORT:

1. Instrument calibration, configuration, and set-up.
2. Input/Output (I/O) Testing to HMI and OITs.
3. Testing of control strategies.

G. Instrument calibration, configuration, and set-up:

1. Calibrate, configure, and set-up all components and instruments to perform 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 provide a summary of the actual settings used in the field to allow an Instrument technician to replace the device entirely and configure it to function as it did before.
b. Add this information to Instrument data sheet and to a copy of manufacturer's standard "Configuration Sheet" or create a separate form.

1) If a separate form, list 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 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 Final System Documentation as specified in Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

H. I/O Testing:

1. Purpose of I/O testing is to check that process equipment, instrument installation, calibration, configuration, field wiring, and control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.
2. PCSS in conjunction with Contractor to test signals under process conditions. Preferred test method will always be to execute test wherever possible to end elements. For example, preferred test will prove valve open/close limit switches by operating valve, not by installing a jumper on limit switch contacts. However, if equipment or process is not available to test a signal over its entire calibrated range, PCSS may test using a simulation method and make a note on sign-off form.
3. Perform the following I/O tests:

a. Discrete Input: At device or instrument, change signal condition from 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. Test discrete output signals by switching equipment to manual control at the HMI and OIT nodes and turning output on or using other means to turn output on. Then verify equipment responds accordingly.
d. Test analog output signals by switching equipment to manual control at HMI and OIT nodes and turning output on or other means to turn output on. Then verify equipment responds accordingly.

I. Testing of Automatic Control Strategies:

1. Verify all automatic control strategies using actual process equipment and instruments, or other means, to verify logic performs as expected. Verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out of range testing for analog inputs, loss of power, and all other strategies specified in control strategy document.

J. Repeat all systems tests specified under factory testing.

K. Test UPS to verify UPS switch power correctly while keeping all UPS powered loads online. Also, test sizing of UPS by switching off-line power to UPS and verify if they maintain specified run time.

L. For all panels with enclosures modified by this Contract, test internal control panel temperature under full running conditions to ensure proper cooling/ventilation is being provided.

M. Upon successful completion of ORT, PCSS to submit a record copy of test results as specified in PART 1 and request scheduling of FDT.

3.5 FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)

A. After facility is started-up and running treatment process in automatic control to extent possible, perform a Functional Demonstration Test. Purpose of FDT is to allow Engineer or Owner representatives to witness actual functionality, performance, and stability of system while connected to process equipment.

B. Required Documents for Test:

1. Set of panel drawings and wiring diagrams from ORT with corrections noted.
2. Set of Contract Documents: Drawings and Specifications.
3. All design-change related documentation.
4. Signed-off master copy of the PCSS developed field testing signoff forms.
5. Testing procedures.
6. Copy of completed calibration forms.
7. One copy of all O & M Manuals for PCSS supplied equipment.

C. Perform a witnessed FDT on each process area. To extent possible, repeat testing performed during ORT.

D. Follow specified daily schedule during factory tests and FDT.

E. After coordinating with Operations, perform a "Black Start" of the plant to confirm plant operation recovers as specified in Contract Documents. Black start means shutting off power to the plant and turning it back on. Perform separate tests by recovering the plant while on generator (if a generator is specified) and while on utility power.

F. Document punch list items and resolutions noted during test on Punch list/Resolution form. In event of rejection of any part or function test procedure, PCSS to perform repairs, replacement, and/or retest within 10 days.

G. Upon successful completion of the FDT, PCSS to submit a record copy of test results as specified in PART 1.

3.6 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

A. After completion of FDT, and system is started-up and running treatment process in automatic control to extent possible, perform a test on the system.

B. While this test is proceeding, Engineer and Owner have full use of system. Only allow plant operating personnel to operate equipment associated with live plant processes. Plant operations remain the responsibility of Owner and decision of plant operators regarding plant operations are final.

C. During this test, PCSS personnel to be present as required 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 hardware and software of system. When PCSS personnel are not on-site, PCSS to provide cell phone/pager numbers that Owner personnel can use to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.

D. PCSS to analyze and correct any malfunctions during test. In event of rejection of any part or function, PCSS to perform repairs or replacement within 5 days.

E. Throughout duration of SAT, do not make software or hardware modifications to the system without prior approval from Owner or Engineer.

END OF SECTION 406121.20

APPENDIX **40 61 21**-A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM

An example template for I/O Status signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

APPENDIX **40 61 21**-B: EXAMPLE AUTOMATIC CONTROL STRATEGIES SIGN OFF FORM

An example template for Automatic Control Strategies signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific Automatic Control Strategies signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

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	PCSS I/O testing	Date	I/O Testing to the HMI	Date	Notes
PLC-SC	LIT-4000-1	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1	0								
PLC-SC	LIT-4010-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1	1								
PLC-SC	SI-4100-1	RAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	2								
PLC-SC	SI-4100-4	RAS Pump No. 4 Speed Feedback	0-100%	15	AI	2	1	3								
PLC-SC	FIT-4102-1	RAS Flow Pumps 1-3	0-1900 GPM	14	AI	2	1	4								
PLC-SC	SI-4110-1	WAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	5								
PLC-SC	N/A	Spare Slot	N/A	N/A	Spare	2	5	N/A								
PLC-SC	SC-4100-1	RAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	0								
PLC-SC	SC-4100-2	RAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7	1								
PLC-SC	SC-4100-3	RAS Pump No. 3 Speed Setpoint	0-100%	14	AO	2	7	2								
PLC-SC	SC-4110-1	WAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	3								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	4								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	5								
PLC-SC	TSH-4000-1	Secondary Clarifier No. 1 High Temp	Normal	8	DI	3	1	0								
PLC-SC	XA-4000-1	Secondary Clarifier No. 1 Motor Overload	Normal	8	DI	3	1	1								
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	2								
PLC-SC	WAHH-4000-1	Secondary Clarifier No. 1 High High Torque	Normal	8	DI	3	1	3								
PLC-SC	YRI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1	4								
PLC-SC	YCI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1	5								
PLC-SC	YFI-4100-1	RAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	6								
PLC-SC	FAL-4100-1	RAS Pump No. 1 Low Flow	Normal	14	DI	3	1	7	50 GPM	RJM	12/18/2011	JAS	12/22/2011	MIC	12/29/2011	Example completed line
PLC-SC	Spare	Spare	Normal	14	DI	3	1	8								
PLC-SC	YRI-4100-1	RAS Pump No. 1 Running	Running	14	DI	3	1	9								
PLC-SC	YCI-4100-1	RAS Pump No. 1 In Remote	In Remote	14	DI	3	1	10								
PLC-SC	YFI-4110-1	WAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	11								
PLC-SC	FAL-4110-1	WAS Pump No. 1 Low Flow	Normal	14	DI	3	1	12								
PLC-SC	Spare	Spare	Normal	14	DI	3	1	13								
PLC-SC	YRI-4110-1	WAS Pump No. 1 Running	Running	14	DI	3	1	14								
PLC-SC	YCI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	15								
PLC-SC	HSS-4000-2	Secondary Clarifier No. 2 Start Command	Start	8	DO	4	6	0								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	1								
PLC-SC	HSS-4100-2	RAS Pump No. 2 Start Command	Start	14	DO	4	6	2								
PLC-SC	HSS-7000-2	Sludge Holding tank Tank 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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4-Jun-14

[Project Name] Appendix B - Automatic Control Strategies Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Testing

Auto. Control Strategies. - Loop operational in Automatic as defined in Control Stategies

Control Strategies Loop #	Control Strategy Description	P&ID	Auto. Control Strategy	Date	Notes
LOOP 281 - 284	LOW FLOW PUMPS	8			
LOOP 290	LOW EQ CHANNEL FLOW NO.4	8			
LOOP 300	MICROFILTRATION AIR SUPPLY LOW PRESSURE	10			
LOOP 351, 352	SITE LIFT STATION PUMP NO.1 AND NO. 2	12			
LOOP 355	SITE LIFT STATION HIGH AND LOW LEVEL CONTROL	12			
LOOP 371, 372	SLUDGE HOLDING TANK NO.1 AND NO. 2 LEVEL	14			
LOOP 381, 382	SLUDGE TRANSFER PUMPS	14			
LOOP 385	SLUDGE TRANSFER PUMPS REMOTE START/STOP COMMAND	14			
LOOP 700	EFFLUENT PUMPING STATION LEVEL	14			
LOOP 701, 702, 703	EFFLUENT PUMP NO.1	14			
LOOP 840	POST AERATION CHANNEL AIR FLOW CONTROL	15			
LOOP 900	SLUDGE TRANSFER PUMPS DISCHARGE FLOW	8			
LOOP 971	CENTRIFUGE SLUDGE FEED PUMP NO.1	8			
LOOP 1001	CENTRIFUGE NO.1 SLUDGE FEED FLOW CONTROL	8			
LOOP 1411, 1412	SODIUM HYPOCHLORITE STORAGE TANKS LEVEL	8			
LOOP 1421, 1422	SODIUM HYPOCHLORITE PUMPS	8			
LOOP 1430	SODIUM HYPOCHLORITE STORAGE TANKS CONTAINMENT AREA HIGH LEVEL DETECTION	14			
LOOP 2051, 2052, 2053	DIESEL ENGINE GENERATOR STATUS	14			
LOOP 2055	TRANSFER SWITCH STATUS	14			
LOOP 2060	GENERATOR KILOWATTS MONITORING	14			
APPENDIX ONE	EQUIPMENT RESTART DURING A POWER LOSS WITH THE GENERATOR RUNNING	14			
APPENDIX TWO	EQUIPMENT RESTART WITH POWER RESTORED AFTER A POWER LOSS	14			
N/A	SELF-HEALING CAPABILITIES OF NETWORK	N/A			
N/A	REDUNDANT SCADA SERVER FAILOVER AND RECOVERY	N/A			

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SECTION 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 4061000 “Process Control and Enterprise Management Systems General Provisions.”

1.4 ACTION SUBMITTALS

A. Preliminary Training Plan Submittal:

1. Prior to the preparation of the Final Training Plans, submit outlines of each training course including course objectives and target audience, resumes of instructors, prerequisite requirements for each class, and samples of handouts for review.

B. Final Training Plan Submittal:

1. Upon receipt of the Engineer's comments on the preliminary training plan, submit the 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 training and instruction to 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. Onsite instructors must be intimately familiar with 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 the training services, deliver all training materials to Owner.

F. Owner reserves the right to videotape all custom training sessions. All training tapes become the sole property of Owner.

G. Cost of Travel for Off-Site Training:

1. Cost of Travel for off-site training is paid directly by the entity employing the staff doing the traveling.

3.2 TRAINING SUMMARY

A. Provide the 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				
Control System Overview Seminar	Covered in AESS scope of work			
Operator Control System Training	Covered in AESS scope of work			
Installed Control System	2	2	1	Maintenance, Administrator

PLC Hardware/Software	2	2	1	Maintenance
Instruments – Magnetic Flowmeter	4	2	1	Maintenance
Instruments - Operator familiarity	2	8	1	Operations
Fiber Optics	4	2	1	Maintenance

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. Installed Control System Training:

1. Provide training for Owner's personnel in the functionality, maintenance, and troubleshooting, of the installed Control System. Conduct the training before the Functional Demonstrator Test (FDT), but not more than two months before.
2. Provide training and instruction specific to the system that is being supplied.
3. Provide training consisting of classroom instructions and hands-on instruction utilizing Owner's system.
4. Provide detailed training on the actual configuration and implementation for this Contract covering all aspects of the system that will allow Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. Provide training covering the following subjects:

    a. System overview.
    b. System hardware components and specific equipment arrangements.
    c. Periodic maintenance.
    d. Troubleshooting and diagnosis.
    e. Network configuration, communications, and operation.
    f. TCP/IP addressing procedures for all Ethernet devices.

C. Programmable Logic Controller (PLC) Hardware and Software:

1. Provide training for Owner's personnel in the operation, maintenance, troubleshooting, etc. with the PLC hardware and software system. Conduct the training before the FDT, but not more than two months before.
2. Provide training and instruction specific to the system that is being supplied.
3. Provide training consisting of classroom instructions and hands-on instruction utilizing Owner's system. Provide detailed training on the actual configuration and implementation for this Contract covering all aspects of the PLC system that will allow Owner's

personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the PLC system. Provide training covering the following subjects:

a. PLC system overview.
b. PLC system architecture.
c. PLC system hardware components and specific equipment arrangements.
d. PLC system startup, shut down, load, backup, and PLC failure recovery.
e. Periodic maintenance.
f. Troubleshooting and diagnosis down to the I/O card level.
g. PLC configuration, communications, and operation.

D. Instrument Manufacturer Training:

1. Provide manufacturer instrument training for those instruments where specifically indicated in the Instruments section. This is on-site training provided by an authorized representative of the manufacturer. The manufacturer's representative is required to be fully knowledgeable in the operation and maintenance of the equipment.

E. Instrument Training:

1. Provide instruction on the maintenance of the field and panel instrumentation for Owner's instrumentation technicians. Conduct this training before the 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.

F. Instruments - Operator Familiarity:

1. Provide operator level instruction on the use of the field and panel instrumentation for Owner's operations staff. Conduct training before the 30-day site acceptance test, but no more than one month before and at a time suitable to Owner. This training takes place at Owner's facility. Include hands on demonstration of the information each transmitter indicates, and the method used to retrieve any operator information from the transmitter, including use of pushbuttons and interpretation of international graphic symbols used on the instruments.

G. Fiber Optic Training:

1. Provide instruction on the maintenance of the fiber optic system for Owner's instrumentation technicians. Conduct training before the FDT, but no more than one month before and at a time suitable to Owner. This training takes place at Owner's facility. Provide training covering the following topics:

a. Fiber cable layout and basic of cable construction.
b. Termination procedures.
c. "Jumper" installation.
d. Testing procedures.
e. Troubleshooting and diagnosis.

END OF SECTION 406126

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SECTION 406193 - PROCESS CONTROL SYSTEM INPUT/OUTPUT LIST

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 Input-Output (I/O) lists.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for I/O list submittal requirements.

1.3 DEFINITIONS

A. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

B. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

1.4 ACTION SUBMITTALS

A. Process Controller Input/Output (I/O) Schedule:

1. Submit complete I/O schedule as specified in 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.”

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 406193

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SECTION 406196 - PROCESS CONTROL DESCRIPTIONS

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: Applications Engineer System Supplier (AESS) Programming Scope:

1. Develop the control system applications to implement the process control descriptions for all new and existing systems. This Section is provided to define control strategies to be used for PLC programming of the system.
2. Contract Documents are a single integrated document, and as such, all Drawings and Specifications apply. It is the responsibility of Contractor and subcontractors to review all Sections to ensure a complete and coordinated project.
3. PCSS is cautioned to read this Section and all related Sections and their entirety prior to starting any programming. Many general control strategies and requirements are defined once in the body of this Section with the specific requirement called out in the individual control strategy. Implement these general strategies throughout this Contract unless specifically directed otherwise in the individual loop process control descriptions.
4. Follow loop and device tagging criteria shown on Drawings without exception.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406866 “Configuration of Controller Software.”

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): Entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

B. Human Machine Interface (HMI): A software-based user interface with supervisory level control of machine level equipment.

C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

D. Operator Interface Terminal (OIT): A hardware component of the SCADA system used for device level control and monitoring.

E. Operator Workstation (OWS): A hardware component of the SCADA system used for supervisory level control and monitoring.

F. Process Control System Supplier (PCSS): Entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

G. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

H. Supervisor Control and Data Acquisition (SCADA): Hardware and software components used for high-level supervisory monitoring of industrial processes. Typical devices that are part of the SCADA network include computers (OWS), PLCs, Ethernet switches, OITs, and HMIs.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Control System Hierarchy:

1. The control descriptions are broken into a hierarchical layer concept. There may be one layer or multiple layers per loop, depending upon that loop. An example of multiple layered loop is shown in Figure 1.

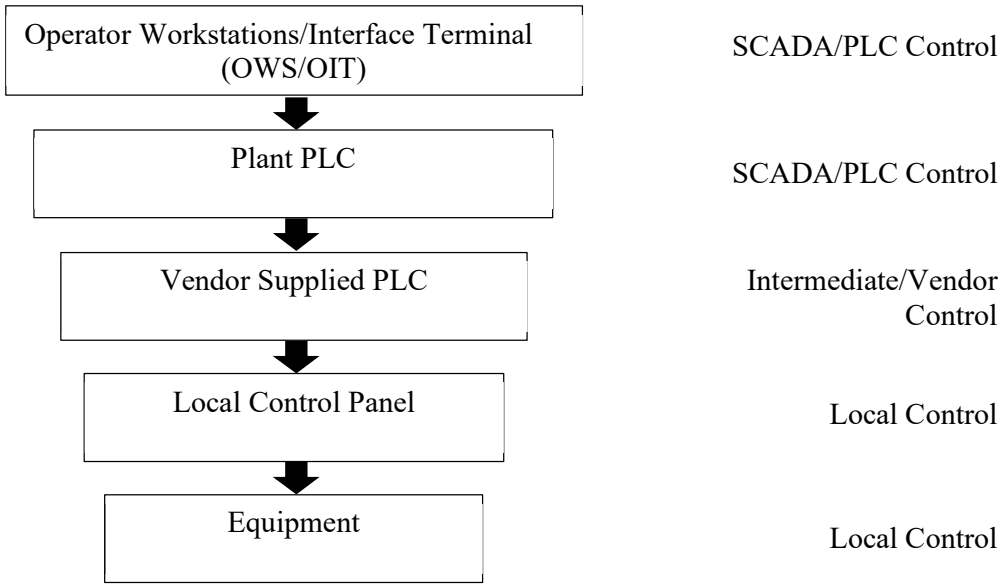

Figure 1. Control System Hierarchy

3.2 GENERAL CONTROLS AND MONITORING

A. Overview:

1. Hardware and/or software functions noted by this Paragraph reference are to be implemented in the PLC control system.

2. Setpoints, as defined by this section, refer to numerical values adjustable from the HMI.
3. PLC is responsible for resetting command bits sent from the HMI to the PLC. If the commanded state cannot be achieved for any reason, the PLC resets the bit to allow the operator to set the command bit again. For example, when pressing the AUTO button on the HMI, the PLC resets the AUTO command from the HMI after the device is in the AUTO Mode. If the AUTO Mode is not available for any reason, the PLC resets the bit, so the AUTO button can be selected at the HMI once AUTO control is available.

B. Interlocks:

1. Hardwired interlocks will interlock the controls locally, at the vendor PLC, and at the plant PLC. If the interlock occurs, the shutdown will cause the equipment to be inoperable at all levels of control.
2. Software interlocks are represented in a particular layer of the operation description and interlock the controls in that layer and the layers above it. However, the interlock does not interlock the commands in the layer before it. For example, a software interlock implemented at the SCADA/PLC level will not stop equipment from being controlled locally.
3. Interlocks that shutdown (stop a piece of equipment and prevent it from being restarted or moved) are displayed on the faceplate pop-up graphic for that piece of equipment.

C. Motors:

1. Provide monitoring and control of the signals shown on the P&IDs.
2. Hardwired and software interlocks are defined in individual loop descriptions.
3. Motors can be started manually by the operator at the HMI, or automatically by the control strategy.
4. Automatic control strategies are defined in individual loop descriptions.
5. The SCADA system stops a motor or drive, if it does not receive the AUTO or REMOTE status or one of its software interlocks trips. If the drive or motor is in HAND or LOCAL, it will continue to run but the SCADA start/stop output will be open.
6. If a motor stops for any reason, it cannot be restarted automatically once the problem with the motor has been resolved. A manual reset from the OWS or OIT is required to resume operation.
7. Motors that have a HAND-OFF-AUTO (HOA) selector, indicate to the operator that the pump is being run in the HAND position. A motor is being run in HAND when the AUTO position is not true and the run confirm status is true. If not in AUTO, the SCADA PLC output contact will open and stop (shutdown) the pump.

D. Valves:

1. Provide monitoring and control of the signals shown on the P&IDs.
2. Hardwired and software interlocks are defined in individual loop descriptions.
3. Valves with only full travel capability can be opened or closed manually by the operator at the HMI, or automatically by the control strategy.
4. Modulating valves with position feedback can be positioned between 0 percent and 100 percent open manually by the operator at the HMI, or automatically by the control strategy.
5. Automatic control strategies are defined in individual loop descriptions with their corresponding process variable used for control.

E. Analog Instruments:

1. Analog instruments refer to indicating devices capable of providing a continuous output relative to time.
2. Provide monitoring of the analog signals shown on the P&IDs.
3. Analog signals may be a continuous voltage (-10V to 10V, 0V to 5V, 0V to 10V) or current (0 mA to 20mA, 4mA to 20mA) as determined by the output of the field instrument. The output range corresponds to the minimum and maximum full-scale measurement.
4. The PLC will linearly scale the output range (voltage or current) to the equivalent values in engineering units.
5. Provide cutoff deadbands for when the analog signal is approaching the minimum or maximum full-scale measurement.

    a. An analog signal measuring less than or equal to 2 percent of full-scale will be forced to zero after an adjustable time delay.
    b. An analog signal measuring greater than 100 percent of full-scale will be clamped at 100 percent.

6. Provide a CALIBRATION mode with an adjustable time setpoint (in hours).

    a. When entering CALIBRATION mode, the last good value is held prior to CALIBRATION mode being activated. The value is held until the calibration time setpoint expires.
    b. The Operator may enter a calibration value, which will be the value held until the calibration time setpoint expires.
    c. When active, clearly indicate the instrument is in CALIBRATION mode on any local OITs and in the HMI system.

F. Discrete Instruments:

1. Discrete instruments refer to indicating devices with any number of non-continuous defined states (e.g., ON/OFF, 0 or 1).
2. Provide monitoring of the discrete signals shown on the P&IDs.

    a. When a contact or status from the instrument is true, the PLC will receive power to its input channel. The PLC registers this as a binary bit of 1.
    b. When a contact or status from the instrument is false, the PLC will receive no power (open circuit) to its input channel. The PLC registers this as a binary bit of 0.

G. PLC Hardware:

1. Monitor status and communication faults at the HMI.

    a. Implement watchdog timers to monitor CPU and I/O module health, and execution time for PLC routines.
    b. Generate an alarm at the HMI if any watchdog timer expires.

2. Program the system time for all PLCs to synchronize with a Network Time Protocol (NTP) server once every 24 hours.

H. Input Validation:

1. Provide input validation for setpoints used in process control (e.g., chemical dosage setpoints, pump flow setpoints).
2. The PLC will verify that the HMI setpoint is within an acceptable predefined range.
3. Out of range values will be rejected by the PLC and the current value will be retained.

3.3 ACCUMULATORS AND TOTALIZERS

A. Accumulators:

1. Display accumulated run time for all equipment with a RUNNING status. Each run time accumulation is resettable from the HMI with a reset push button.
2. PLC will update the flow totals at 12:00 a.m. local time.

Runtime	Display Format
Current Day:	XX.XX Hrs.
Yesterday:	XX.XX Hrs.
Current Month:	XXX.X Hrs.
Previous Month:	XXX.X Hrs.
Accumulated Total:	XXXXXX Hrs.

B. Flow Totalizers:

1. Totalize all flow indications.

   a. If the flowmeter provided has a configurable pulse output for totalized flow, perform flow totalization using the pulse output. The PLC calculates totalized flow by multiplying the number of pulses by the volume per pulse.
   b. If the flowmeter provided does not have a configurable pulse output for totalized flow, perform flow totalization using the analog 4-20mA signal.

      1) Do not totalize if the analog signal is outside the 4-20 mA range.
      2) Do not totalize if the value of the flow input is less than 2 percent of the full range of the input.
      3) Do not totalize if a discrete status exists that can be used to determine if flow is present (for example, no flow can be present unless a pump is running).

2. Each flow totalization is resettable from the HMI/OIT with a reset push button.
3. Display totalized flow in million gallons (MG), thousands of gallons (kGal), or Gallons (Gal) in accordance with the following:

Totalizer	MG Format	kGal Format	Gal Format
Current Day:	X.XXX	XXX.XX	XXXX.X
Yesterday:	X.XXX	XXX.XX	XXXX.X
Current Month:	XXX.X	XXX.X	XXXX
Previous Month:	XXX.X	XXX.X	XXXX
Accumulated Total:	XXXX	XXXX	XXXX

4. Use appropriate flow totalizer units for the total volume anticipated for the time period. Unless requested by Owner, water process flows are totalized in million gallons (MG) and chemical flows are totalized in gallons (Gal). Auxiliary flow (e.g., backwash) units are determined based on the total flow for the day.
5. Chemical systems which do not have flowmeters will calculate usage based on the chemical tank volume. The PLC will calculate tank volume based on the measured level and the vessel geometry or the measured weight and the specific weight of the chemical.
6. PLC will update the flow totals at 12:00 a.m. local time.

3.4 ALARMING AND EQUIPMENT FAILURES

A. Analog Alarms:

1. Provide analog alarming capability for all analog signals monitored by the PLC.
2. Supervisor level users can set a common time setpoint (initially set to 5 seconds) that is used to generate alarms. The following alarms (setpoints to be Supervisor adjustable) are generated based on the analog feedback value. Each alarm includes the ability for individual enabling and disabling.

    a. High-High.
    b. High.
    c. Low.
    d. Low-Low.
    e. Loss of Signal.

3. LOSS OF SIGNAL alarm is generated when an analog signal goes outside the 4-20 mA range due to a failure at the instrument or PLC card. The following SCADA programming occurs:

    a. If the analog signal is used in a control loop or ratio control loop, that loop is placed into MANUAL.
    b. If the analog signal is used in a calculation, that calculation uses the last good analog signal. If the calculation is used in a control loop, that loop is placed into MANUAL.

4. SETPOINT REJECTED alarm is generated at the HMI when an analog setpoint is out of range and rejected by the PLC.

B. Discrete Alarms:

1. Program all discrete alarm signals wired to the PLC (float switches, pressure switches, overload alarms) to alarm after an HMI adjustable time delay expires.
2. The maximum alarm delay for Safety related alarms (e.g., E-stop) is 500ms. Set each alarm timer during startup.

C. Motor Failure Alarms:

1. Supervisor level users can set a common elapsed time setpoint for each scenario below:

    a. Motors being remotely controlled generate a FAIL-TO-START alarm when the PLC sends the START command to the motor and it does not receive a RUNNING status from the motor after a supervisor adjustable time setpoint. When a FAIL-TO-START alarm is generated, the START output command

from the PLC is deenergized and the motor is prevented from starting until a reset is issued from the HMI.

b. Motors being remotely controlled generate a FAIL-TO-STOP alarm when the PLC sends the STOP command to the motor and it continues to run after a supervisor adjustable time setpoint.

c. Motors with adjustable speed control generate a SPEED DEVIATION alarm when the motor is running and the PLC sends a speed setpoint to the motor and it does not reach the correct speed (within a deadband, initially set to 10 percent) within a supervisor adjustable time setpoint. The motor remains running if the SPEED DEVIATION alarm is activated.

D. Valve Failures:

1. Supervisor level users can set a common time setpoint that is used to generate the following alarms. When a valve position alarm is active, the PLC output is maintained unless explicitly stated in the individual loop descriptions (e.g., a fail to open alarm does not trigger the PLC to close the valve).

a. All discrete valves (OPEN-CLOSE) being remotely controlled generate a FAIL-TO-OPEN alarm when the PLC sends the OPEN command to the valve and it does not reach the OPENED limit within a supervisor adjustable time setpoint.

b. All discrete valves (OPEN-CLOSE) being remotely controlled generate a FAIL-TO-CLOSE alarm when the PLC sends the CLOSE command to the valve and it does not reach the CLOSED limit within a supervisor adjustable time setpoint.

c. All modulating valves (POSITIONING) being remotely controlled generate a FAIL-TO-POSITION alarm when the valve feedback does not match the PLC commanded position within a supervisor adjustable time setpoint.

3.5 AUTOMATIC CONTROLS

A. Lead/Lag and Duty/Standby Strategy:

1. Pump Priority:

a. When pumps are called to operate by the automatic sequence, the order of their priority is determined by the following mode selection.

1) Operator Mode: The operator manually selects the priority of each pump (LEAD/LAG/STANDBY/OFFLINE) using radio buttons on a popup display. The order can be changed at any time, but no two pumps can be selected to have the same priority. The pump cannot run in automatic mode or be used in any of the following automatic sequences if placed OFFLINE.

2) Alternation Mode: Used for pumps operating in a DUTY/STANDBY configuration. The pump priorities are rotated each time the DUTY pump is stopped by the control strategy.

3) Sequential Mode: Used for groups of three or more pumps (e.g., LEAD/LAG/STANDBY). The pumps are inserted into the sequence in ascending numerical order and the PLC rotates the pumps using a revolving queue. After an adjustable time setpoint expires, the LEAD pump becomes the STANDBY and the previous LAG pump becoming the new LEAD.

2. Automatic Operation:

    a. If the individual loop description requires that the pumps operate in the LEAD/LAG/STANDBY mode, the LAG is called to start when the following conditions are met after a time delay. If more than one LAG pump is included in the strategy (LEAD/LAG1/LAG2/STANDBY), the sequence repeats.

        1) LEAD pump is running at maximum speed for an adjustable length of time.
        2) The process variable being controlled is more than 5 percent from the target value. For example, in flow control, the flow must be 5 percent below the target.

    b. If multiple pumps are called to run by the automatic logic, the pumps will run at the same speed.
    c. If the automatic strategy determines that a pump is needed and the pump for the required sequence position is unavailable, the pump with the next highest position immediately starts.
    d. If the individual loop description requires the pumps to operate in the DUTY/STANDBY mode, the STANDBY pump only starts if the DUTY pump is not available to run when called to start by the automatic strategy.

B. PID Control:

1. When individual control loops require PID control, use the PLC manufacturer's standard PID control functions. Provide a PID faceplate with the following parameters:

    a. Setpoint (SP): Reference to the setpoint. This is the setpoint entered (either manually from the HMI or via program logic, as required by the individual loop description) and is maintained by the PID controller.
    b. Process Variable (PV): Reference to the process variable. The process variable is the feedback from a field device or instrument for comparison to the SP by the PID controller.
    c. Output (CV): Reference to the controlled variable. This is the signal varied by the PID controller in order to maintain the PV at the desired SP.

2. PID controller accepts inputs for proportional (P), integral (I), and derivative (D) setpoints used to tune the controller response. PID tuning parameters can be entered manually by the Operator at the HMI or calculated automatically if the PID controller supports autotuning functionality.
3. Operator can place the PID controller in MANUAL or AUTOMATIC mode.

    a. In MANUAL, the Operator will enter the desired output (CV). The PID controller will use setpoint tracking to write the process variable (PV) to the controller setpoint (SP) to ensure bumpless transfer when the controller is switched from MANUAL to AUTO.
    b. In AUTO, the PID controller adjusts the output (CV) to hold the process variable (PV) at the setpoint (SP).

4. Configure PID controller to prevent reset windup when operating in MANUAL mode or when the output (CV) has reached maximum limit.

3.6 INDIVIDUAL CONTROL DESCRIPTIONS AND CONTROL SEQUENCES

LOOP 1201, 1202, 1203 WELL DISCHARGE FLOW

A. General:

1. Continuous monitoring of raw water flow by means of a flow transmitter to SCADA.

B. Control:

1. Raw water flow indication used to control the Wells described in WELL MONITORING AND CONTROL.

C. Alarms/Monitoring:

1. Provide flow totalization, analog alarming, and monitoring as described in “Accumulators and Totalizers,” “General Controls and Monitoring,” and “Alarming and Equipment Failures” Articles of this Section.

2. Generate a NO FLOW alarm if no flow is measured while any of the Wells are running.

D. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this Section.

LOOP 1201, 1202, 1203 WELL LEVEL

A. General:

1. Continuous monitoring of Well Draw Down Level by means of a level transmitter to SCADA.

B. Control:

1. Level indication used to control the Wells described in WELL MONITORING AND CONTROL.

C. Alarms/Monitoring:

1. Provide analog alarming and monitoring as described in “General Controls and Monitoring,” and “Alarming and Equipment Failures” Articles of this Section.

D. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this Section.

LOOP 1201, 1202, 1203 WELL DISCHARGE PRESSURE

A. General:

1. Continuous monitoring of Well Discharge Pressure by means of a pressure transmitter to SCADA.

B. Control:

1. Pressure indication used to control the Wells described in WELL MONITORING AND CONTROL.

C. Alarms/Monitoring:

1. Provide analog alarming and monitoring as described in “General Controls and Monitoring,” and “Alarming and Equipment Failures” Articles of this Section.

D. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this Section.

LOOP 1201, 1202, 1203 WELL MONITORING AND CONTROL

A. General:

1. Wells shall run locally via the Local Pump Control Panel. Wells shall be able to be controlled remotely via SCADA. When in Remote/Manual mode, operations shall start and stop a well pump and enter the well pump speed. When in Remote/Auto mode, the VFD shall modulate the well pump speed to maintain a flow setpoint as entered by the operator via SCADA. In Remote/Auto mode, the well pumps 1 and 2 shall not start automatically, they must be started by the operator. In Remote/Auto mode, well pump 3 shall start and stop based on discharge lake level setpoints.

B. Interlocks:

1. Permissives for well pumps 1 and 2 to run include the either destination valves are open.

C. Alarms/Monitoring:

1. Provide alarming and monitoring as described in “General Controls and Monitoring,” and “Alarming and Equipment Failures” Articles of this Section.

D. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this Section.

LOOP 1205 WELL PUMP 1/2 ROUTING VALVE

E. General:

1. The well pump routing valve shall be controlled locally via the local valve actuator. The well pump routing valve shall be able to be controlled remotely via SCADA. When in Remote/Manual mode, operations shall open and close the well pump routing valve. There is no Remote/Auto mode.

F. Interlocks:

1. None.

G. Alarms/Monitoring:

1. Provide alarming and monitoring as described in “General Controls and Monitoring,” and “Alarming and Equipment Failures” Articles of this Section.

H. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this Section.

END OF SECTION 406196

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SECTION 406343 - PROGRAMMABLE LOGIC CONTROLLERS

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 programmable logic controllers<Insert description of any other essential item included in the Section.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.3 DEFINITIONS

A. Analog Input (AI): An electrical signal (1-5 Volts DC or 4-20 milliamps, for example) to be interpreted by a PLC.

B. Analog Output (AO): An electrical signal (1-5 Volts DC or 4-20 milliamps, for example) sent from a PLC to a field device.

C. Digital/Discrete Input (DI): A binary signal (0 or 1) to be interpreted by a PLC.

D. Digital/Discrete Output (DO): A binary signal (0 or 1) sent from a PLC to a field device.

E. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

F. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.

G. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

H. Peer to Peer: Communication between two or more devices, typically PLC’s, in which each device can control the communication exchange.

I. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

J. Remote I/O (RIO): I/O that is located remotely from the processor. Remote I/O can communicate over a variety of communication protocol and can use standard rack based I/O, or specialized Remote I/O hardware referred to as Distributed I/O.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. 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 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. I/O Cards: Provide spares for each unique I/O module type installed. Provide two or 10 percent of installed quantity, whichever is greater.
2. Network interface, remote I/O, and communication modules: Provide one spare module for each unique type of module installed.
3. Miscellaneous components (including cables): Provide spares for each unique component installed.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.9 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Configuration: Networked programmable controller incorporated into system control panel.

2.2 SPARE I/O, SLOTS, AND FUTURE EXPANSION

A. Spare PLC I/O:

1. Provide 20 percent minimum of four points per type (AI, AO, DI, and DO) for future use, regardless of whether any of those point types are used in that panel or not.
2. Provide spare I/O points of same type of I/O modules supplied.

B. Future PLC Expansion (Non-Chassis-Based PLC Systems):

1. Provide adequate space to the right of the last I/O card per row of I/O cards for 2 future I/O cards.
2. Card width based on the widest I/O card provided in panel.
3. Wire all unused points on all I/O to terminal blocks in the order that they occur on the I/O modules. Wire all unused points complete with fuses, surge protectors, relays, and any other accessories that are provided with active points of the same type.

2.3 COMPACT PLC SYSTEM

A. Manufacturers:

1. Provide all PLCs from a single manufacturer. If the PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third-party vendors will be acceptable.
2. Manufacturers and their products are subject to compliance with requirements. Provide the following:

    a. Rockwell Automation Allen-Bradley – 1769-L33(L3) CompactLogix.
    b. Remote I/O:
        1) Rockwell Automation Allen-Bradley FlexIO.

    c. Substitutions: Not Permitted.

B. General:

1. Provide processor, power supply, I/O modules, communication modules, and remote interface modules as required to meet system requirements.
2. PLC is modular based, rather than chassis-based.
3. Listed and classified by UL, CSA, or FM approval as suitable for purpose specified and indicated.
4. Contains the required memory and functional capacity to perform the specified sequence of operation with the scheduled inputs and output points.
5. Designed for continuous industrial service.

6. Provide products of a single manufacturer.
7. Provide equipment models that are currently in production.
8. In the event of power interruption, the system undergoes an orderly shutdown with no loss of memory and resumes normal operation without manual intervention when power is restored.
9. Provide PLCs that communicate between workstations, servers, instruments, switches, controllers, process actuators, etc. as shown on the Drawings.
10. PLC capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.

C. Physical:

1. Vibration: 3.5mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-150 Hz. Vibration tested in accordance with IEC 68-2-6 and JIS C 0911. The system is to be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500 Hz. In accordance with one of the following:

    a. DIN rail mounted PLC, 10 – 57 Hz., amplitude 0.075 mm, acceleration 25-100 Hz.
    b. Panel or plate mounted PLC: 2-25 Hz., amplitude 1.6mm, acceleration 25-200 Hz.
    c. In compliance with IEC 60068 and IEC 61131.

2. Shock: 15G, 11msec. Shock tested in accordance with IEC 68-2-27 and JIS C 0912. The system is to be operational during and after testing.
3. Operating Temperature: 32 to 140 degrees F (0 to 60 degrees C).
4. Storage Temperature: -13 to 158 degrees F (-25 to 70 degrees C).
5. Relative Humidity: 10 to 95 percent, non-condensing.
6. Noise Immunity: Tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978.
7. Altitude (Operating): 0 to 6,500 feet (0 to 1,980 meters).
8. Altitude (Storage): 0 to 9,800 feet (0 to 2,990 meters).
9. Degree of protection: NEMA 1 (IP20).
10. All products have corrosion protection.

D. Identification:

1. Identify all major assemblies and sub-assemblies, circuit boards, and devices using permanent labels or markings indicating:

    a. Module product type such as analog or digital.
    b. Module catalog number.
    c. Module major revision number.
    d. Module minor revision number.
    e. Module manufacturer vendor.
    f. Module serial number.

E. Power Supplies:

1. Power Input: 85 to 265VAC, 47 - 63Hz.
2. Provide DC power supplies capable of handling ripple up to 2.4V peak to peak.
3. Power supply provide power for the processor and applicable modules.

4. Provide clearly visible LED to indicate that the incoming power is acceptable, and the output voltage is present.
5. Provide over-current and over-voltage protection designed to operate in most industrial environments without the need for isolation transformers.
6. Size power supplies to accommodate the nominal load plus 30 percent.
7. Provide power supplies capable of sustaining brown out conditions of at least 1/2 of a cycle, a harmonic rate of 10 percent, and continuous operation through momentary interruptions of AC line voltage of 10ms or less.
8. Automatically shut down the PLC system whenever its output power is detected as exceeding 125 percent of its rated power.
9. Provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line.

F. Discrete Input & Output Modules:

1. General:

   a. Digital input and output modules provide ON/OFF detection and actuation capability.
   b. Provide cards of I/O type and count as required to implement the functions specified plus an allowance for active spares, as specified herein.
   c. Provide modules capable of being installed or removed while chassis power is applied.
   d. Provide the following status indicators.

      1) On/Off state of the field device.
      2) Module's communication status.
      3) Module health.

2. Module Specifications – 120VAC Input Module:

   a. Nominal Input Voltage: 120VAC.
   b. On-State Current: 15mA at 132VAC, 47 - 63Hz maximum.
   c. Maximum Off-State Voltage: 20V.
   d. Maximum Off-State Current: 2.5mA.
   e. Number of Points per Card: 16.

3. Module Specification – 120 VAC Solid State Output Module:

   a. For each triac type discrete output, provide an associated interposing relay located in the same control panel. Provide 120 VAC power for relay outputs from the associated motor starter control circuit (when used with motor starters) or other 120 VAC source (when I/O is not associated with a particular motor starter).
   b. Output Voltage Range: 74 - 265 VAC, 47 - 63 Hz.
   c. Output Current Rating:

      1) Per Point: 0.5A maximum at 86 degrees F (30 degrees C); 0.25A maximum at 140 degrees F (60 degrees C); Linear Derating.
      2) Per Module: 4A maximum at 86 degrees F (30 degrees C); 2A maximum at 140 degrees F (60 degrees C); Linear Derating.

d. Surge Current per Point: 5A for 43ms each, repeatable every 2s at 140 degrees F (60 degrees C).
e. Minimum Load Current: 10mA per point.
f. Maximum On-State Voltage Drop: 1.5V peak at 2.0A and 6V peak at load less than 50mA.
g. Maximum Off-State Leakage: 2.5mA per point.
h. Number of Points per Card: 16.

G. Analog Input & Output Modules:

1. General:

a. Analog input modules convert an analog signal (1 to 5 Volts DC, 4 to 20 milliamps, for example) that is connected to the module's screw terminals into a digital value.
b. Furnish analog output modules to convert a digital value that is delivered to the module into an analog signal on the module's screw terminals.
c. Provide modules designed to be installed or removed while power is applied.
d. Provide the following status indicators:

1) Module's communication status.
2) Module health.
3) Input/output devices.

e. Hardware and software indication provided when a module fault has occurred. Each module provided with an LED fault indicator and the programming software displays the fault information.
f. Provide analog modules that are software configurable through the I/O configuration portion of the programming software.
g. Following status can be examined in ladder logic:

1) Module Fault Word: Provides fault summary reporting.
2) Channel Fault Word: Provides under-range, over-range, and communications fault reporting.
3) Channel Status Words: Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms and calibration faults.

h. Provide 24 VDC power for analog instrument loops as a part of the system. Derive 24 VDC power supply from the 120 VAC input power circuit to the PLC. Group the field side of the 24 VDC power sources(s) as individual or grouped (of logically associated circuits) fusing and provide with a readily visible, labeled blown fuse indicator.

2. Differential Analog Input Module:

a. Input Range: 0-20 mA.
b. Resolution: approximately 16 bits across range.
c. Input Impedance: Greater than 249 Ohms.
d. Overvoltage Protection: 8V ac/dc with on-board current resistor.
e. Normal Mode Rejection: 60 dB at 60 Hz.
f. Common Mode Noise Rejection: 120 dB at 60 Hz, 100 dB at 50 Hz.

g. Isolation Voltage:

1) Channel to Ground/Chassis – 100 percent tested at 1000 VDC minimum for 1s based on 250 VAC.

h. Number of Points per Card: 8.

3. Isolated Analog Output Current Module:

a. Output Current Range: 4 to 20 mA.
b. Current Resolution: 12 bits across 20 mA.
c. Open Circuit Detection: None.
d. Output Overvoltage Protection: 24V DC/AC maximum.
e. Output Short Circuit Protection: 20 mA or less (electronically limited).
f. Calibration Accuracy: Better than 0.1 percent of range from 4 mA to 20 mA.
g. Number of Points per Card: 8.

H. Required Accessories:

1. Include all necessary cables as specified by the manufacturer. Assemble and install cables per manufacturer recommendations.

2.4 PLC SOFTWARE

A. Manufacturer: As required to match supplied PLCs.

B. General:

1. Provide PLC configuration and application development software package complete with documentation and installation media.
2. Install PLC software package and associated licensing and/or activation on the computers shown on Drawings.
3. Allows for on-line/off-line program development, annotation, monitoring, debugging, uploading, and downloading of programs to the PLCs.
4. Provide required hardware (including cables, cable adapters, etc.) for connection to PLCs.
5. Provide software licenses required to achieve the functionality described in the Specifications.
6. Include a software license agreement allowing Owner the right to use the software as required for any current or future modification, documentation, or development of the PLCs provide for this project.
7. Provide software capable of the following IEC 61131-3 functions:

a. Ladder logic.
b. Function block.
c. Sequential function chart.
d. Structured text.

8. Add-on instruction editor allows for the development of custom reusable function blocks. The software permits function block modification while on-line.

9. Software is Microsoft Windows-based and run on the supplied computers.
10. Software includes a security feature to prevent unauthorized personnel from modifying and downloading the programs.
11. Provide an I/O simulator which allows the PLC application load program to be tested on a PC with simulated analog and digital inputs and outputs, allowing I/O testing and debugging to be performed in a safe, isolated environment without the need for running the PLC CPU and process I/O boards.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.2 IDENTIFICATION

A. Refer to control system architecture for tagging designations.

END OF SECTION 406343

SECTION 406613 - SWITCHES AND ROUTERS

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 switches and routers.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 406343 “Programmable Logic Controllers.”

1.3 DEFINITIONS

A. Fiber optic Ethernet switch (FOES): An Ethernet based networking device with a combination of fiber optic and copper physical connections.

B. Local Area Network (LAN): A localized group of network devices (e.g. buildings, homes, offices, etc..).

C. Managed Ethernet switch (MES): An Ethernet based networking device that permits the management, configuration, and monitoring of a local area network.

D. Power over Ethernet (PoE): A method of providing electrical current over an Ethernet connection.

E. Small form-factor pluggable (SFP): A hot-pluggable network interface module connecting a device motherboard (Ethernet switch, router, etc..) to a fiber optic or copper networking cable.

F. Unmanaged Ethernet Switch (UMES): An Ethernet based networking device with a fixed configuration (i.e. “plug-and-play” devices).

G. Virtual Private Network (VPN): An encrypted connection between a private network and a public network (the internet).

H. Wide Area Network (WAN): A network that covers a broad geographic area, typically through use of a public network (e.g. communication across cities, national boundaries, etc..).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 TECHNOLOGY OBSOLESCENCE MITIGATION

A. Due to rapidly evolving technology of the equipment specified herein, the requirements specified are to establish a baseline for the type of equipment required. Provide the current version of hardware and software of similar specification at the time of purchase equivalent in cost to that which is specified.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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

2.2 INDUSTRIAL MANAGED ETHERNET SWITCH FOR PLC PANEL

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:

a. Allen-Bradley: Stratix 5800 version.
b. Substitutions: Not Permitted.

B. General:

1. Provide a DIN rail mountable industrial managed Ethernet switch for connection to the network as shown in the Drawings and specified herein.
2. Provide ethernet switches by the same manufacturer for the project, regardless of type.

C. Physical Features:

1. SFP slots: 4 x 1G/10G SFP slots.
2. Copper ports: 8 x 10/100/1000BaseT(X) ports.
3. Operating temperature: 0 to 130 degrees F.
4. Power: redundant 24VDC power input.
5. Enclosure: Metal case.
6. Rating: UL Class 1, Division 2 Groups A, B, C, and D.

D. Network Features:

1. Layer 2 switching.
2. Spanning Tree Protocol (STP).
3. Rapid Spanning Tree Protocol (RSTP) (IEEE 802.1w).
4. Full duplex on all port.
5. Auto negotiation and manual configurable speed and duplex.
6. Wire speed switching fabric.
7. IGMP snooping.
8. IGMP filtering.
9. Configuration password protected.
10. Configuration backup capability required.

11. SNMP V3.
12. Lock port function for blocking unauthorized access based on MAC address.

E. Additional Features:

1. Provide dry contact rated for 24VDC 5A to be used for common trouble alarm and programmable alarm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where computers 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 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 270526 “Grounding and Bonding for Communications Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

A. Switchers and routers will be considered defective if it does not pass tests and inspections.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. For Managed Ethernet Switches:

    a. Enable the lock port function to block unauthorized access based on MAC address for each switch and router. Assign static IP addresses to devices connecting to switch.
    b. Lock down all spare switch and router ports.

3.7 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, ensure service agreement includes software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within 2 years from date of Substantial Completion. Ensure upgrading software includes operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days in advance to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

END OF SECTION 406613

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SECTION 406619 - MEDIA CONVERTERS

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 media converters.

B. Related Requirements:
   1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

   1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 TECHNOLOGY OBSOLESCENCE MITIGATION

A. Not applicable to this Section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.11 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.12 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 COPPER TO FIBER MEDIA CONVERTER

A. Manufacturers
   1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
      a. Rockwell Automation 1783-ETAP1F.
      b. Substitutions: Not allowed.

B. General:

   1. Provide a copper to fiber media converter as shown in the Drawings.

C. Physical Features:

   1. RJ45 port: 10/100/1000BaseT(X)
   2. Fiber uplink: 1000Base-X (LC/ST/SC connectors).

3. Fiber optics: Multi- or single-mode capability as shown in the Drawings.
4. Operating temperature: 0 to 130 degrees F.
5. Power: 24 VDC.
6. Enclosure: DIN-rail mountable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where media converters 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 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 IDENTIFICATION

A. Refer to drawings for tagging designations

3.4 FIELD QUALITY CONTROL

A. Media converters will be considered defective if it does not pass tests and inspections.

B. 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.

3.6 SOFTWARE SERVICE AGREEMENT

A. Not Required

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 406619

SECTION 406717 – INDUSTRIAL ENCLOSURES

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 industrial enclosures.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406733 “Panel Wiring.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Touch-up Paint: Provide touch-up paint of each type and color used for all cabinets, panels, and consoles supplied.

1.8 QUALITY ASSURANCE

A. Perform work in accordance with UL 508.

B. Provide components compatible with functions required to form complete working system.

C. Provide UL 508 label on complete assembly.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 INDUSTRIAL ENCLOSURES PLC PANEL

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. nVent: Hoffman.
b. Rittal.
c. Saginaw.
d. Substitutions: Not Permitted.

B. Structure and Enclosure:

1. Panels in indoor, dry, non-corrosive environments:

a. NEMA 12, painted steel or aluminum construction, as required by the schedule in PART 3.

2. Panels in outdoor, wet, or chemically corrosive environments:

    a. NEMA 4X, stainless-steel or FRP construction, as required by the schedule in PART 3.

3. Panels located in hazardous locations:

    a. Rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).

4. Construction:

    a. Freestanding and floor-mounted vertical panels:

        1) Panels of 12-gauge sheet steel
        2) Front panels or panels containing instruments: provide 10-gauge stretcher-leveled sheet steel, reinforced to prevent warping or distortion.

    b. Wall and Unistrut mounted panels:

        1) Panels no less than 14-gauge steel,

    c. Consoles:

        1) Panels of 12-gauge sheet steel.
        2) Front panels: provide 10-gauge stretcher-leveled sheet steel, reinforced to prevent warping or distortion.

5. Provide angle stiffeners on the back of the panel face to prevent panel deflection under instrument loading or operation, as follows:

    a. Structural framework internal to the panel allows for instrument support and panel bracing.
    b. Interior structure framework to permit panel lifting without racking or distortion.
    c. Removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.

6. Full height and fully gasketed access door with full-length, continuous, piano type stainless steel hinges with stainless steel pins.

    a. Provide doors with three-point stainless steel latch and heavy-duty stainless-steel locking handle.
    b. Provide front access doors of sufficient width to permit instrument or control device mounting without interference from flush mounted instruments.
    c. Clamp-type door latches are not permitted.

7. Avoid kinks and sharp bends in wiring.

    a. Route wiring for easy access to other components for maintenance and inspection purposes.

8. Panel suitable for top and bottom conduit entry as required by the Electrical Drawings

    a. For top mounted conduit entry, provide panel top with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations.
    b. Provide all conduit and cable penetrations with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

C. General Requirements:

1. UL labeled control panels and cabinets.

    a. UL listing includes enclosure, specific equipment supplied with enclosure, and equipment installation and wiring within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and other equipment necessary to achieve compliance with UL 508A requirement. The Drawings do not detail all UL 508A requirements.

2. Panel door handles with lock, or a hasp and staple for padlocking: key the locks for all control panels provided under this Contract alike.
3. Arrange devices for rear of panel mounting within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment.

    a. Locate heat generating devices, such as power supplies, at or near the top of the panel.

4. Mount all components in a manner that permits servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component.

    a. Mount interior panel components on removable plates (sub-panels) and not directly on the enclosure.
    b. Unless shock mounting is required by the manufacturer to protect equipment from vibration, provide rigid and stable mounting.
    c. Mount and orient components in accordance with manufacturer's recommendations.
    d. Identify internal components with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawings and specifications.

5. Mount all panel components on a single rear-of-panel sub-panel unless the density of devices exceeds the panel mounting space permitted by the minimum panel dimensions specified. Side panel mounted components are not permitted without review and approval by Engineer.

6. Type 316 stainless-steel hardware and fasteners:

    a. Provide drilled and tapped mounting screws; self-tapping screws are not permitted.

7. Install suitable gaskets and faceplates, required to maintain NEMA rating of the panel.

D. Mounting Elevations:

1. Refer to ISA Recommended Practice RP60.3 for guidance on layout and arrangement of panels and panel mount components. Account for housekeeping pad dimensions.
2. Locate centerline of indicators and controllers no lower than 48 inches or higher than 66 inches above the floor on a panel face.
3. Locate centerline of lights, selector switches, and pushbuttons no lower than 32 inches or higher than 70 inches above the floor on a panel face.
4. Locate tops of annunciators no higher than 86 inches above the floor on a panel face.
5. Install panel components in accordance with manufacturer's guidelines.

2.2 INDUSTRIAL ENCLOSURES VIDEO PANEL

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Tripp Lite Smart Rack 5U Low-Profile Vertical-Mount. Switch-Depth Wall-Mount Rack Enclosure, SRWF5U
b. Substitutions: Not Permitted.

2.3 TEMPERATURE CONTROL

A. Provide force air ventilation or air conditioning units as required to prevent temperature buildup inside of panel.

B. Heat Load Calculations:

1. Submit heat load calculations for all control panels located in areas where either venting is not possible due to NEMA rating of panel or control panel is located in an area or building without air conditioning.
2. Utilize manufacturer available thermal calculators to determine heating/cooling requirements (i.e. Saginaw SCE thermal calculator, nVent Hoffman cooling selection tool, or equivalent).
3. Ensure the internal temperature of the panel is regulated between 45 to 104 degrees F (7 to 40 degrees C) under all conditions.
4. Account for the following conditions in the heat load calculations:

a. Loading and dissipation effects on all surfaces of the enclosure. Account for surfaces not available for heat transfer (e.g., against a wall).
b. Internal heat load of components (load and duty cycle).
c. For outside temperature limits, refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

C. Sun Shields:

1. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:

a. Fabricate sun shields from a material suited for the area classification rating of its environment.
b. Design, fabricate, install, and support the unit to fully cover and shade the top, sides, and back of the enclosure, and to partially shade the front panel of the enclosure from direct exposure to sunlight from sunrise to sunset.
c. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure, to preserve rigidity.
d. Design and mount sun shields with a minimum 3-inch air gap around the enclosure for air circulation and heat dissipation.
e. Drilling holes or welding studs directly to the enclosure for sun shield mounting is not permitted.
f. Slope the top section of the sun shield a minimum angle of 5 degrees from horizontal.

    1) Wall mounted enclosures: slope the top section downward away from the wall and towards the front of the enclosure.
    2) Free standing, floor mounted, and frame mounted enclosures: slope the top section downward towards the back side of the enclosure.

g. Incorporate a narrow and more steeply sloped drip shield segment on the front edge of the top section to shed water away from the front of the enclosure and prevent dripping or running directly onto the front panel of the enclosure.
h. Fabricate sun shields with continuous seam welds that are ground smooth.
i. Smooth round or chamfer exposed corners, edges, and projections to prevent injury.

D. Louvers

1. If louvers are used, provide louver plate and filter kit.
2. Provide louver plates of stamped sheet metal construction.
3. Provide washable and replaceable filters.
4. Install louvers on the rear, top, or bottom of the panel, as required by the panel installation location.
5. For wall mounted enclosures with their backs directly adjacent to a wall, install louvers on the sides.

E. Forced Air Ventilation:

1. Provide forced air ventilation fans to create positive internal pressure within the panel.
2. Provide washable and replaceable filters.
3. Fan motors operate on 24 VDC.

F. Air Conditioning:

1. For panels with internal heat that cannot be adequately dissipated with natural convention and heat sinks, or forced air ventilation, provide an air conditioner sized to deliver sufficient cooling.
2. NEMA rating equivalent to the NEMA rating of the panel. Maintain NEMA rating of panel when installed.
3. Provide air conditioner with conformal coating on exposed surfaces.

4. Mount air conditioners on panel side. If provided, cut sun shields to accommodate air conditioner.

G. Heating:

1. Provide an integral heater, fan, and adjustable thermostat for outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture, to reduce condensation and maintain the minimum internal panel temperature.

    a. Mount unit near enclosure bottom with discharge away from heat-sensitive equipment.
    b. Provide Hoffman DAH series, Stego PTC series, or equal.

2.4 ACCESSORIES

A. Nameplates

1. Identify the panel and individual devices as required, unless otherwise indicated:

    a. Include up to three lines:

        1) First line containing the device tag number as shown on the Drawings.
        2) Second line containing a functional description (e.g., Recirculation Pump No. 1).
        3) Third line containing a functional control description (e.g., Start).

2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings:

    a. Furnish nameplates as 3/32-inch thick, black against white background unless otherwise noted, Lamicoid with engraved inscriptions. Bevel and smooth edges of nameplate.
    b. Nameplates with chipped or rough edges are not acceptable.

3. Mount or fasten cabinet mounted nameplates with epoxy adhesive or stainless-steel screws.
4. Provide a panel nameplate with a minimum of 1-inch high letters for every panel.
5. Provide legend plates or 1-inch by 3-inch engraved nameplates with 1/4-inch lettering for identification of door mounted control devices, pilot lights, and meters.
6. Use single Lamicoid nameplates with multiple legends for grouping of devices such as selector switches and pilot lights that relate to one function.

B. Print Storage Pockets

1. Provide print storage pockets of steel construction, welded onto the door of the enclosure.
2. Size storage pockets to accommodate all prints required to service the equipment, and to accommodate 8.5-inch by 11-inch documents without folding.

C. Corrosion Control

1. Protect panels from internal corrosion by use of corrosion-inhibiting vapor capsules. Size and quantity as necessary per manufacturer recommendations.

2. Manufacturer:

a. Zerust VC.
b. Hoffman Model AHCI.
c. Or equal.

2.5 GENERAL FINISH REQUIREMENTS

A. Descale, degrease, fill, grind and finish sections.

B. Finish steel-fabricated enclosures with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which are applied by either hot air spray or conventional cold spray methods.

1. Brushed anodized aluminum, stainless steel, and FRP panels do not require a paint finish.

C. Grind smooth, sandblast and then clean with solvent. Fill surface voids and grind smooth.

D. Immediately after cleaning, apply one coat of a rust-inhibiting primer inside and outside, followed by an exterior intermediate and topcoat of a two-component type epoxy enamel.

1. Apply final sanding to the intermediate exterior coat before top coating.

E. Apply a minimum of two coats of manufacturer’s standard, flat light-colored lacquer, on the panel interior after priming.

F. Unless otherwise noted, finish exterior colors as ANSI 61 gray with textured finish.

G. Finish products after assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where industrial enclosures 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 INSTALLATION

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 ADJUSTING

A. Adjust hardware and moving parts to function smoothly and lubricate as recommended by manufacturer.

PART 4 - INDUSTRIAL ENCLOSURE SCHEDULE

A. Provide the following industrial enclosures:

Table 1. Industrial Enclosure Schedule

Panel Designation	Minimum Size	Maximum Size	Enclosure Rating	General Requirements
PLC-W1	36 x 36 x 20 inches	48 x 36 x 20 inches	NEMA 4X	Wall mounted, single door with sunshield.
PLC-W2	36 x 36 x 20 inches	48 x 36 x 20 inches	NEMA 4X	Wall mounted, single door with sunshield.
PLC-W3	36 x 36 x 20 inches	48 x 36 x 20 inches	NEMA 4X	Wall mounted, single door with sunshield.
FTC-1	24 x 24 x 12 inches	24 x 24 x 12 inches	NEMA 4X	Wall mounted, single door with sunshield.

END OF SECTION 406717

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SECTION 406733 - PANEL WIRING

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 requirements for internal wiring of control panels and consoles.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 406763 “Control Panel Mounted UPS.”
4. Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”

1.3 DEFINITIONS

A. American Wire Gage (AWG): Measurement of the cross-sectional area of a conductor.

B. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

C. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

D. 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.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Perform work in accordance with UL 508.

B. Provide components compatible with functions required to form complete working system.

C. Provide UL 508 label on complete assembly.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring:

1. Provide stranded, type MTW interconnecting wiring:

a. Use 600-volt insulation rated for not less than 90 degrees Celsius.
b. Segregate wiring for systems operating at voltages in excess of 120 VAC from other panel wiring.

1) Locate either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier.

c. Develop panel layout such that technicians have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.

2. For power distribution wiring on the line side of fuses or breakers:

    a. Use 12 AWG minimum.
    b. For control wiring on the secondary side of fuses:

        1) Use 16 AWG minimum.
        2) Utilize 18 AWG shielded, twisted pair cable insulated for not less than 600 volts for electronic analog circuits.

3. Cover power distribution blocks with protective guards to meet “finger-safe” requirements of IP20.
4. Route power and low voltage DC wiring systems in separate wireways.

    a. Cross different system wires at right angles.
    b. Separate different system wires routed parallel to each other by at least 6-inches.
    c. Terminate different wiring systems on separate terminal blocks.
    d. Do not fill wiring troughs to more than 60 percent visible fill.

5. Terminations:

    a. Terminate wiring onto single tier terminal blocks:

        1) Uniquely and sequentially number each terminal block.
        2) Direct wiring between field equipment and panel components is not acceptable.
        3) Multi-level terminal blocks or strips are not acceptable.

    b. Arrange terminal blocks in vertical rows and separated into groups (power, AC control, DC signal).

        1) Provide each group of terminal blocks with a minimum of 25 percent spares.

    c. Use compression type, fused, unfused, or switched terminal blocks.

        1) Use two terminals per point for discrete inputs and outputs (DI and DO) with adjacent terminal assignments.
        2) Wire all active and spare PLC and controller points to terminal blocks.

    d. Use three terminals per point for analog inputs and outputs (AI and AO) per shielded pair connection with adjacent terminal assignments for each point.

        1) The third terminal is for shielded ground connection for cable pairs.

            a) Ground the shielded signal cable at the PLC cabinet.
            b) Wire all active and spare PLC and controller points to terminal blocks.

    e. Use sleeve-type wire and tube markers with heat impressed letters and numbers.
    f. Use only one side of a terminal block row for internal wiring.

1) Field wiring side of the terminal not to be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free-standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.

g. Isolate circuit power from the SCADA cabinet to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards with an isolating switch terminal block with flip cover that is supplied with a dummy fuse.

1) Use Phoenix Contact CLIPLINE series or equal.
2) One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.

h. Isolate all PLC discrete outputs to the field with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator.

1) Use Phoenix Contact CLIPLINE series or equal.

6. Clearly identify wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection as such.
7. Clearly tag and color code wiring.

a. Tag numbers and color coding to correspond to panel wiring diagrams and loop drawings prepared by the PCSS.
b. Power wiring, control wiring, grounding, and DC wiring to utilize different color insulation for each wiring system used.
c. Color coding scheme to be in accordance with UL 508a, following the below criteria:

1) 120 VAC ➔Hot Black
2) 120 VAC Neutral ➔ White
3) 120 VAC Hot (Foreign) ➔ Yellow
4) 120 VAC Return (Foreign)➔ Yellow
5) Switched Hot ➔Red
6) 24 VDC + ➔Blue
7) 24 VDC - ➔White on Blue
8) 4-20 mA + ➔Red
9) 4-20 mA - ➔Black
10) Ground-Signal ➔Green
11) Ground-Panel ➔Yellow on Green

8. Provide surge protectors on all incoming power supply lines at each panel per requirements of Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”

9. Each field instrument furnished under Division 40 and shown on the Drawings as deriving input power from the control panel(s) to have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication.

    a. Power instruments requiring 120VAC power as shown on the drawings.

10. Wiring trough for supporting internal wiring:

    a. Plastic type with snap-on covers.
    b. Side walls to be open top type to permit wire changing without disconnecting.
    c. Trough to be supported to the subpanel by stainless steel screws.
    d. Do not bond trough to the panel with glue or adhesives.

11. Provide each panel with a single tube, LED light fixture, 20 Watt in size (minimum)

    a. Mounted internally to the ceiling of the panel.
    b. Light fixture to be switched and be complete with the lamp.

12. Each panel to have a specification grade duplex convenience receptacle with ground fault interrupter:

    a. Mount internally within a stamped steel device box with appropriate cover.
    b. Convenience receptacle is not to be powered from a UPS.
    c. Protect by a dedicated fuse or circuit breaker.

13. Each panel to be provided with an isolated copper grounding bus for all signal and shield ground connections.

    a. Shield grounding to be in accordance with the instrumentation manufacturer's recommendations.

14. Provide each panel with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
15. Each panel to have control, signal, and communication line surge suppression in accordance with Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”
16. Microprocessor-based electronic devices in the panel that are powered by 120VAC to be powered by the UPS.
17. Provide each panel with a circuit breaker to interrupt incoming power.
18. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. to be in compliance with the requirements of Division 26.

B. Relays not provided under Division 26 and required for properly completing the control function specified in Division 40, Division 26 or shown on the Drawings to be provided under this Section.

C. Orientation of devices including PLC and I/O when installed to be per the manufacturer's recommendations.

1. No vertical orientation of PLC racks are allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and also approved by the Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: 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 270526 “Grounding and Bonding for Communications Systems.”

END OF SECTION 406733

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.
2. Section 406717 “Industrial Enclosures.”

1.3 DEFINITIONS

A. Uninterruptible Power Supply (UPS): A device capable of providing emergency battery power when the main power source fails.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 TECHNOLOGY OBSOLESCENCE MITIGATION

A. Not applicable to this Section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.11 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.12 WARRANTY

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. [Provide the following:

a. Phoenix Contact QUINT4-UPS-DC-IQ.
b. Substitutions: Not Permitted.

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. UPS must be EthernetI/P capable with Allen Bradley AOP.
3. Current limiting circuitry to protect inverter output under any load condition.
4. 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.

5. Suitable for installation in a UL508A listed panel.
6. DIN rail mountable.
7. UL recognized components for industrial applications in accordance with UL508 without derating.

D. Performance Requirements:

1. Ratings:

    a. Output power: 24 VDC.
    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. Acoustical Noise:

    a. Noise generated by UPS under normal operation not to exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 25 degrees C (77 degrees F) and full load.

6. 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:

1) Isolated SPDT dry contacts provided to indicate UPS status for remote monitoring. Contacts rated for 250VAC @ 5A or 30VDC @ 5A

a) Individual contacts provide for separate annunciation of the following alarm and status conditions:

a. UPS Running on Battery.
b. UPS Fail.

2) Provide the following information via Ethernet/IP communications:

a. UPS Running on Battery.
b. Battery low.
c. Replace Battery.
d. UPS Fail.
e. UPS runtime.
f. UPS used runtime.
g. Battery mode runtime.
h. Charger fail.
i. Battery end of lifetime.

PART 3 - EXECUTION

3.1

3.1 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. 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 270526 “Grounding and Bonding for Communications Systems.”

3.3 IDENTIFICATION

A. Refer to drawings for tagging designations.

3.4 FIELD QUALITY CONTROL

A. Uninterruptible power supplies will be considered defective if it does not pass tests and inspections.

B. 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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SECTION 406866 - CONFIGURATION OF CONTROLLER SOFTWARE

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: If referred to anywhere else in the project manual, AE or AESS services include, but are not limited to, those services specified in this Section.

B. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system. Control all equipment in full conformity with the Contract Drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment.

1. Provide configuration of the PLC provided for all equipment shown on Drawings, except for controls equipment shown being provided as part of a vendor package system.

C. Coordinate all work with plant operating personnel to minimize impacts on daily operation. Note delays caused for any reason and formally submitted to Engineer and Owner in the form of a letter.

D. Related Requirements:
1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406196 “Process Control Descriptions.”
3. Section 406343 “Programmable Logic Controllers.”

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): Entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

B. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.

C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

D. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

E. Process Control System Supplier (PCSS): Entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

F. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

1.4 PREINSTALLATION MEETINGS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.” The meetings below are in addition to the meetings specified in that section.

1.5 ACTION SUBMITTALS

A. Controller Program Submittal:
   1. For each controller, submit the following using the controller manufacturer's built-in printing functions. Electronic submission of Adobe Portable Document Format ("pdf") files in lieu of paper submittals is acceptable. Review will be for general program organization, level of documentation, and overall programming standards (basic pump and valve control, for example). The review will not attempt to confirm the logic works correctly for every loop.

      a. PLC programs showing ladder logic, function block, high level language or another controller language used. Include individual rung, network, and/or command descriptions with abundant comments to clearly identify function and intent of each code segment. Clearly present each logic segment, describe the function of each timer, label and define the purpose of each subroutine call, etc. Ensure that program documentation is sufficiently clear to allow determination of compliance with the process control requirements included in the control descriptions and with the Drawings. The submittal demonstrates that all logic provided under this project follows the same structure and format and reflects a common programming approach.
      b. Submit a memory usage report for the controller. Indicate total memory capacity and unused memory capacity.
      c. Submit cross reference index of I/O allocation and controller memory address. Include every physical I/O point as well calculated or virtual I/O required for the implementation of the process scheme.

   2. Submit details of control system communication. Submit a "memory map" or other means showing which signals are exchanged between PLCs. Also submit an HMI tag database showing all signals exchanged between the PLCs and HMI. Define any specific communication block memory addresses.

B. Submit all electronic files associated with the controller such that Owner and Engineer can open a complete copy of the controller program using the controllers native programming package.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONTROLLER PROGRAMS

A. Develop application programs in a structured manner and follow an intuitive arrangement so that an instrumentation technician with basic programming knowledge will be able to understand. Utilize standard program templates or subroutines for repetitive logic such as equipment control, flow total calculations, equipment runtime calculations.

B. Make changes to application programs and software configuration, based on comments during submittals, factory tests, field tests, and during commissioning process to meet the design intent.

END OF SECTION 406866

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SECTION 407000 - INSTRUMENTATION FOR PROCESS SYSTEMS

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 the general requirements to furnishing, installing, and servicing PCSS provided instruments.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 4071XX “Sections for flow measurement.”
3. Section 4073XX “Sections for pressure, strain, and force measurement.”

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): Entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Section 4071XX “Sections for flow measurement”: The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 ACTION SUBMITTALS

A. Submit complete documentation for all field instruments in one comprehensive submittal. Use ISA-TR20.00.01-2007 data sheet format as a cover sheet for each instrument prior to data sheets. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment, sorted by Loop Number.

B. Submit separate data sheets for each instrument type:

1. Plant Equipment Number and ISA tag number per Drawings.
2. Product (item) name used herein and on Drawings.
3. Manufacturer's complete model number.
4. Location of the device.
5. Input - output characteristics.
6. Range, size, and graduations in engineering units.

C. Submit the following information for each instrument type:

1. Include construction details, material descriptions, dimensions of individual components and profiles.
2. Sizing calculations where applicable.
3. Indicate which instruments will be provided with certified calibration data (i.e., all flow metering devices) as part of O&M manual.
4. Include rated capacities, operating characteristics, electrical characteristics and furnished specialties and accessories.
5. Two-wire or four-wire device type as applicable.
6. Indicate which instruments will be provided with manufacturer's maintenance services if specified.

D. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Refer to individual instrument specifications for spare parts requirements.

B. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for PCSS requirements regarding submission of maintenance materials.

1.8 QUALITY ASSURANCE

A. Refer to individual instrument specifications for quality assurance requirements as well as which specific instruments require manufacturer's start-up and training services.

B. Provide components compatible with functions required to form complete working system.

C. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for overall quality assurance requirements for PCSS scope of work.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 INSTRUMENT TAGS

A. Permanent stainless steel or other non-corrosive material tag firmly attached and indelibly marked with the instrument tag number, as indicated in the Drawings. Tag equipment before shipping to the site.

B. Provide 1/8-inch by 3/8-inch, Type 316 stainless-steel button head machine screws.

C. All supplied instrument transmitters and instrument transmitter elements require a stainless-steel identification tag.

1. Attach tag via stainless-steel chain or stainless-steel wire, 24-gauge minimum, to a non-removable part of the device.
2. Stamp the ISA alphanumeric instrument number as indicated on the P&ID, loop, or detail drawings into the tag.
3. Minimum tag size is 1 inch H x 3 inch W with 3/16 inch thick alphanumeric characters.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See installation requirements in individual specification sections.

B. Refer to Instrumentation Drawings.

END OF SECTION 407000

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SECTION 407113 - MAGNETIC FLOW METERS

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 magnetic flow meters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.5 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

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

1.6 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Furnish sensors, field preamplifiers, signal conditioners, offset and span adjustments, amplifiers, transducers, transmitters, control devices, interconnecting cables, and unit conversions and algorithms as required for application.

2.2 MAGNETIC FLOW METERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following or equal:

a. Endress-Hauser Promag W400.
b. Substitutions: Not Permitted.

B. General:

1. Low-frequency, electromagnetic induction-type flow meter, producing a linear signal directly proportional to flow rate, consisting of flow tube, signal cable, and transmitter.

C. Type:

1. Between-flange mounting.
2. Comply with AWWA M33.

D. Performance and Design Criteria:

1. Process Fluid: Refer to Device Schedule.
2. Accuracy: Plus or minus 0.5 percent of actual flow rate over a 30:1 range, within velocity limits of 0.1 to 10 ft/sec (0.03 to 3.04 meters/sec).
3. Flow Tubes:

a. Body Material: Carbon Steel.

4. Liner: Polyurethane or hard rubber.

5. Flanges: ANSI 150 lb. or DIN PN 16.
6. Flange Material: Stainless steel.
7. Environment: For meters with remote mounted transmitters, meters below grade to be suitable for submergence for up to 48 hours to a depth of 30 feet (9 m). Meters above grade to be NEMA 4X (IP65).
8. Electrodes:

    a. Type 316L stainless steel.
    b. Bullet-nose, self-cleaning.

E. Accessories:

1. Rated for hazardous area, Class I, Division 2.
2. Provide manufacturer cable between transmitter and receiver.
3. Furnish stainless-steel grounding rings, wires, and gaskets as recommended by the manufacturer. All materials must be suitable for the process and surrounding pipe.

2.3 TRANSMITTERS

A. Manufacturer: Same manufacturer as meter.

B. Transmitter Output:

1. 4- to 20-mA DC analog signal.

C. Housing: NEMA 4X (IP65), suitable for surface or pipe stand mounting.

D. Display:

1. Touch-screen programming, functioning through enclosure window without opening enclosure.
2. Size: Four lines by 16 characters.
3. Type: Backlit digital display.
4. User-selectable engineering units.
5. Readout of diagnostic error messages.

E. Control Power:

1. 120VAC, single phase, 60 Hz.
2. Provide local transformers as required.

F. Mounting:

1. Mounting: Remote, up to 30 feet from flow meter.

G. Required Accessories:

1. A fully configurable and locally viewable totalizer integral to the transmitter.
2. Current signal output simulation.
3. Empty pipe detection.
4. Self-diagnostics.

5. Signal Cable: Provided by flow meter manufacturer.
6. Automatic zero adjust.
7. For outdoor installations, provide sunshield of sturdy, corrosion- and UV-resistant material.

2.4 DEVICE SCHEDULE

A. Well Discharge Flow, FE/FIT-1201, FE/FIT-1202, FE/FIT-1203.

1. Meter Size: 6 inch.
2. Flow Range: 0 – 600 gpm.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.2 IDENTIFICATION

A. Refer to item in this specification for tagging designation.

END OF SECTION 407113

SECTION 407243 - PRESSURE AND DIFFERENTIAL PRESSURE TYPE LEVEL METERS

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 pressure and differential pressure type level meters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

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

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 HYDROSTATIC-SUBMERSIBLE LEVEL MEASUREMENT DEVICES

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Emerson’s Rosemount 3051 with Hart and integral manifold.
b. Gauge Pressure Units: Rosemount; Model 3051s TG.
c. Absolute Pressure Units: Rosemount; Model 3051s TA
d. Substitutions: Not Permitted.

B. Type:

1. Submersible, hydrostatic pressure type level transmitter.

C. Function/Performance:
1. Temperature Compensation: Provided over a range of 32 to 122 degrees F.
2. Accuracy: Plus or minus 0.04 percent of span, unless otherwise noted.
3. Over Pressure: Protected for over pressure of 1.5 times the span.
4. Output: 4-20 mA proportional to the calibrated span.

D. Physical:

1. Provide an assembly with a Type 316 stainless-steel or titanium body with a bottom diaphragm.
2. Provide sensor with integral cable. Provide a vent tube as part of the cable for the transducer.
3. Provide a tension-relieving mounting clamp from a 4-inch flange. Provide Type 316 stainless-steel material for both clamp and flange.
4. Wetted Metallic Parts: Type 316 stainless steel, unless otherwise noted.

    a. Includes drain/vent valves; process flanges and adapters, and process isolating diaphragm.

5. Wetted O-Rings: Glass filled TFE, graphite filled PTFE, or Viton, unless otherwise noted.
6. Bolts and Nuts (if required): Type 316 stainless steel, unless otherwise noted.
7. Fill Fluid: Silicone, unless otherwise noted.
8. Sensor: Submersible (IP68), and CSA approved or CENELEC certified intrinsically safe when intrinsically safe barriers are provided for the instrument loop.
9. 24 VDC loop powered.

E. Required Accessories:

1. Signal cable as recommended by the manufacturer, for installation between the sensor and transmitter as shown on the drawings. Provide reinforced cable to support the weight of the transducer and cable.
2. Cable clamp for suspending instrument provided by instrument supplier.
3. All fittings required for pressure calibration of the instrument.

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

2.3 DEVICE SCHEDULE

A. Well Level, PE/LIT-1201, PE/LIT-1202, PE/LIT-1203.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where pressure and differential pressure level meters 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 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 270526 “Grounding and Bonding for Communications Systems.”

3.4 IDENTIFICATION

A. Refer to item in this specification for tagging designation.

3.5 FIELD QUALITY CONTROL

A. Pressure and differential pressure type level meters will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup check according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

A. Not Required.

END OF SECTION 407243

SECTION 407326 - GAUGE-PRESSURE TRANSMITTERS

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 gauge-pressure transmitters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

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.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

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

1.7 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.8 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 GAUGE PRESSURE TRANSMITTERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following or equal:

a. Endress + Hauser PMP Series.
b. Rosemount 3051CG.
c. Siemens Sitrans P DS III.
d. Substitutions: Not Permitted.

B. Type:

1. Microprocessor based, intelligent type.

C. Function/Performance:

1. Accuracy: 0.075 percent of span.
2. Operating Temperature: -4 to 176 degrees F (-20 to 80 degrees C).
3. Temperature Effect: Combined temperature effects less than 0.2 percent of maximum span per 82 degrees F (28 degrees C) temperature change.
4. Output Signal: 4 to 20 mA DC linear with pressure, with HART protocol.
5. Output: Zero adjustable over the range of the instrument calibrated span is greater than the minimum calibrated span.
6. Stability: 0.05 percent of upper range limit for one year.
7. Response Time: Less than 1 ms.
8. Display: Digital indicator displaying pressure in the engineering units indicated on the Drawings or in the instrument device schedule.
9. Diagnostics:

a. Self-diagnostics with transmitter failure driving output to above or below out of range limits.

b. Simulation capability for inputs and loop outputs.
c. Test terminals available to ease connection for test equipment without opening the loop.
d. Registers to record minimum and maximum pressure and temperatures transmitter has been exposed to be available.

10. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored.

D. Physical:

1. Power Supply: 24 VDC loop power.
2. Enclosure:

a. NEMA 4X (IP66), explosion proof.
b. Approved for Class I, Division 1, Groups C and D.
c. Instruments for hazardous locations have Factory Mutual (FM), Canadian Standards Association (CSA), and CENELEC approvals and certifications as specified and as indicated on Drawings or in the instrument device schedule.

3. Process Wetted Parts (except for ozone/oxygen service):

a. Isolating diaphragm and other wetted metal parts: Type 316L stainless steel.
b. Gaskets and O-rings: Teflon.

4. Sensor Fill Fluid (except for ozone/oxygen service): Silicone.

E. Required Accessories:

1. Shutoff Cocks: Furnished by gauge manufacturer.
2. Provide diaphragm seals as shown on Drawings.

F. Device Schedule:

1. Well Discharge Pressure, PIT-1201, PIT-1202, PIT-1203:

a. Range: 0-200 psig

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where gauge pressure transmitter 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 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 IDENTIFICATION

A. Refer to item in this specification for tagging designation.

3.4 FIELD QUALITY CONTROL

A. Gauge-pressure transmitters will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system’s operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, manufacturer shall provide training to Owner's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

END OF SECTION 407326

SECTION 407856 - ISOLATORS, INTRINSICALLY SAFE BARRIERS, AND SURGE SUPPRESSORS

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 surge suppressors.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 407000 “Instrumentation for Process Systems.”
4. Section 4072XX “Sections for level measurement.”

1.3 DEFINITIONS

A. Section 4072XX “Sections for level measurement”: The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Warranty: Manufacturer and Installer agree to repair or replace components of that fail(s) in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 SURGE PROTECTION FOR CONTROL SYSTEMS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:

a. Phoenix Contact Series.
b. Substitutions: Not Permitted.

B. Function/Performance:

1. Provides surge protection of electronic instrumentation from induced surges propagated along the signal and power supply lines from lightning, utility, or the plan electrical systems.
2. Protection system lower than the instrument withstand level, while not interfering with normal operation.
3. Maintenance free and self-restoring.

4. Response time: Less than 50 nanoseconds.
5. Discharge surge current: At least 8kA (at an 8x20µs impulse waveform).

C. Required Surge Protection:

1. Analog Signal (4-20mA) Circuits:

a. Provide surge protection where any part of the circuit is outside of the building envelope.
b. Protect circuits at both the transmitter and the control system end of the circuit.
c. Mount transmitter surge protectors in separate NEMA 4X enclosure or conduit mount.
d. Use of a single device to protect both 120VAC and 4-20mA wires is acceptable.
e. Provide surge protector from one of the following:

1) Phoenix Contact PT Series.
2) Substitutions: Not Permitted.

2. Control Panel Power Feed (120VAC):

a. Provide protection of 120VAC power feed into control panels, instruments, and control room equipment.
b. Provide surge protector from one of the following:

1) Phoenix Contact “Mains-PlugTrab.”
2) Substitutions: Not Permitted.

3. Non-Fiber Based Data Highway or Communications Circuits:

a. Provide protection on all communication and data highway circuits that leave a building or are routed external to a building.
b. Provide circuit protection at both ends of the line.
c. Provide surge protector from one of the following:

1) Phoenix Contact PlugTrab Series.
2) Substitutions: Not Permitted..

4. Inductive Loads:

a. Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120VA or less that drive solenoid, coil, or motor loads.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 270526 “Grounding and Bonding for Communications Systems.”

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Isolators, intrinsically safe barriers and surge suppressors will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 MAINTENANCE SERVICE

A. Not Required.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407856

SECTION 432520 - SUBMERSIBLE TURBINE WELL 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: Submersible vertical turbine well pumps (pumps), including their respective column pipe, and submersible motors.

B. Contractor to be fully responsible for all elements of pump installation and setting, including:

1. Depth of setting.
2. Discharge column pipe.
3. Column check valve.
4. Water level instrumentation.
5. Supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation, and maintenance of the equipment.
6. Pump Manufacturer or Supplier shall have unit responsibility for complete pumping system including but not limited to the pump, motor, and variable frequency drive.

C. Related Requirements

1. Section 13005 "Production Well."
2. Section 406100 “Process Control and Enterprise Management Systems General Provisions”.
3. Section 406121.20 “Process Control System Testing”.
4. Section 406126 “Process Control System Training”.
5. Section 406196 “Process Control Descriptions”.
6. Section 407000 “Instrumentation for Process Systems”: General instrumentation requirements.

1.3 DEFINITIONS AND ABBREVIATIONS

A. AOR: Allowable Operating Region.

B. Failsafe: Normally closed contacts that open on alarm condition.

C. I/O: Input/Output (signals).

D. LCP: Local Control Panel.

E. PCSS: Process Control System Supplier; refer to Section 406100 for additional information.

F. POR: Preferred Operating Region.

G. P&ID: Process and Instrumentation Diagram.

H. Unit Responsibility: Sole responsibility for all components provided as part of pumping system.

1.4 ACTION SUBMITTALS

A. If manufacturing techniques differ, completely describe all aspects that do not conform to specifications.

B. Product Data: Submit manufacturer’s literature, which may include drawings, describing the equipment including materials of construction, to indicate full conformance with specifications.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for submersible turbines and motors.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Total weight of pumping unit as well as weights of individual components.

C. Shop Drawings:

1. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished including pump and motor.
2. Schematic electrical wiring diagram and other data as required for complete pump installation.
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. Details of motor shroud/flow inducer for motor cooling.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's certified rating curves, to satisfy the specified design conditions including:

1. Operating speed specified.
2. Pump characteristics of head and flow showing full recommended range of performance including shut-off head for pump proposed. Curve for pump proposed not catalog sheets showing a family of curves.
3. Anticipated operating condition.
4. Brake horsepower.
5. Bowl efficiency.
6. Guaranteed net positive suction head required (NPSHR).
7. Identify POR and AOR (refer to ANSI/HI 9.6.3).

8. Plot curves on 8-1/2-inch by 11-inch sheets at as large a scale as practical specifically for proposed pump from no flow at shut-off head to pump capacity at minimum specified TDH.
9. Variable Speed Pumps: Include variable speed curves with five evenly spaced speeds plotted from maximum to minimum recommended speeds.
10. Curves shall be rising head capacity curve for stable pump operation.

B. Certification that velocity of flow past motor is adequate for motor cooling, based upon motor proposed and size of well casing. Submit details of enclosing flow inducer/suction sleeve/shroud required to provide cooling.

C. Tabulated data for drive motors including rated horsepower, full load rpm, power factor, efficiency curves at 1/2, 3/4 and full load, service factor, and kW input, including when pump operates at design point. Submit a certified statement from motor manufacturer that motors are capable of continuous operation on variable frequency drive power supply without affecting their design life for bearings or windings.

D. Test Reports:

1. Copies of all test data as described in PARTs 2 and 3.
2. A schedule of the date of shop testing and delivery of the equipment to the job site.
3. Description of pump factory test procedures and equipment.
4. Rotor balance report demonstrating compliance with balancing requirements of AWWA E102.

E. Welding certificates.

F. Material Test Reports: Certified analysis of impeller material: by a qualified testing agency.

G. Source quality-control reports.

H. Field quality-control reports.

I. Sample Warranty: For manufacturer's warranty.

J. Certify all product components suitable for contact with drinking water by an accredited certification organization in accordance with NSF/ANSI 61, Drinking Water System components – Health Effects, and NSF/ANSI 372, Drinking Water System Components – Lead Content.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Manual:

1. Provide an Operating and Maintenance Manual for the equipment specified herein, specifically prepared for this installation and including all required drawings, equipment and materials information, descriptions, complete bill of materials, etc., as required to instruct operating and maintenance personnel unfamiliar with such equipment.

B. Warranty Documentation: submit warranty complying with requirements herein.

C. Project Record Documents:

1. Submit Project Record Documents recording actual locations and final orientation of all equipment and accessories.

1.7 QUALITY ASSURANCE

A. Furnish and coordinate all motors with the pump manufacturer.

B. Furnish units from a single manufacturer.

C. Install for satisfactory operation as shown on Drawings.

D. Manufacturer to be fully responsible for the design, arrangement, and operation of all connected rotating equipment components.

E. Pumps to be in accordance with the Hydraulic Institute Standards, except when otherwise specified herein.

F. Equipment to be standard pumping equipment proven to have been manufactured by a manufacturer concerned and experienced in the production of such.

G. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

H. Manufacturer to confirm in writing that the motor is compatible with the selected variable frequency drive.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in Manufacturer’s original packaging and inspect for damage. As necessary, provide inspection report to Manufacturer identifying any damage and rework necessary prior to installation.

B. Storage: Store pumps and all appurtenances according to Manufacturer’s instructions.

C. Do not disassemble factory assembled parts and components for shipment unless written permission received from Engineer.

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’s instructions.
3. Protect unpainted finished iron and steel surfaces to prevent rust and corrosion.
4. Protect finished surfaces of exposed flanges with wood or equivalent blank flanges.
5. Protect bearings against formation of rust in accordance with bearing manufacturer’s recommendations. Apply lubricant or corrosion inhibiting treatment during

transportation, storage, handling, installation, and lapse of time prior to start-up. Intermittently manually rotate equipment prior to start-up to ensure distribution of lubricant/protection.

1.9 SITE CONDITIONS

A. Ambient temperature range: minus 30 to 104 degrees F.

B. Field Measurements: as applicable confirm field measurements and interferences prior to fabrication. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace pumping system that fail in materials or workmanship within specified warranty period

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Pumps to conform to AWWA E-102, Submersible Vertical Turbine Pumps.

B. Furnish and coordinate motors with pump manufacturer.

C. Furnish units from a single manufacturer.

D. Install for satisfactory operation as shown on Drawings.

E. Manufacturer to be fully responsible for design, arrangement, and operation of all connected rotating equipment components.

F. Pumps to be in accordance with the Hydraulic Institute Standards, except otherwise specified herein. Pump performance Acceptance Grade: 2B.

G. Equipment to be standard pumping equipment proven to have been manufactured by a manufacturer concerned and experienced in the production of such.

H. Pumps to have a continuously rising (from runout toward shutoff) head-flow rate performance curve for stable pump operation within the AOR.

I. Comply with NSF/ANSI 61, Drinking Water System Components – Health Effects, and/or NSF/ANSI 372, Drinking Water System Components – Lead Content.

J. Submersible pump to be set in a newly constructed water supply well. Work includes excavation and backfill necessary to install specified pit-less adapter or well head after cutting

well casing to level shown on Drawings. Install all instrumentation to be fitted in the well as is specified in Division 40.

K. Refer to Section 406196 for "Process Control Descriptions".

L. Pumping Units:

1. Designed and built for 24-hour continuous service at all points within the required range of operation, without overheating, without cavitation, and without excessive vibration or strain.
2. Designed and proportioned as to have liberal strength, stability, and stiffness and to be especially constructed to meet the Specifications.

M. Design Criteria:

Item Description	Design Conditions
Service	Raw Water
Grundfos Basis of Design Model	xxxxx
Number of Pumps	3
Maximum Motor Full Load Speed (FLS) (rpm)	3,600
Maximum Allowable Motor Horsepower (non-overloading throughout operating range) (HP)	20
Motor Design Voltage/Phase/Frequency	460/3/60
Maximum Anticipated Pumped Fluid Temperature (degrees F.)	75
Minimum Pump and Column Discharge Size (inches)	6
Minimum Pump Shut-Off Head at Motor FLS Acceptable Range (minimum/maximum) (feet)	120-180
Flow Rate at Secondary Operation Point (gpm)	300
Minimum TH at Secondary Operation Point (feet)	85
Minimum Overall Efficiency at Secondary Operation Point (percent)*	50
Maximum NPSH3 at Secondary Operation Point (feet)	25
Intermediate (Design) Point Flow Rate (gpm)	450
Minimum TH at Intermediate (Design) Point Flow Rate (feet)	75
Minimum Overall Efficiency at Intermediate (Design) Point Flow Rate (percent)*	55
Best Efficiency Point (BEP) Flow Rate Acceptable Range (minimum/maximum) (gpm)	450-700
Minimum Overall Efficiency at BEP (percent)*	55
Primary Operation Point TH (feet)	35
Minimum Flow Rate at Primary Operation Point (gpm)	800
Minimum Overall Efficiency at Primary Operation Point (percent)*	40
Maximum NPSH3 at Primary Operation Point (feet)	36

* Note that minimum overall efficiencies listed are "wire-to-water" in accordance with ANSI/HI 11.6 – latest edition.

N. Pump Setting Details

1. Approximate Elevation of Finished Ground Surface at Well Head:

   a. Well 1: 9.2 feet NAVD88.
   b. Well 2: 9.5 feet NAVD88.
   c. Well 3: 8.8 feet NAVD88.

2. Approximate Elevation of Discharge Centerline:

   a. Well 1: 13.2 feet NAVD88.
   b. Well 2: 13.3 feet NAVD88.
   c. Well 3: 12.8 feet NAVD88.

3. Approximate Elevation of Pump Intake:

   a. Well 1: (-)50.8 feet NAVD88.
   b. Well 2: (-)50.5 feet feet NAVD88.
   c. Well 3: (-)51.2 feet feet NAVD88.

4. Approximate static well water surface elevation: 0 feet NAVD88.
5. Approximate minimum pumping water level elevation with drawdown: (-)35 feet NAVD88.

O. Pump to be capable of temporary operation at and near shut off head for 30 seconds during pump startup and shut down.

2.2 SUBMERSIBLE MOTOR PUMP DRIVE SYSTEM

A. Manufacturers:

1. Franklin
2. Grundfos.

B. Hermetically sealed water-filled submersible motor.

C. Electric power supply: 480 Volt, 3 Phase, 60 Hz.

D. Service factor: 1.0 (inverter duty).

E. Motor speed: To match pump speed.

F. Minimum full load efficiency: 85 percent.

G. Minimum full load power factor: 80 percent.

H. Maximum motor diameter: 8.5-inches.

I. Motor capable of full load operation submerged in water up to 25 degrees C.

J. Nameplate rating on motor at 1.0 service factor not to be exceeded at any point on pump performance curve.

K. Enclose hermetically sealed stator and resin embedded windings in an all-welded Type 304 or Type 316 stainless-steel case, to dissipate heat quickly to the surrounding well water. Provide an elastomer expansion diaphragm with ample sized expansion chamber within motor case to equalize internal and external pressures at any depth of submergence. Motor to not require a breather plug or pressure relief valve for proper operation.

L. Motor Windings: Solid copper conductor with class "Y" (waterproof) insulation rated for motor voltage.

M. Seals: Single mechanical type shaft seal with Carbide/Silicon Carbide seal faces to seal motor at shaft extension to pump coupling.

N. Wetted Fasteners: Type 316 stainless steel with Monel nuts.

O. Rotor dynamically balanced and mounted on an amply sized stainless steel shaft stabilized by water lubricated sleeve type carbon composite bearings.

P. Thrust bearing to carry weight of rotating assembly plus thrust of pump operating a shut-off head to be water lubricated self-aligning and self-equalizing Kingsbury Type assembly with multiple micro-finished stainless-steel bearing shoes providing contact with a graphite or carbon composite rotating ring. Capability to run in either direction without damage.

Q. Motor factory filled with propylene glycol-potable water internal lubricating solution for maximum reliability and long life.

R. Provide a flow inducer (suction sleeve/shroud) of same material as well column pipe as required to provide adequate motor cooling. Submit details.

1. Size inducer in conformance with motor manufacturer's recommendations to maintain minimum head losses and velocity for adequate motor cooling, based upon well diameter.
2. Provide centralizers to position inducer uniformly around motor housing and within well casing. Provide guides to assist raising and lowering of motor past size transitions within well casing.
3. Design inducer to receive flow from well screen above elevation of motor to assure external cooling flow passes along entire length of motor.

S. Power Cable: Three-conductor plus ground power cable enclosed within a common jacket. Size conductors for voltage drop less than three percent at motor rated full load current and voltage measured at starter. Cable designed for submerged service, non-hygroscopic. Cable jacketing of neoprene or equal and insulation of Ethylene Propylene Rubber (EPR) or equal. Provide Type 316 stainless steel cable clamps to securely fasten cable at intervals of not more than 10-feet. Terminate cable at junction box at surface on. Furnish cable splicing kit for splicing of cable to motor leads.

T. Motor Thermal Protection: Motor to incorporate three thermal switches, one per stator winding, connected in series, to monitor motor temperature. Should any thermal switch open, motor to

stop and activate an alarm. Coordinate selections of devices and settings with total distance from control cabinet to pump mounted in well.

2.3 PUMP CONSTRUCTION

A. Manufacturers:

1. Grundfos.

B. Pump Bowls: Type 304 stainless steel

1. Bowl Bolting: Type 304 stainless steel with Monel nuts, where nuts are used.
2. Equip bowls with Type 420 stainless steel wear rings installed on suction side of bowl seat.
3. Pump Bowl Bearings: ASTM B505, Alloy C89835 bismuth tin bronze.

C. Impellers:

1. Closed type.
2. Material: Cast stainless steel, Type 304 (certified analysis of impeller metal pour required).
3. Dynamically balanced.
4. Enclosed type impeller design to include adequate material to provide for future machining for addition of wear ring to restore impeller efficiency.
5. Impellers fastened to shaft with lock collets or keys of ASTM A276, Type 316 stainless steel.

D. Pump Shaft: Stainless steel, Type 304.

1. Shaft diameter in accordance with AWWA E102 of sufficient diameter to transmit motor torque with a liberal safety factor, minimize vibration, and rigidly support impellers between bowl bearings.

E. Shaft Coupling:

1. Size shaft coupling between motor and pump bowl shaft in accordance with AWWA E102, of sufficient size and strength to withstand maximum torque generated by motor plus safety factor.
2. Coupling: Match material of pump shaft.
3. Coupling keyed, threaded, or splined to pump shaft.

F. Suction Adapter:

1. One-piece casting of stainless steel, Type 404 to serve as suction inlet, lower bearing housing and motor adapter.
2. Suction inlet to include an ASTM A-276, Type 304 stainless steel strainer. Inlet area equal to at least five times impeller inlet area.

3. Bottom bearing: ASTM B505, Alloy C89835 bismuth tin bronze sleeve type fully enclosed in bearing shell provided with large grease reservoir. Bearing packed with non-soluble grease or equal.
4. Design motor adaptor to prevent entrance of abrasive material into top end of motor. Provide a sand collar of rubber or bronze, ASTM B505, Alloy C89835 to protect suction adapter bearings from abrasives in liquid pumped.

G. Column Pipe:

1. Column wall thickness in accordance with AWWA E102.
2. Type 316L stainless steel, ASTM A276 male NPT thread by male NPT thread between pump discharge and column check valve. Coordinate end connections with equipment vendors.
3. Certa-Lok Type 316 stainless steel drop pipe adapter with Certa-Lok male by male NPT thread between column check valve and Certa-Lok PVC drop pipe.
4. Certa-Lok Type 316 stainless steel drop pipe adapter will connect to Certa-Lok PVC drop pipe. Certa-Lok PVC drop pipe to use Certa-Lok drop pipe coupling with Certa-Lok female by Certa-Lok female, gaskets, splines, and screws.
5. Certa-Lok Type 316 stainless steel drop pipe adapter with Certa-Lok male by male NPT thread will connect to top section of Certa-Lok PVC drop pipe. Certa-Lok drop pipe adapter will connect to custom stainless steel wellhead as shown on the Drawings.
6. Provide a minimum of four radially spaced guide vanes welded to discharge column pipe immediately above pump bowl assembly to assure that submersible pump and motor assembly is properly centered within well casing.

H. Column Check Valve:

1. Provide manufacturer’s standard check integral to the pump.
2. Alternatively, provide a spring loaded, positive-sealing column silent globe check valve located immediately above bowl assembly.

    a. Check valve diameter same as column. Provide cast stainless steel reducer if required to accommodate pipe sizes between bowl discharge and column.
    b. Check valve body constructed of cast stainless steel. Spring of Monel. Disc and shaft of Type 316 stainless steel with bronze bushings. Bolts of Type 316 stainless steel with Monel nuts.
    c. Valve pressure rating to accommodate maximum total dynamic head of pump through entire performance range from shutoff to runout.

I. Well Head Assembly:

1. Pump Head Assembly: Provide a pump head assembly of fabricated 316SST ASTM A276 S316 00 consisting of a flange from which the vertical discharge pipe is suspended. Provide a flange that can be mounted to the fiberglass flanged adapter on the well casing in the well, as shown on the Plans. Coordinate shop submittals of the fabricated fiberglass well casing adapter and the pump head assembly so that flange patterns are compatible. The assembly shall incorporate a welded flange and shall rigidly support the total weight of the motor, bowl assembly, discharge pipe, cable, and column of water. Provide a flanged end on the vertical discharge pipe with flange pattern to match the well discharge column pipe special flange pattern. The flanged plate shall have a cable seal of adequate

size to accommodate the cable size and well vent and water level indicator. Provide eyebolts, lugs, or other means for securing slings to facilitate setting and lifting the pump.

J. Name Plates: Stainless steel nameplate (with embossed data) securely mounted to body of equipment.

1. Pump Nameplates Include:

a. Manufacturer’s name.
b. Model number.
c. Serial number.
d. Rated flow capacity.
e. Head.
f. Speed.

2. Nameplate for Motor:

a. Manufacturer's name.
b. Model number.
c. Serial number.
d. Horsepower.
e. Speed.
f. Input voltage.
g. Amps.
h. Number of cycles.
i. Power.
j. Service factors.

2.4 ACCESSORIES

A. Low Level Shut-Off:

1. Wire suspension electrodes with solid-state relay for low level shut-off and alarm, to be installed under this Section, furnished under in Division 40.

2.5 SHOP PAINTING

A. Shop prime and finish coat each component of pumping system including pump, motor, column, and associated equipment. Prepare, shop-prime and finished-coat in accordance with manufacturer's standard practice prior to shipment. Colors as selected by Engineer from manufacturer’s standards. Provide adequate supply of touch-up paints.

B. Clean interior and exterior surfaces of pump column pipes and discharge heads and exterior of bowl assemblies of rust and mill scale, grease, dirt, and other foreign matter and apply manufacturer’s standard epoxy coatings.

C. Coatings on wetted surfaces to be epoxy type n compliance with AWWA E-103, ANSI/NSF 61, ANSI/NSF 61 Annex G, and ANSI/NSF 372 for use with drinking water systems. Surface preparation to conform to coating manufacturer's recommendations.

D. Protect nameplates during painting.

2.6 SOURCE QUALITY CONTROL

A. Certified Factory Pump Tests:

1. Factory test each pump in accordance with ANSI/HI 14.6, American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests and AWWA E102.
2. Prior to conducting a pump test, notification of such test and list of test equipment and test procedures shall be forwarded to ENGINEER at least 10 working days before the scheduled test date. All electronic transducers, meters, gauges, and other test instruments shall be calibrated in accordance with the frequency listed in the Hydraulic Institute Standards. Copies of calibration data shall be provided. Differential pressure type flow meters, such as venturis shall have been calibrated within 5 years. Mechanical variation of the meter throat diameter will be accepted as verification of calibration validity.
3. Visually inspect cast surfaces of all components per MSS SP-55.
4. Perform hydrostatic tests on each bowl assembly and in full compliance with ANSI/HI 14.6.
5. Perform certified pump performance tests of each pump including head, capacity, brake horsepower, wire to water pump efficiency, and NPSH3 in accordance with ANSI/HI 14.6.

    a. Testing to be performed at full rated pump speed of complete bowl assembly.
    b. Take at least seven operating points along pump curve plus shut-off head, with two points clustered close to specified design point.
    c. Test to demonstrate pump meets ANSI/HI 14.6, acceptance grade 2B at design point.
    d. If manufacturer does not have historical test records for NPSH3 at specified design pump speed, test one pump to demonstrate NPSH3 versus flow rate.
    e. Submit complete report of test including description of procedure, test set-up arrangement, calibration data, raw and final test data, and certified pump performance curves.
    f. Test results submittal to be reviewed and approved by Engineer prior to release for shipment from factory.
    g. Calibrate all meters, gauges, and other test instruments within Manufacturer's established time period prior to scheduled test and include certified calibration data test submittal. If manufacturer has no ISO standard calibration period, Hydraulic Institute Standards to govern.
    h. Job motor or factory test motor may be used as pump driver during performance test.
    i. Testing will be non-witnessed.
    j. If any pump tested fails to meet specification requirements, modify until it meets all specification requirements. If any pump tested fails to meet efficiency requirements at any listed flow or head conditions and all reasonable attempts to correct the inefficiency are unsuccessful, replace pumps with units that meet specified requirements.

6. Factory test each motor and submit copies of test results. Tests to include the following:

    a. Perform routine tests on motors Report results as described on NEMA MG1-12.54 "Report of Test Form for Routine Tests on Induction Motors." Test efficiency in accordance with IEEE Publication No. 112. Measure power factor on representative motors.
    b. Pressure check stators for leaks to ensure a guaranteed leak proof housing.
    c. Perform standard shop no load running current test, high potential test, and winding resistance test.

7. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate with other trades, equipment, and systems to the fullest extent possible.

B. Take necessary field measurements to determine exact dimensions for work and required sizes of equipment under Contract. Verify pertinent data and dimensions.

3.2 INSTALLATION

A. Installation to comply with AWWA E102 and applicable standards of Hydraulic Institute.

1. Ensure that protection of the well and sanitary seal is provided during excavation and subsequent backfilling of soil during the installation of the pitless well adapter.
2. If damage is inflicted to any part of well or sanitary seal, repair all damaged materials to satisfaction of Engineer.
3. Clean welded joints and restore protective coatings.

B. Pumping unit installation to comply with applicable State Health Department Requirements governing installation of pumps in Water Wells.

C. Provide tack welded strap restraints of same material as column pipe to positively lock to pump to discharge column to prevent unscrewing due to motor starting torque. Continue strap restraints up pump column to elevation recommended by manufacturer.

3.3 FIELD QUALITY CONTROL

A. Installation of, pump and motor and column piping to be inspected/monitored by a factory representative of pump manufacturer in presence of Engineer.

B. If Contractor does not provide qualified installation staff on the job during pump installation, Engineer may direct Contractor to provide services of a manufacturer's factory representative to provide necessary instructions to ensure a proper installation.

C. Submit a certificate from manufacturer stating that installation of their equipment is satisfactory, equipment is ready for operation, and Owner's operating personnel have been suitably instructed in operation, lubrication, and care of each unit.

3.4 STARTUP SERVICE

A. Provide services of a factory representative to check completed pump installation and supervise start-up of pumping system.

B. After pump has been completely installed, conduct a test of equipment with a factory representative of pump manufacturer in presence of Engineer to demonstrate compliance with pump design. Furnish all instruments, meters, gauges, and incidentals which may be required for testing.

C. Upon recording pump discharge and pressure at five capacity points, shut-down and allow water level to recover within 1-inch of static levels. At this time, operate pump within plus or minus two percent of the design capacity for a period of one hour. Measure pump capacity, discharge head, horsepower input and motor speed shall be made. Water level drawdowns in observation wells shall be recorded at intervals approved by Engineer.

D. If compliance with above requirements are not met and corrections not effected within 30 days of a mutually agreed date, then replace pump unit with one that will meet operating requirements. Such replacement shall be in full accordance with all requirements as specified herein. Rejection of pumping unit may not preclude its use after rejection if removal of the pumping unit, prior to furnishing a replacement unit, will adversely affect Owner.

3.5 CHLORINATION AND CLEANING OF WELLS

A. Disinfect all equipment and material to be installed in well by chlorination just prior to installation. Perform by spraying with a solution having a chlorine residual of not less than 200 mg/L.

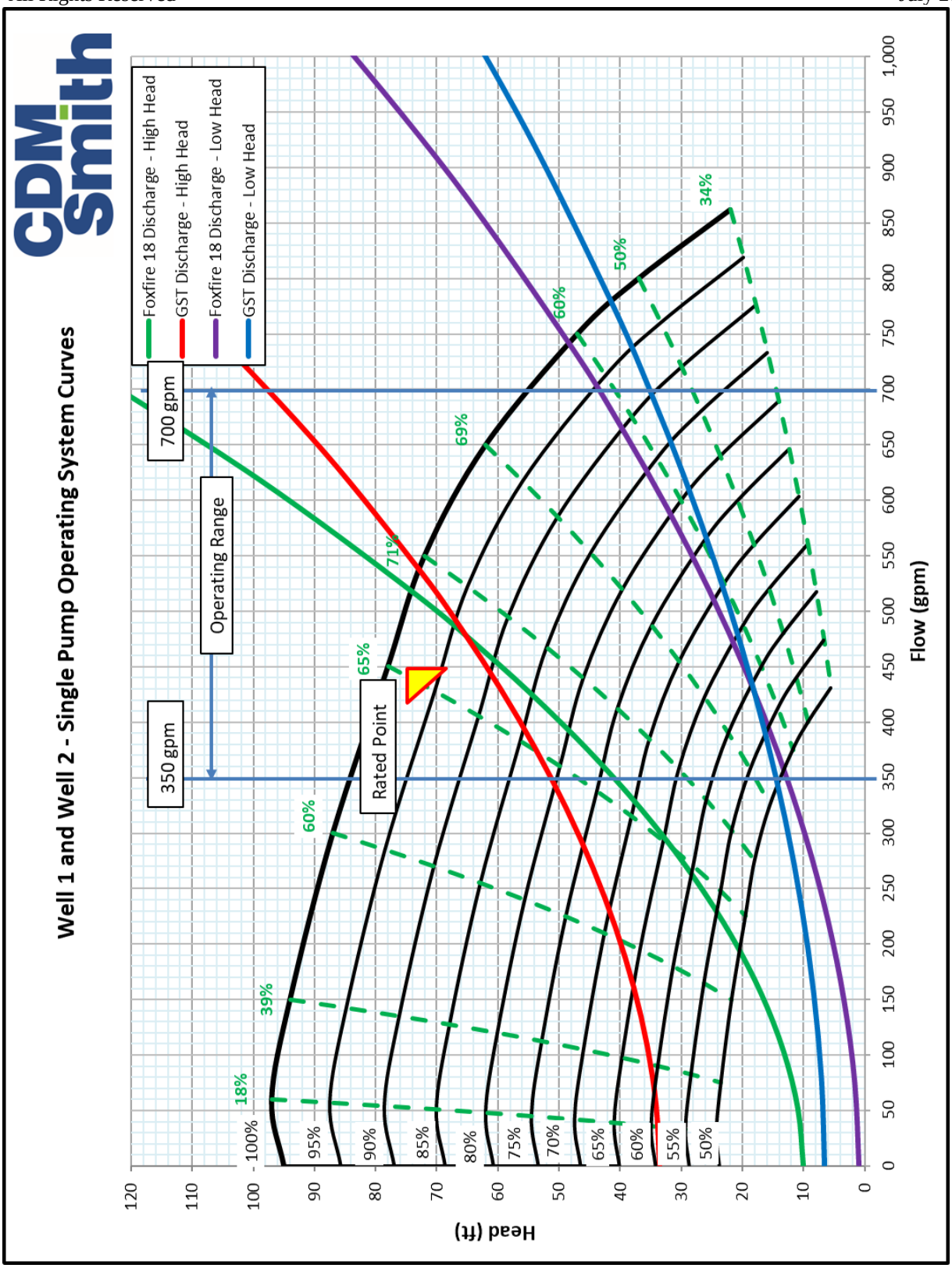
B. After permanent equipment is installed, chlorinate well with a solution of Chlorine which when mixed with water equal in volume to that contained within well will result in an average chlorine residual of 50 mg/l concentration throughout entire volume of water in casing. Circulate solution in well casing and pump column to achieve 50 mg/L concentration throughout water column. Then, leave solution undisturbed for at least 12 hours but for no more than 24 hours and then pump to waste. If discharge of chlorinated water would be harmful to vegetation or wildlife, take measures to impound highly chlorinated water or to neutralize chlorine. Federal, state, or local environmental regulations may require special provisions or permits prior to disposal of highly chlorinated water. Discuss strength of solution and manner of introduction with ENGINEER and obtain their approval obtained prior to performance to ensure compliance with State Health Requirements. Schedule chlorination so that Engineer may be present before chlorine solution is introduced into well. Contractor shall be responsible for sampling and additional disinfecting until State approval for use of facility; as related to its work, is obtained. Perform well disinfection in accordance with AWWA C654-03.

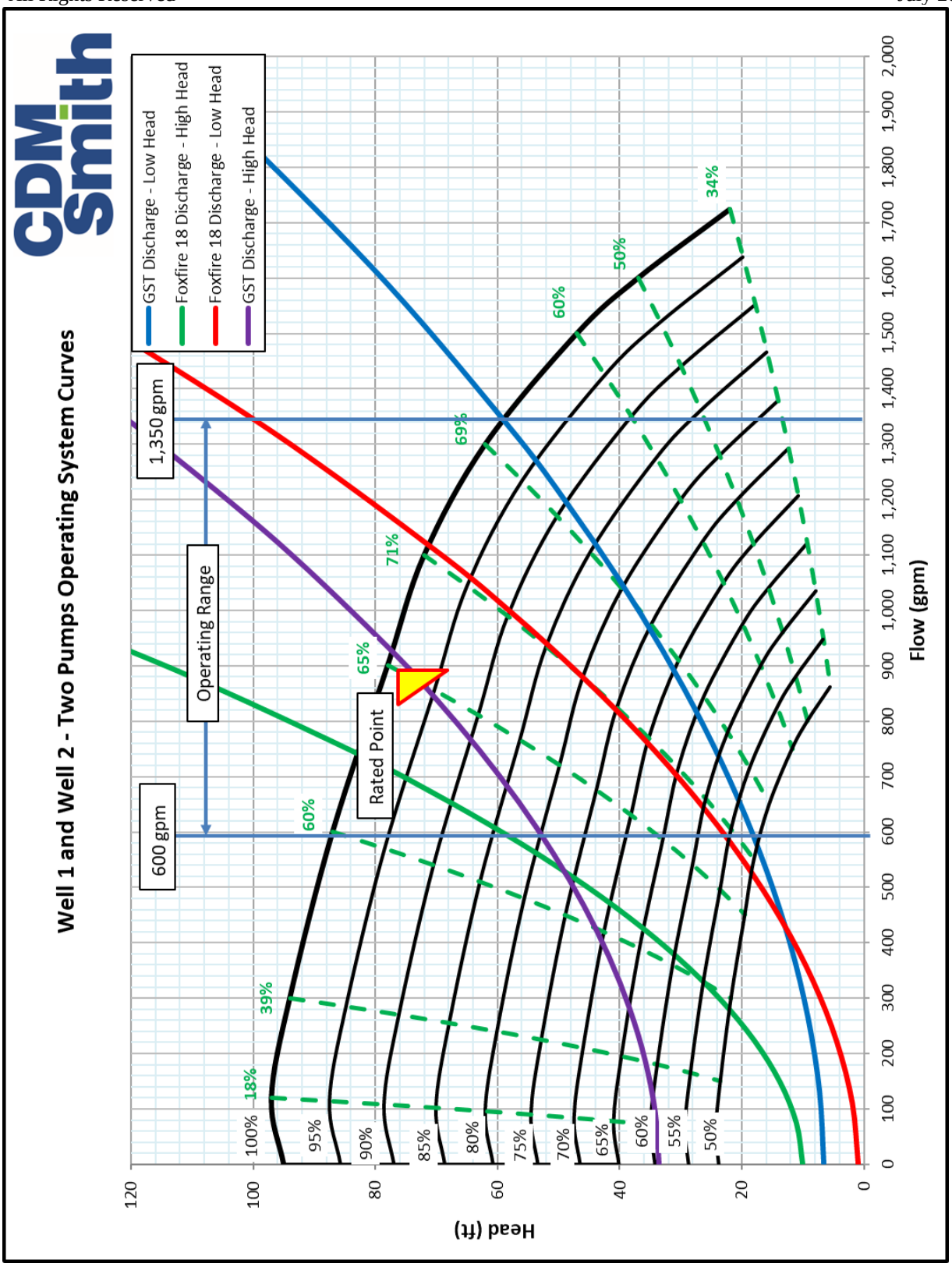
C. Following disinfection, conduct bacteriological testing in conformance with State and Local Regulations.

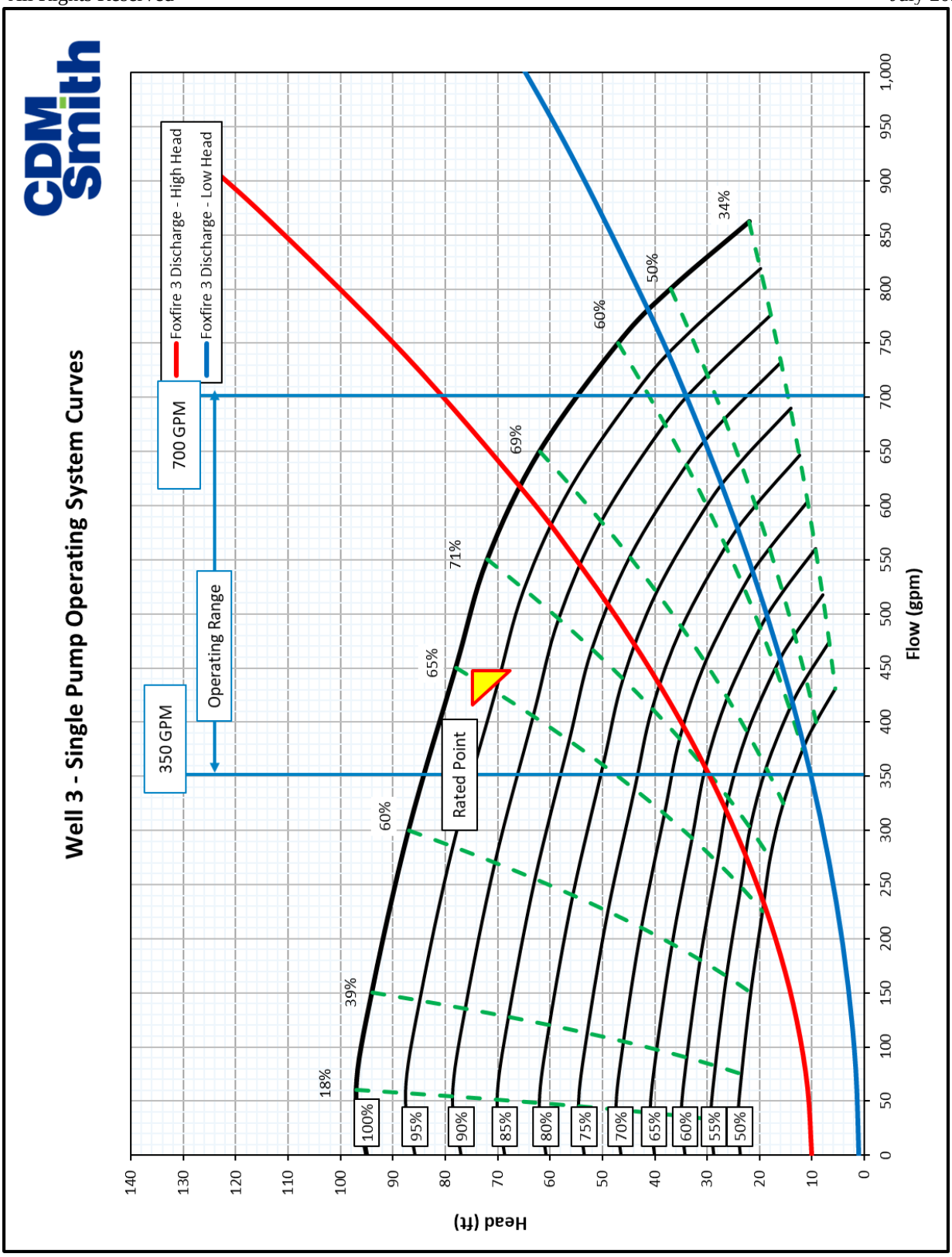
3.6 ATTACHMENTS

A. Refer to following pages for these attachments:

1. Well 1 and Well 2 - Single Pump Operating System Curves.
2. Well 1 and Well 2 - Two Pumps Operating System Curves.
3. Well 3 - Single Pump Operating System Curves.







END OF SECTION 432520

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