ISSUED FOR BID
DETAILED DESIGN
SPECIFICATIONS

CEDAR BAY (DISTRICT II) PUMP STATIONS AND FLOW REROUTING PROJECT

ROBENA ROAD BOOSTER PUMP STATION

P.N. 6103-215629

JEA

January 2021

CDM Smith

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SECTION 01010
SUMMARY OF WORK

PART 1 GENERAL

1.01 LOCATION OF WORK

A. The work consists of the construction of a new in-line wastewater booster pump station located on Robena Road at 30 degrees 26 minutes 56.85 seconds N Latitude and 81 degrees 42 minutes 35.01 seconds W Longitude.

1.02 SCOPE OF WORK

A. Furnish all labor, material, equipment and incidentals required and complete all work required by these Specifications, JEA's Water and Sewer Standards Manual, January 2020 or latest version and as shown on the Drawings to construct a wastewater booster pump station at the Robena Road site.

B. Contractor shall strictly follow the JEA Manual of Water and Wastewater Standards and Specifications, issued January 2020 or latest version, during construction for standard construction details and specific requirements, unless shown otherwise on the Contract Drawings and specifications.

C. The following scope of work for this contract shall include but is not necessarily limited to, the following, all in accordance with the Contract Documents:

1. Mobilization/Demobilization, General Requirements, Bonds and Insurance, Permitting, Project Controls, Testing, Record Drawings and As-Builts.

2. Site Work
   a. Erosion and sedimentation control
   b. Clearing and Grubbing
   c. Site restoration including grassing, and other restoration
   d. Grading and Drainage
   e. Pavement repair, mill and overlay as indicated on the Drawings
   f. Sidewalk installation and repair and replacement
   g. Driveway installation between pump station slab and existing road
   h. Stormwater Detention Pond
   i. Gates and Fencing
   j. Landscaping and Irrigation

3. Construction of the new inline booster pump station at Robena Road site as specified herein, including but not limited to:
   a. Pump station concrete slab and pump pedestals
   b. Installation of one diesel engine driven pump with enclosure.
   c. Installation of two (2) dry-pit submersible booster pumps and two (2) dry-pit submersible jockey pumps driven by variable frequency drives
   d. Installation of pump station valves and appurtenances
   e. Installation of above grade and below grade mechanical piping
   f. Installation of a pre-engineered electrical building and associated electrical equipment
   g. Installation of diesel engine driven generator

h. Installation of generator and diesel pump fuel tanks
i. Installation of strap-on flow meter assembly
j. Dewatering system as required

4. Force Mains and Yard Piping
   a. Installation of yard piping and valving as shown on the Drawings and as specified in the Specifications.
   b. Dewatering system as required
   c. Verification of existing utilities along Robena Road at the entrance of the proposed Robena Road Booster Pump Station.

5. Operational and maintenance manuals for all equipment

6. Equipment and services for acceptance testing

7. Review of equipment installation

8. Warranties and bonds

9. All testing required during construction and startup

10. All instrumentation and electrical components including but not limited to: conduit, wire, electric motors, control panels, variable frequency drives, motor control centers, and field instruments

11. Permits listed below:
    a. FDEP and COJ Specific Permit to Construct the Pump Station Improvements.
    b. FDEP Fuel Storage Tank License Modification (COJ Environmental Quality Division).
    c. FDEP ERP Stormwater.
    d. USACE Wetlands Permit.
    e. SJRWMD Dewatering Permit if required, will be obtained by the Contractor.
    f. COJ 10-Set Review (Building / Zoning / Stormwater Management / Erosion Control Traffic / Landscape).
    g. National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from a Construction Site Notice of Intent (NOI) – Contract documents will specify that the NPDES obtained by the Contractor.

12. All other work in these contract documents not covered by the items listed above.

D. Substantial Completion: To satisfy the definition of Substantial Completion, all on-site Work including punch list items required by the Contract have been completed to where the Contractor can vacate the site and only those elements of submittal and closeout nature remain for the attainment of Final Completion and as previously described.

E. Final Completion: The last stage of construction shall be final construction and shall include the final remaining items subject to Engineer's approval as well as items listed in Section 01700 – Contract Closeout.

1.03 WORK SEQUENCE

A. Perform Work in sequence as specified herein to ensure completion of the Work in the Contract Time. Completion dates of the various stages shall be in accordance with the approved construction schedule submitted by the Contractor.

B. A general construction sequence is provided in Specification Section 01014. It is important for the existing adjacent force main to remain in service while the proposed improvements are being implemented.

C. The Contractor shall submit a written construction schedule including ancillary functions including shop drawing preparation and submittal, off-site and on-site testing, commissioning activities, and performance testing to the Engineer for approval prior to commencing work. Completion dates of the various stages shall be in accordance with the approved construction schedule submitted by the Contractor.

1.04 CONTRACTOR'S USE OF PREMISES

A. Contractor shall have use of the premises for the performance of the Work at Robena Road Pump Station only. Contractor shall coordinate activities with any other Contractor who will be performing work in the same general area.

B. Contractor shall limit the use of the premises for their Work and for storage to allow for:

1. Work by other Contractors.

2. Owner occupancy

C. Contractor shall assume full responsibility for security of all his/her and his/her subcontractors' materials and equipment stored on the site.

D. If directed by the Owner or Engineer, move any stored items which interfere with operations of Owner or other Contractors.

E. Obtain and pay for use of additional storage or work areas if needed to perform the Work.

1.05 CONTRACTOR'S STAGING, STORAGE AND STOCKPILE AREA

A. A staging, storage and stockpile area will be made available by the Owner at the project site. The Contractor is not allowed to store any equipment outside these limits.

1.06 OWNER OCCUPANCY

A. Coordinate all construction operations with Owner or Engineer to minimize conflict and to facilitate Owner usage.

B. Contractor's Responsibilities

1. Coordinate delivery date for each pre-purchased item with Owner, if applicable.

2. Review shop drawings, product data and samples. Notify Owner and Engineer of any discrepancies or problems anticipated with use of pre-purchased item.

3. Receive and unload items at site.

4. Inspect items jointly with Owner and record any shortages, damaged or defective items.

5. Assume responsibility for items, including insurance, upon acceptance of items at site.

6. Handle items at site, including uncrating and storage. Protect items from exposure to elements and damage.

7. Assemble, install, connect and finish products and provide warranty for Contractor furnished materials and workmanship as specified.

8. Repair or replace items damaged as a result of Contractor's work.

END OF SECTION

SECTION 01014
CONSTRUCTION SEQUENCE

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. The construction progress schedule required under Section 01310 shall reflect the conditions presented in this section.

B. See Sections 01465 and 01730 for additional requirements and Divisions 11 through 16, inclusive, on specific equipment startup and testing requirements.

C. Special precautions are necessary to ensure that no damage occurs to these facilities including piping, utilities, roads, interiors of structures and structures in general that are to remain in operation and are not to be modified or replaced. Any temporary facilities, materials, equipment and labor required to ensure that no damage occurs shall be provided by the Contractor as part of the Work and at no additional cost to the Owner.

D. The Owner reserves the right to postpone shutdowns due to operational and/or weather-related concerns.

1.02 DEFINITIONS AND TERMS

A. Construction Scheduling Constraints: Constraints for performance of the Work, required because of special sequencing with other parts of the Work, calendar time constraints and special testing, commissioning and procedures are identified in this Section. These constraints are in additional to the standard procedural constructions such as show and working drawings, testing, commissioning, training, etc. These constraints shall be included in the Contractor’s progress schedule

B. Special Conditions: Certain special conditions related to performance of the Work are identified in this Section and shall be included in the Contractor’s progress schedule.

1.03 NOTIFICATION REQUIREMENTS

A. The Contractor shall give a minimum of 14 days advance written notice to the Engineer and Owner of each component proposed for shutdown, tie-in, or disruption, all of which shall be subject to Owner’s approval and limitations. Shutdowns, tie-ins or disruptions specifically mentioned in this Section must conform to this requirement and any others requested by the Engineer or Owner.

1.04 SUBMITTAL REQUIREMENTS

A. Contractor shall submit shop drawings and working drawings in accordance with Section 01300 to show details of all temporary services, bypasses, shutdowns, tie-ins, and connections to existing systems.

1.05 SITE CONDITIONS

A. Several areas of construction under this Contract shall be coordinated with Owner Personnel and accomplished in a logical order to allow construction to be completed within the time allowed by Contract Documents. Coordinate the activities with the other contractors, if any, to allow orderly and timely completion of all the work.

B. When access through construction areas must be disrupted, provide alternate acceptable access for the operators or other contractors.

C. Coordinate the activities in the interface or common areas with these other contractors and the Owner personnel. Submit to the Engineer a description and schedule as to how the common areas will be utilized, recognizing the required coordination with other contractors and the operators.

D. Various interconnections for the bypass and tie-in of the existing force main at the Robena Road pump station will depend on the closure of various valves and gates. Many of these valves and gates may not seal properly. Coordinate with the Owner Personnel prior to attempting any such closure and provide any corrective measure of temporary facilities necessary to attain the shut-off needed to perform the work at no additional cost to the Owner and without interrupting the operation.

E. Various interconnections within the pump station may require temporary partial power shutdown. Make every effort necessary to minimize the shutdown time and coordinate with the Owner Personnel and/or utility authorities prior to attempting any such power shutdown. Furthermore, provide any corrective measure or temporary facilities necessary to perform the work at no additional cost to the Owner and without interrupting the pump station operation.

F. When the work requires an existing facility to be taken out of operation, temporarily or permanently, notify the Engineer and Owner 7 days in advance.

G. During Start-Up Testing, make available the manpower, equipment and manufacturer's representatives required to make any necessary adjustments and training.

1.06 CONSTRUCTION CONSTRAINTS

A. The following is a list of constraints to consider in developing the overall plan of construction. This list is not intended to release the Contractor from the responsibility to coordinate the work in any manner which will ensure project completion within the time allowed. The following areas are not necessarily listed in their required sequence of construction. A suggested sequence within each area, where necessary, is included.

B. Sitework

1. All erosion control devices shown on the Drawings shall be installed prior to any clearing and grubbing at the Robena Road site.

2. All underground pipes, conduits, cables, duct banks, and structures shall be located by electronic locator equipment and test pits in each area of excavation and flagged and mapped before any excavation is performed for structures, pipes, cables, conduits, duct banks, or removals. Working drawings of existing and proposed new work shall be

prepared to scale and submitted to the Engineer in advance of excavation. The Contractor shall be fully responsible for any process outages caused by disruption of underground facilities including responsibility for regulatory fines and the Owner's costs of dealing with regulatory agencies.

3. The Contractor's field office shall be set up and fully equipped and all utilities connected within 30 days from the Notice to Proceed. The office shall be removed not earlier than the date of substantial completion and not later than the date of final payment.

4. All underground pipes, conduits, cables, duct banks, and structures installation work shall be organized and scheduled to accomplish the following:
   a. The Owner access to operating facilities shall be maintained at all times.
   b. All underground work in each area shall be performed concurrently to avoid subsequent trenching through the same areas.
   c. Yard electrical work and piping work shall be shown on the same working drawings and fully coordinated horizontally and vertically.
   d. Existing systems shall remain fully operational except for pre-planned, scheduled, and organized temporary outages.

5. New concrete pavement shall not be installed until all piping, cables, conduits, and duct banks under the paved area have been installed. Roads shall be stabilized with crushed stone until that time. The surface pavement course and cap on existing roads shall not be installed until all other construction work is finished. Any weak areas in base course or existing pavement shall be removed and replaced prior to the final surface course installation.

6. Locations and numbers of sedimentation control facilities shall be adjusted as the work progresses so that all site runoff flows through sedimentation control facilities at all times. Facilities shown are minimums only. At no time shall undesilted water be allowed to leave the site. Maintenance and upgrading of facilities shall be scheduled weekly and after all rain events.

7. The Contractor shall submit a Notice of Intent to Use a General Permit for Short Term Construction Dewatering to the St. Johns River Water Management District prior to starting any dewatering activity at the project site.

8. All connections to existing facilities shall be scheduled through the Engineer and the Owner to minimize the impact on existing pump stations and construction progress.

9. All existing trees on the site around and/or adjacent to the construction area shall be protected and remain undamaged at all times. If the Contractor anticipates damage to a tree due to construction activities the Contractor shall contact the Engineer immediately and prior to commencing work in that area.

C. Testing

1. All facilities and systems shall be tested as a condition precedent to substantial completion. See Section 01465 and equipment specifications for additional requirements. Start-up plans for each facility and equipment shall be submitted, reviewed and approved by the Engineer.

1.07 PERMITS

A. The Contractor shall arrange for all required inspections and shall close out the permits at the end of the Contract.

1.08 SEQUENCE OF CONSTRUCTION – FORCE MAIN CONNECTION AT ROBENA ROAD

A. Below is a sequence of construction for the connection to the existing 20-inch force main at the new Robena Road Pump Station. Contractor is responsible for the actual sequence of construction to be implemented and shall submit a proposed sequence of construction to the Engineer and Owner for review and approval. Contractor is responsible for coordinating with the Owner for this installation. Contractor shall notify the Owner 14 calendar days in advance of any anticipated work for the connection to the existing 20-inch force main.

1. Night 1 - verify existing 20-inch bypass force main valves are closed. Open cut and remove existing 20-inch plugs or caps on 20-inch bypass force mains as shown on the Drawings.

2. Night 1 - connect to the existing 20-inch force main suction piping to the new Rampart Road Booster Pump Station.

3. Night 2 - Open both existing 20-inch bypass force main valves and put new Robena Road Pump Station into service.

4. Night 2 – Restore open-cut as required.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01026
APPLICATION FOR PAYMENT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Submit Applications for Payment to the Owner in accordance with the schedule established by Conditions of the Contract and Agreement between Owner and Construction Contractor.

B. The accepted Schedule of Values, Section 01370, shall be used as the basis for the Construction Contractor's Application for Payment.

1.02 RELATED WORK

A. Agreement between Owner and Construction Contractor is included in the Front-End Documents provided by the Owner.

B. Standard General Conditions of the Construction Contract are included in the Front-End Documents provided by the Owner.

C. Schedule of Values are included in Section 01370.

D. Audio Video Taping and Construction Photographs are included in Section 01380.

E. Contract Closeout is included in Section 01700.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, applications typed on forms provided by the Owner, Application for Payment, with itemized data typed on 8-1/2-in by 11-in or 8-1/2-in by 14-in white paper continuation sheets.

B. Provide itemized data on continuation sheet.

1. Format, schedules, line items and values: Those of the Schedule of Values accepted by the Engineer.

C. Provide construction photographs in accordance with Section 01380.

D. As a prerequisite for payment, Construction Contractor shall submit the followings:

1. Updated cash flow

2. Updated schedule

3. Man hours

4. JSEB participation

5. Updated record drawings (red-lines)

1.04 PREPARATION OF APPLICATION FOR EACH PROGRESS PAYMENT

A. Application Form

1. Fill in required information, including that for Change Orders executed prior to date of submittal of application.

2. Fill in summary of dollar values to agree with respective totals indicated on continuation sheets.

3. Execute certification with signature of a responsible officer of Contract firm.

4. Owner shall provide a template example Application for Payment.

B. Continuation Sheets

1. Fill in total list of all scheduled component items of Work, with item number and scheduled dollar value for each item.

2. Fill in dollar value in each column for each scheduled line item when work has been performed or products stored.
   a. Round off values to nearest dollar, or as specified for Schedule of Values.

3. List each Change Order executed prior to date of submission, at the end of the continuation sheets.
   a. List by Change Order Number and description, as for an original component item of work.

4. To receive approval for payment on component material stored on site, submit copies of the original paid invoices with the application for payment.

1.05 SUBSTANTIATING DATA FOR PROGRESS PAYMENTS

A. When the Owner requires substantiating data, submit suitable information, with a cover letter identifying.

1. Project.

2. Application number and date.

3. Detailed list of enclosures.

4. For stored products:
   a. Item number and identification as shown on application.
   b. Description of specific material.

B. Submit one copy of data and cover letter for each copy of application.

C. Maintain an updated set of red-line drawings to be used as as-build drawings in accordance with Section 01720. As a prerequisite for monthly progress payments, exhibit the updated record drawings for review by the Owner and the Engineer.

D. Maintain an updated set of Enterprise Asset Management (EAM) and Schedule of Assets. As a prerequisite for monthly progress payments, exhibit the updated documents for review by the Owner and Engineer.

1.06 PREPARATION OF APPLICATION FOR FINAL PAYMENT

A. Fill in Application form as specified for progress payments.

B. Use continuation sheet for presenting the final statement of accounting as specified in Section 01700.

C. Submit all Project Record Documents in accordance with Section 01050 and 01700.

1.07 SUBMITTAL PROCEDURE

A. Submit Draft Application for Payment with required documentation to the Owner at the time stipulated in the Agreement via e-mail. When approved, submit hardcopies to Owner's Accounts Payable.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01045
CUTTING, CORING, AND PATCHING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section covers the cutting, coring, rough and finished patching of holes and openings Holes and opening maybe in existing construction, or in parts of new construction. Procedures for cutting and patching will be the same for either condition.

B. All cutting, coring, and rough patching shall be performed by the Construction Contractor. Finish patching shall be the responsibility of the Construction Contractor and shall be performed by the trade associated with the application of the particular finish.

C. Provide all 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 or improperly scheduled work.

3. Remove and replace defective work.

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

5. Remove samples of installed work as specified for testing.

6. Provide penetrations of structural surfaces and materials for installation of piping, ductwork, equipment and electrical conduit.

7. Provide penetrations of non-structural surfaces and materials for installation of piping, ductwork, equipment and electrical conduit. The determination of what is a nonstructural surface or material shall be made by the Engineer.

8. Remove, install, or relocate materials or equipment.

1.02 RELATED WORK

A. Summary of Work is included in Section 01010.

B. Site work is included in Division 02.

C. Concrete is included in Division 03.

D. Masonry is included in Division 04.

E. Conduit sealing methods is included in Division 16.

F. Duct penetration assemblies are included in Division 15.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, a written request prior to executing any cutting or alteration which is not shown or detailed on the contract documents which affects or requires:

1. Cutting structural members.

2. Holes drilled in beams or other structural members.

3. Work of the Owner or any separate contractor.

4. Structural value or integrity of any element of the project.

5. Integrity or effectiveness of weather-exposed or m-oisture-resistant elements or systems.

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

7. Visual qualities of sight-exposed elements.

B. Request shall include:

1. Identification of the project.

2. Description of affected work.

3. The reason for cutting, alteration or excavation.

4. Effect on work of Owner or any separate contractor, or on structural or weatherproof integrity of project.

5. Description of proposed work:
   a. Method and extent 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. If the work is considered out of scope, provide a cost proposal.

8. Confirmation of coordination with any separate contractor whose work will be affected.

9. Related shutdown requests if required to do the work.

10. Request for hot work permit if required to do the work.

C. Submit written notice to the Engineer designating the date and the time the work will be uncovered.

D. When a written request is required, do not proceed with the work until a written notice to proceed is received from the Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Comply with specifications and standards for each specific product involved. Where there is no equivalent specification, the Construction Contractor shall notify the Engineer who will provide a specification for the materials to be used.

B. Concrete and grout for rough patching shall be as specified in Divisions 3.

C. Materials for finish patching shall be equal to those of adjacent construction. Where existing materials are no longer available, use materials with equivalent properties and that will provide the same appearance. The materials are to be approved by the Engineer prior to their use.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect existing conditions of project, 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 work.

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

3.02 PREPARATION

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

B. Protect surrounding materials and equipment prior to starting work.

C. Contain and control cooling liquids and slurry produced by the cutting and coring operations.

D. When the cutting or coring will result in the structure or equipment being exposed to provide adequate weather protection.

E. Provide dewatering for excavation work in accordance with Division 2.

3.03 PERFORMANCE

A. Execute cutting and demolition by methods which 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. When excavating in close proximity to piping, duct banks or other items subject to damage, use hand excavation.

C. All equipment and workplace safety shall conform to OSHA standards and specifications pertaining to plugs, noise and fume pollution, wiring and maintenance.

D. Where possible, employ original installer or fabricator to perform cutting and patching for:

1. Weather-exposed or moisture-resistant elements.

2. Sight-exposed finished surfaces.

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

F. Restore work which has been cut or removed; install new products to provide completed work in accordance with requirements of Contract Documents.

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.

H. Remove rubble and excess patching materials from the premises.

3.04 CORING

A. All coring shall be performed in such a manner as to limit the extent of patching. Locate the rebar before coring to minimize cut throughs.

B. Coring shall be performed with an approved non-impact rotary tool with diamond core drills.

C. Size of holes shall be suitable for pipe, conduit, sleeves, equipment or mechanical seals to be installed.

D. Fit work to minimize space to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

E. Fit to pipes and other penetrations in tanks to be water tight using seals or other methods defined in the specifications.

F. All holes cut through concrete and masonry walls, slabs or arches shall be core drilled unless otherwise approved. All work shall be performed by mechanics skilled in this type of work.

G. If holes are cored through floor slabs they shall be drilled from below where possible. If holes are drilled from above, provide protection and containment below the area being drilled to catch the plug and contain liquid and slurry.

3.05 CUTTING

A. All cutting shall be performed in such a manner as to limit the extent of patching.

B. Fit work to minimize space to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

C. Cutting shall be performed with a concrete saw and diamond saw blades of proper size.

D. Provide for control of slurry generated by sawing operation on both sides of wall and from below if cutting a floor.

E. When cutting a reinforced concrete wall or floor, the cutting shall be done so as not to damage the bond between the concrete and reinforcing steel left in structure. Cut shall be made so that steel neither protrudes nor is recessed from face of the cut.

F. Adequate bracing of area to be cut shall be installed prior to start of cutting. Check area during sawing operations for partial cracking and provide additional bracing as required to prevent a partial release of cut area during sawing operations.

G. Provide equipment of adequate size to remove cut panel.

H. Saw cut concrete and masonry prior to breaking out sections.

I. Install work at such time as to require the minimum amount of cutting and patching.

J. All cutting of structural members shall be done in a manner directed by the Engineer.

K. Cut opening only large enough to allow easy installation of the equipment, ducting, piping or conduit.

L. When existing conduits or pipe sleeves are cut off at the floor line or wall line, they shall be filled with grout or suitable patching material.

3.06 PROTECTION

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

B. Provide protection from elements for that portion of the project which may be exposed by cutting and patching work.

C. Maintain excavations free from water.

3.07 PATCHING

A. Rough patching shall be such as to bring the cut or cored area flush with existing construction unless otherwise shown.

B. Finish patching shall match existing surfaces as approved.

C. Patching shall be of the same kind and quality of material as was removed.

D. The completed patching work shall restore the surface to its original appearance or better.

E. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed to include the joint between the existing material and the patch.

F. Equipment damaged during cutting and patching shall be replaced or repaired by the equipment manufacturer, at the Engineer's sole discretion and at the expense of the Construction Contractor doing the work.

G. Repaint any damage to factory applied paint finishes using touch-up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted in accordance with the field painting requirements specified in Section 09902 at the expense of the Construction Contractor doing the work.

H. Slurry or tailings resulting from coring or cutting operations shall be contained and vacuumed or otherwise removed from the area following drilling or cut.

I. Equipment shall be protected against mechanical and water damage during cutting and patching. Provide protective covers or use other means such as temporary relocation to protect equipment that is at risk of damage from the cutting and patching

J. Provide protection for existing equipment, utilities and critical areas against water or other damage caused by drilling operation.

END OF SECTION

SECTION 01046
CONTROL OF WORK

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor must meet all general requirements of JEA Water and Wastewater Standards (January 2020 or latest edition) and the following general construction requirements outlined in this Section hereinafter.

1.02 PRIVATE LAND

A. The Contractor shall not enter or occupy private land outside of easements, except by permission of the land owner.

1.03 PIPE LOCATIONS

A. The Contractor shall locate pipelines substantially as indicated on the Drawings. The Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings are noted on the Drawings, such notation is for the Contractor 's convenience and does not relieve him from laying and jointing different or additional items where required.

1.04 OPEN EXCAVATIONS

A. The Contractor shall adequately safeguard all open excavations by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons and damage to property. The Contractor shall provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. The Contractor shall remove bridges provided for access during construction when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the Engineer. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the Engineer may require special construction procedures such as limiting the length of the open trench, prohibiting stacking excavated material in the street and requiring that the trench shall not remain open overnight.

B. The Contractor shall take precautions to prevent injury to the public due to open trenches. The Contractor shall provide adequate light at all trenches, excavated material, equipment, or other obstacles which could be dangerous to the public at night.

1.05 TEST PITS

A. The Contractor shall excavate test pits, at the direction of the Engineer, to locate underground pipelines or structures in advance of the construction. The Contractor shall backfill test pits immediately after their purpose has been satisfied and restore and maintain the surface in a manner satisfactory to the Engineer.

1.06 CARE AND PROTECTION OF PROPERTY

A. The Contractor shall be responsible for the preservation of all public and private property and use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, the Contractor shall restore such property to a condition similar or equal to that existing before the damage was done, or make good the damage in other manner acceptable to the Engineer.

1.07 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

A. The Contractor shall assume full responsibility for the protection of all buildings, structures, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains and electric and telephone cables, whether or not they are shown on the Drawings. The Contractor shall carefully support and protect all such structures and utilities from injury of any kind. Immediately repair any damage resulting from the construction operations.

B. Assistance will be given the Contractor in determining the location of existing services. The Contractor, however, shall bear full responsibility for obtaining all locations of underground structures and utilities (including existing water services, drain lines and sewers). Maintain services to buildings and pay costs or charges resulting from damage thereto.

C. The Contractor shall notify all utility companies in writing at least 72 hours (excluding Saturdays, Sundays and Legal holidays) before excavating in any public way.

D. If, in the opinion of the Engineer, permanent relocation of a utility owned by the Owner is required, the Engineer may direct the Contractor, in writing, to perform the work. Work so ordered will be paid for at the Contract unit prices. No claim for delay will be allowed due to such relocation.

E. Along the proposed pipe lines as indicated on the plans, the Contractor shall remove the surface materials only to such widths as will permit a trench to be excavated which will afford sufficient room for proper efficiency and proper construction. All applicable regulations shall be followed. Where sidewalks, driveways, pavements, and curb and gutter are encountered, care shall be taken to protect against fracture or disturbance beyond reasonable working limits. All fractured, broken, or disturbed surfaces shall be restored to their original condition prior to completion of the work.

F. Restoration of all surfaces including road subbase, soil cement, limerock base, asphaltic concrete surface, portland cement concrete pavement and driveways, sidewalks, and concrete curbs shall be in strict accordance with Drawings. All grassing and mulching shall be done. Sites shall be restored to existing conditions. Any modifications from existing conditions shall require prior approval from owner of existing structure, property, or utility.

G. Lawn areas shall be left in as good or better condition as before starting the work. Where sod is to be removed, it shall be carefully restored with new sod of the same type. Solid sodding shall be placed on all slopes greater than 4:1, within 10 feet of all proposed structures and where existing sod is removed or disturbed by the work. In addition, Contractor shall restore all storm drains, culverts, inlets, and storm manholes to equal or better condition.

H. Any fence, or part thereof, that is damaged or removed during the course of the work shall be replaced or repaired by the Contractor and shall be left in as good a condition as before the starting of the work. The manner in which the fence is repaired and replaced and the materials used shall be subject to the approval of the Engineer.

I. All trees and shrubs not shown to be removed on the plans shall be protected by the Contractor at his expense. No excavated materials shall be placed so as to injure such trees and shrubs. Trees or shrubs destroyed by negligence of the Contractor or his employees shall be replaced by him with new stock of similar size and age at the sole expense of the Contractor.

1.08 WATER FOR CONSTRUCTION PURPOSES

A. Contractor shall provide and install the water meter and backflow preventer for water required for construction services, Coordinate with JEA Pearl Street for the appropriate equipment. Contractor shall pay all fees and water usage charges. All water usage shall be metered.

1.09 MAINTENANCE OF FLOW

A. The Contractor shall provide for the flow of sewers, drains and water courses interrupted during the progress of the work, and immediately cart away and remove all offensive matter. Discuss the entire procedure of maintaining existing flow with the Engineer at least seven (7) days prior to the interruption of any flow.

1.10 PROTECTION OF CONSTRUCTION AND EQUIPMENT

A. All newly constructed work shall be carefully protected from injury in any way. No wheeling or walking or placing of heavy loads on it shall be allowed and all portions damaged shall be reconstructed by the Contractor at his own expense.

B. All structures shall be protected in a suitable manner. Proposed methods of protection shall be submitted to the Engineer. Should any of the floors or other parts of any structures become heaved, cracked or otherwise damaged, all such damaged portions of the work shall be completely repaired and made good by the Contractor at his own expense and to the satisfaction of the Owner. If, in the final inspection of the work, any defects, faults or omissions are found, the Contractor shall cause the same to be repaired or removed and replaced by proper materials and workmanship without extra compensation for the materials and labor required. Further, the Contractor shall be fully responsible for the satisfactory maintenance and repair of the construction and other work undertaken herein, for at least the guarantee period described in the Contract.

1.11 COOPERATION WITHIN THIS CONTRACT

A. All firms or persons authorized to perform any work under this Contract shall cooperate with Contractor and Subcontractors or trades and assist in incorporating the work of other trades where necessary or required.

B. Cutting and patching, drilling and fitting shall be carried out where required by the trade or subcontractor having jurisdiction, unless otherwise indicated herein or directed by the Engineer.

1.12 CLEANUP AND DISPOSAL OF EXCESS MATERIAL

A. During the course of the work, the Contractor shall keep the site of operations as clean and neat as possible. The Contractor shall dispose of all residue resulting from the construction work and, at the conclusion of the work, remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures and any other refuse remaining from the construction operations and leave the entire site of the work in a neat and orderly condition.

B. In order to prevent environmental pollution arising from the construction activities related to the performance of this Contract, the Contractor shall comply with all applicable Federal, State and local laws and regulations concerning waste material disposal, as well as the specific requirements stated in this Section and in other related sections.

C. Disposal of excess excavated material in wetlands, stream corridors and plains is strictly prohibited even if the permission of the property owner is obtained. Any violation of this restriction by the Contractor or any person employed by him will be brought to the immediate attention of the responsible regulatory agencies, with a request that appropriate action be taken against the offending parties. The Contractor will be required to remove the fill and restore the area impacted at no increase in the Contract Price.

1.13 GRADES, SURVEY LINES, AND PROTECTION OF MONUMENTS

A. All work shall be constructed in accordance with the lines and grades shown on the drawings. The full responsibility for keeping alignment and grade shall rest upon the Contractor.

B. Bench marks and base line controlling points shall be established prior to beginning work. Reference marks for lines and grades as the work progresses will be located to cause as little inconvenience to the prosecution of the work as possible. The Contractor shall so place excavation and other materials as to cause no inconvenience in the use of the reference marks provided. Contractor shall remove any obstructions placed contrary to this provision.

C. The Contractor shall furnish and maintain, at his own expense, stakes and other such materials and give such assistance, including qualified helpers, for setting reference marks to the satisfaction of the Engineer. The Contractor shall check reference marks by such means, as he may deem necessary. The Contractor shall, at his own expense, establish all working or construction lines and grades as required from the reference marks and shall be solely responsible for the accuracy thereof.

D. Property corners and survey monuments shall be preserved using care not to disturb or destroy them. If a property corner or survey monument is disturbed or destroyed during construction, whether by accident, careless work, or required to be disturbed or destroyed by construction work, said property corner or survey monument shall be restored by a land surveyor registered in the state of Florida. All costs for this work shall be paid for by the Contractor.

END OF SECTION

SECTION 01050
PROJECT CONTROLS (SURVEYING)

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall provide and pay for field engineering services required for project; including but not limited to:

1. Survey work required for project controls and layout.

2. Certified as-built surveys specified herein.

B. The Contractor shall retain the services of a registered land surveyor licensed in the state of Florida to:

1. The Contractor shall identify existing control points and property line corners indicated on the Drawings.

2. The Contractor shall verify and record all existing structure locations in the vicinity of, or adjacent to, the proposed Work; and, the locations of all pro-posed structures and facilities.

3. The Contractor shall maintain an accurate record of locations of all new buried piping and existing buried piping and other buried existing facilities (piping, conduits, and structures) encountered and/or relocated during construction of the new Work.

4. The Contractor shall maintain accurate locations of all new structures, including corner locations, tank locations and equipment locations within the project site.

1.02 RELATED WORK

A. Summary of Work is included in Section 01010.

B. Contract Closeout is included in Section 01700.

C. Record Drawings are included in Section 01720.

D. JEA Water and Wastewater Standards Manual, Section 501.

1.03 SUBMITTALS

A. The Contractor shall submit, to the Engineer, in accordance with Section 01300, the name, address and state registration and license number of proposed registered land surveyor.

B. On request of the Engineer, the Contractor shall submit documentation to verify accuracy of field engineering work.

C. At the end of the project, and prior to final payment, the Contractor submit certified drawing(s) (with the Surveyor's title block) of the items listed below. All surveys shall be tied to the applicable Grid System and shall indicate all pre-existing and new project benchmarks. Vertical Control shall conform to the project elevation datum designated on the plans.

1. Certified site survey at 1-in = 50-ft scale or larger, but not greater than 1-in = 20-ft scale, on 24-in by 36-in sheet(s), indicating the building corners, sidewalks, paved areas and location of all above ground structures within the project site or limits of construction.

2. Certified survey, drawn to the same scale as the Engineer's yard piping drawings, showing the locations, lines and grades in plan and profile views of all below-grade lines (piping and concrete-encased electrical ducts) exterior to buildings and other buried facilities (e.g., valves, tanks, etc.). This requirement includes all utilities installed as a part of the scope of this project, as well as existing lines encountered during the installation of the new Work.

3. Certified survey showing the locations, lines and grades of all pipes 4-inch diameter and larger above ground, buried and exterior to buildings and other buried facilities (e.g. valves, tanks, vaults, etc.) installed as a result of the work. This shall be at the same scale as the Engineer’s yard piping drawing.

4. Topographical surveys shall be scaled 1-in = 50-ft scale or larger, but not greater than 1-in = 20-ft scale, on 24-in by 36-in sheet(s), with 2-foot contour intervals for 1 inch:50 feet scale drawings and 1-foot contour intervals for 1 inch:20 feet scale drawings.

5. Certified survey showing elevations of all flow control points, such as weirs, elevations of all new structures, pipe inverts, rim elevations on manholes, and elevations of equipment.

1.04 QUALIFICATIONS OF SURVEYOR

A. Registered land surveyor, licensed in the state of Florida.

1.05 SURVEY REFERENCE POINTS

A. Existing basic horizontal and vertical control points for the project are those designated on Drawings.

B. The Contractor shall locate and protect control points prior to starting site work and preserve all permanent reference points during construction.

1. The Contractor shall make no changes or relocations without prior written notice to and approval by the Engineer.

2. The Contractor shall report to the Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

3. The Contractor shall require the surveyor to correctly replace project control points which may be lost or destroyed. Establish replacements based on original survey control.

1.06 PROJECT SURVEY REQUIREMENTS

A. The Contractor shall establish a minimum of two permanent bench marks on site, referenced to data established by survey control points.

1. Record locations, with horizontal and vertical data, on the as-built Survey.

2. Permanent benchmarks shall be installed and spaced for convenient reference and use at locations along the pipeline route and/or on the plant site.

3. Benchmarks shall be installed to National Geodetic Survey standards and shall include horizontal and vertical data, as well as the installation date.

B. The Contractor shall establish lines and levels; locate and lay out:

1. Site improvements.
   a. Stakes for grading, fill and topsoil placement.
   b. Utility slopes and invert elevations.
   c. Sidewalks, pavement, fencing, storm drainage facilities, and other finish surface work.
   d. Locations, sizes and depths of manholes, valves and fittings.

2. Batter boards for structures.

3. Building foundation, column locations and floor levels.

4. Controlling lines and levels required for mechanical and electrical trades.

C. If lines, levels or layouts are lost or destroyed, or if required by the Owner or Engineer, the Contractor shall verify layouts by same methods.

D. The Surveyor shall provide all elevation in North American Vertical Datum of 1988 (NAVD 88).

E. The Contractor shall establish all lines and grades prior to construction of line work for all force mains, transmission mains, storm drainage piping, gravity sewers and other new utility lines at 100-ft increments, at defined breaks in grade, and at manholes.

F. The following dimensional references must be depicted on the As-Built drawings.

1. Depths of various elements of foundation in relation to finish first floor datum.

2. All underground piping with elevations and dimensions. Changes to piping location. Horizontal and vertical locations of all underground utilities and appurtenances, referenced to permanent surface improvements. Actual installed pipe material, class, etc. All pipes and valves shall be labeled using the method as per the contract drawings.

3. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.

4. Field changes of dimension and detail.

5. Changes made by Field Order or by Change Order.

6. Details not on original contract drawings.

7. Equipment and piping relocations.

8. All underground duct banks with elevations and dimensions, horizontal and vertical locations of underground duct banks, and manholes along duct banks.

9. All underground cable elevations and horizontal locations of underground cables.

10. All existing and new structures clearly indicated.

11. All elevations of new structures clearly indicated.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 RECORDS

A. The Contractor shall maintain a complete, accurate log of all control and survey work as it progresses.

B. The Contractor shall update the project as-built survey on a monthly basis, based on the work performed during the month. The Contractor shall submit one copy of up to date as-built documentation with Contractor's monthly applications for payment.

C. The Contractor shall maintain an accurate record of new and existing piping, conduit and structure changes, revisions, relocations, and modifications.

D. At the end of the project, the Contractor shall submit the following:

1. Four signed and sealed prints of all required as-built survey information

2. Copy of all AutoCAD files of documents specified in Article 1.03.C, above on a CD or DVD.

END OF SECTION

SECTION 01110
ENVIRONMENTAL PROTECTION PROCEDURES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials and equipment and perform all work required for the prevention of environmental pollution in conformance with applicable laws and regulations, during and as the result of construction operations under this Contract. For the purpose of this Section, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and/or recreational purposes.

B. The control of environmental pollution requires consideration of air, water and land, and involves management of noise and solid waste, as well as other pollutants.

C. The Contractor shall schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the work. The Contractor shall provide erosion control measures such as diversion channels, sedimentation or filtration systems, berms, staked hay bales, seeding, mulching or other special surface treatments as are required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc. All erosion control measures shall be in place in an area prior to construction activity in that area. Specific requirements for erosion and sedimentation controls are specified in Division 2.

D. This Section is intended to provide that construction is achieved with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. These are general guidelines. It is the Contractor's responsibility to determine the specific construction techniques to meet these guidelines.

E. All phases of sedimentation and erosion control shall comply with and be subject to the approval of the Owner. The Contractor shall prepare a sedimentation and erosion control plan meeting the requirements all applicable Federal, State, and Local regulatory agencies. After approval of the plan is provided by the Owner the Contractor can initiate construction. It shall be the responsibility of the Contractor to modify the plan as needed to address changing site conditions to comply with applicable regulations. No additional compensation shall be provided for environmental protection procedures.

1.02 APPLICABLE REGULATIONS

A. The Contractor shall comply with all applicable Federal, State and local laws and regulations concerning environmental pollution control and abatement.

1.03 NOTIFICATIONS

A. The Engineer will notify the Contractor in writing of any non-compliance with the foregoing provisions or of any environmentally objectionable acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the environmental protection requirements shall notify the Contractor in writing, through the Engineer, of any non-

compliance with State or local requirements. After receipt of such notice from the Engineer or from the regulatory agency through the Engineer, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Owner may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.

1.04 IMPLEMENTATION

A. Prior to commencement of the work, the Contractor shall meet with the Engineer and the Owner to develop mutual understandings relative to compliance with these provisions and administration of the environmental pollution control program.

B. The Contractor shall remove temporary environmental control features, when approved by the Engineer and incorporate permanent control features into the project at the earliest practicable time.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EROSION CONTROL

A. The Contractor shall provide positive means of erosion control such as shallow ditches around construction to carry off surface water. Erosion control measures, such as siltation basins, check dams, mulching, jute netting and other equivalent techniques, shall be used as appropriate. Offsite surface water shall be diverted around the site, to a downstream channel ahead of siltation barriers. Flow of surface water into excavated areas shall be prevented. Ditches around construction area shall also be used to carry away water resulting from dewatering of excavated areas. At the completion of the work, ditches shall be backfilled and the ground surface restored to original condition.

3.02 PROTECTION OF STREAMS AND SURFACE WATERS

A. The Contractor shall take all precautions to prevent, or reduce to a minimum, any damage to any stream or surface water from pollution by debris, sediment or other material, or from the manipulation of equipment and/or materials in or near such streams. Water that has been used for washing or processing, that contains oils or sediments that will reduce the quality of the water in the stream, shall not be directly returned to the stream. Divert such waters through a settling basin or filter before being directed into streams or surface waters.

B. The Contractor shall not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels.

C. The Contractor shall take all preventative measures to avoid spillage of petroleum products and other pollutants. In the event of any spillage, prompt remedial action shall be taken in accordance with a contingency action plan approved by the Florida Department of

Environmental Protection. The Contractor shall submit two copies of approved contingency plans to the Engineer.

D. Water being flushed from structures or pipelines after disinfection, with a Cl_2 residue of 2 mg/l or greater shall be treated with a dechlorination solution, in a method approved by the Engineer, prior to discharge.

3.03 PROTECTION OF LAND RESOURCES

A. The Contractor shall restore land resources within the project boundaries and outside the limits of permanent work to a condition, after completion of construction that will appear to be natural and not detract from the appearance of the project. The Contractor shall confine all construction activities to areas shown on the Drawings.

B. Outside of areas requiring earthwork for the construction of the new facilities, the Contractor shall not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.

C. Before beginning operations near them, the Contractor shall protect trees that may possibly be defaced, bruised, injured, or otherwise damaged by the construction equipment, dumping or other operations, by placing boards, planks, or poles around them. Monuments and markers shall be protected similarly.

D. Any trees or other landscape features scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to their original condition. The Engineer will decide the method of restoration to be used and whether damaged trees shall be treated and healed or removed and disposed of.

1. All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1-in in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.

2. Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and are beyond saving in the opinion of the Engineer, shall be immediately removed or replaced.

E. The locations of the Contractor's storage and other construction buildings required temporarily in the performance of the work, shall be cleared portions of the job site or areas to be cleared as shown on the Drawings and approved by the Engineer and shall not be within wetlands or floodplains. The preservation of the landscape shall be an imperative consideration in the selection of all sites and in the construction of buildings. Drawings showing storage facilities shall be submitted for approval of the Engineer.

F. If the Contractor proposes to construct temporary roads or embankments and excavations for plant and/or work areas, he shall submit the following for approval at least ten days prior to scheduled start of such temporary work.

1. A layout of all temporary roads, excavations, embankments and drainage to be constructed within the work area.

2. Details of temporary road construction.

3. Drawings and cross sections of proposed embankments and their foundations, including a description of proposed materials.

4. A landscaping drawing showing the proposed restoration of the area. Indicate the proposed removal of any trees and shrubs outside the limits of existing clearing area. Indicate locations of guard posts or barriers required to control vehicular traffic and protect trees and shrubs to be maintained undamaged. The Drawing shall provide for the obliteration of construction scars as such and shall provide for a natural appearing final condition of the area. Modification of the Contractor's approved drawings shall be made only with the written approval of the Engineer. No unauthorized road construction, excavation or embankment construction including disposal areas will be permitted.

G. The Contractor shall remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess of waste materials, or any other vestiges of construction as directed by the Engineer. I-t is anticipated that excavation, filling and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation thereon. The disturbed areas shall be prepared and sodded as described in Section 02932, or as approved by the Engineer.

H. All debris and excess material will be disposed of outside wetland or floodplain areas in an environmentally sound manner.

3.04 PROTECTION OF AIR QUALITY

A. Burning - The use of burning at the project site for the disposal of refuse and debris will not be permitted.

B. Dust Control - Maintain all excavations, embankment, stockpiles, access roads, plant sites, waste areas, borrow areas and all other work areas within or without the project boundaries free from dust which could cause the standards for air pollution to be exceeded and which would cause a hazard or nuisance to others.

C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of petroleum products is prohibited. The use of chlorides may be permitted with approval from the Engineer.

D. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor shall have sufficient competent equipment on the job to accomplish this. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs, as determined by the Engineer.

3.05 NOISE CONTROL

A. The Contractor shall make every effort to minimize noises caused by the construction operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with Federal and State regulations.

3.06 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

A. The Contractor shall maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created and approval for removal is provided by the Engineer.

END OF SECTION

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SECTION 01170
SPECIAL PROVISIONS

PART 1 GENERAL

A. Any modifications to the design or design intent shall require the prior written approval of the Design Engineer of Record. Request for Information relating to the design intent shall be submitted to the Engineer for forwarding to the Design Engineer of record for his/her response. Shop Drawings and Submittals shall be submitted to the Engineer for forwarding to the Design Engineer of Record for review and approval in accordance with Section 01300. All testing required under this Agreement shall be performed in the presence of the Design Engineer of Record as applicable unless such observations of the testing are waived by the Design Engineer of Record.

B. Contractor shall strictly follow JEA's Water and Sewer Standards Manual, January 2020 or latest edition during the construction of the new Robena Road Booster Pump Station as well as these contract documents. Contractor shall issue a Request for Information in the event of a discrepancy between the contract documents and JEA's Manual for Engineer and Owner to clarify.

1.02 INSTALLATION OF EQUIPMENT

A. Special care shall be taken to ensure proper alignment of all equipment with particular reference to the pumps and electric drives. The units shall be carefully aligned on their foundations by qualified millwrights after their sole plates have been shimmed to true alignment at the anchor bolts. The anchor bolts shall be set in place and the nuts tightened against the shims. After the foundation alignments have been approved by the Engineer, the bedplates or wing feet of the equipment shall be securely bolted in place. The alignment of equipment shall be further checked after securing to the foundations, and after conformation of all alignments, the sole plates shall be finally grouted in place. The Contractor shall be responsible for the exact alignment of equipment with associated piping and under no circumstances, will "pipe springing" be allowed.

B. All wedges, shims, filling pieces, keys, packing, grout, or other materials necessary to properly align, level and secure apparatus in place shall be furnished by the Contractor. All parts intended to be plumb or level must be proven exactly so. Perform all grinding necessary to bring parts to proper bearing after erection.

1.03 SLEEVES AND OPENINGS

A. The Contractor shall provide all openings, channels, chases, etc, in new construction and furnish and install anchor bolts and other items to be embedded in concrete, as required to complete the work under this Contract. Perform all cutting, coring and rough and finish patching required in existing construction for the work of all trades.

B. The Contractor shall furnish all sleeves, inserts, hangers, anchor bolts, etc, required for the execution of their work. It shall be their responsibility before the work of the Contractor is begun to furnish him with the above items and with templates, drawings or written information covering chases, openings, etc, which they require and to follow up the work of the Contractor as it progresses, making sure that their drawings and written instructions are carried out. Failing to do this, they shall be responsible for the cost of any corrective measures which may be

required to provide necessary openings, etc. If the Contractor fails to carry out the directions given him, covering details and locations of openings, etc., Contractor shall be responsible for any cutting and refinishing required to make the necessary corrections. In no case shall beams, lintels, or other structural members be cut without the approval of the Engineer.

1.04 SUBMITTALS

A. Submit to the Engineer in accordance with Section 01300, a valve schedule as specified in Paragraph 1.10.

1.05 GREASE, OIL AND FUEL

A. All grease, oil and fuel required for testing of equipment shall be furnished with the respective equipment. The Owner shall be furnished with a year's supply of required lubricants including grease and oil of the type recommended by the manufacturer with each item of equipment supplied under Divisions 11, 15, and 16.

1.06 TOOLS

A. Any special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation and maintenance of any equipment shall be furnished with the respective equipment.

B. Tools shall be furnished in heavy steel tool boxes complete with lock and duplicate keys.

1.07 POWER SUPPLY

A. Unless otherwise specified, all motors 1/2 Hp and larger shall be designed for a power supply of 460 Volts, 3 Phase, 60 Hz, and all motors 1/3 Hp and smaller shall be designed for a power supply of 120 Volts, single phase, 60 Hz.

1.08 POWER FACTOR CORRECTION CAPACITORS

A. All single and multi-speed three phase induction motors 5 Hp and larger shall be furnished with factory provided power factor correction capacitors.

B. Capacitors shall be sized by the manufacturers such that over voltage due to self-excitation will be prevented and transient torques limited to normal values. Full load power factor shall be corrected to not less than 0.95 where such correction will not violate the provisions of NEC Article 460.

C. Capacitor enclosures shall be compatible with those specified for their respective motors, i.e., dust-tight for indoor installation in non-hazardous areas and weatherproof for outdoor installations.

D. Capacitors shall be dry or oil insulated with integral fuse protection and discharge resistor. The insulating medium shall be non-flammable and meet U.S. Environmental Protection Agency Standards.

E. Capacitors shall be installed under Division 16.

1.09 ARCHITECTURAL COATINGS

A. Maintain coordination among all Sections (windows, window walls, louvers, doors and frames, etc.) requiring PVF or PVC coatings. All coatings shall match to the satisfaction of the Engineer with regard to color and texture. Items rejected by the Engineer shall promptly be removed from the job site.

1.10 PIPE MARKING

A. Pipe marking is included in Division 9 under Painting, but it shall be the Contractor's responsibility to assist, as required by the Engineer, in identifying pipe contents, direction of flow and all else required for proper marking of pipe.

1.11 VALVE IDENTIFICATION

A. The Contractor shall prepare a valve schedule for all valves required for his work showing a number, the location, type, function, and normal operating position, for each valve. The schedule shall be submitted to the Engineer for approval not less than 120 days prior to start-up.

B. The Contractor shall furnish tags for all valves required for the work. Valve tags shall be 2-in diameter, 19-gauge, stainless steel, with stainless steel hooks suitable for attaching the tag to the valve operator. Tags shall be stamped or etched with the valve number and the information on the valve schedule coded in a system provided by the Owner. Submit two samples of the type of tag proposed and the manufacturer's standard color chart and letter styles to the Engineer for approval.

C. The Contractor shall install valve tags on all valves required for his work.

1.12 NOISE LIMITATIONS

A. All equipment to be furnished under this Contract, unless specified otherwise in the technical specifications, shall be designed to ensure that the sound pressure level does not exceed 85 decibels over a frequency range of 37.8 to 9600 cycles per second at a distance of 3-ft from any portion of the equipment, under any load condition, when tested using standard equipment and methods. Noise levels shall include the noise from the motor. Mufflers or external baffles shall not be acceptable for the purpose of reducing noise. Data on noise levels shall be included with the shop drawing submittal.

1.13 SPARE PARTS

A. Where spare parts are specified in the technical sections, furnish all spare parts recommended by the manufacturer or system supplier for one year of service. In addition, furnish all spare parts itemized in each Section.

B. Collect and store all spare parts in an area to be designated by the Owner. Furnish the Owner with an inventory listing all spare parts, the equipment they are associated with, the name and address of the supplier and the delivered cost of each item. Copies of actual invoices for each item shall be furnished with the inventory to substantiate the delivery cost.

C. Spare parts shall be packed in cartons, properly labeled with indelible markings with complete descriptive information including manufacturer, part number, part name and equipment for which the part is to be used and shall be properly treated for one year of storage.

1.14 RIGHT TO KNOW LAW

A. The Contractor shall submit to the Florida Department of Environmental Protection the Material Safety Data Sheets for all substances or mixture of substances used on the Project by him or his Subcontractors prior to commencing any work.

1.15 HURRICANE PREPAREDNESS PLAN

A. Within 30 days of the date Notice to Proceed, submit a Hurricane Preparedness Plan to the Engineer and the Owner for approval. The Plan shall describe in detail the necessary measures which the Contractor will perform, at no additional costs to the Owner, in case of a hurricane warning. Revise Plan as required by the Engineer and Owner.

1.16 WEATHER PROTECTION

A. In the event of inclement weather, the Contractor shall protect the Work and materials from damage or injury from the weather. If, in the opinion of the Engineer, any portion of the Work or materials has been damaged by reason of failure on the part of the Contractor or subcontractors to so protect the Work, such Work and materials shall be removed and replaced with new materials and Work to the satisfaction of the Engineer.

1.17 SERVICES OF MANUFACTURERS' FIELD SERVICE TECHNICIAN

A. Bid prices for equipment furnished by the Contractor under Divisions 11, 13, 15 and 16 shall include the cost of a competent field service technician of the manufacturers of all equipment to supervise the installation, adjustment and testing of the equipment and to instruct the Owner's operating personnel on operation and maintenance. The approved Manufacturer's operation and maintenance data as specified in Section 01730 shall be delivered to the Engineer prior to instructing the Owner's personnel. This supervision may be divided into two or more time periods as required by the installation program or as directed by the Engineer.

B. After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Manufacturer's field service technician shall inspect, operate, test and adjust the equipment. The inspection shall include at least the following points where applicable.

1. Soundness (without cracked or otherwise damaged parts)

2. Completeness in all details, as specified and required

3. Correctness of setting, alignment and relative arrangement of various parts

C. Upon completion of this work, the Manufacturer's field service technician shall submit, in triplicate, to the Engineer a complete, signed report of the results of his/her inspection, operation, adjustments and tests. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified and suggestions for precautions to be taken to ensure proper maintenance.

D. A certificate from the Manufacturer stating that the installation of the equipment is satisfactory, that the unit has been satisfactorily tested, is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of the unit shall be submitted prior to the startup and performance demonstration hereinafter specified. The certificate shall indicate date and time instruction was given and names of operating personnel in attendance. This certification shall be submitted on the certification sheet, a sample of which is at the end of this Section.

E. See the detailed Specifications for additional requirements for furnishing the services of the manufacturer's field service technician.

END OF SECTION

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SECTION 01200
PROJECT MEETINGS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. The Owner shall schedule and administer pre-construction meeting, periodic progress meetings and specially called meetings throughout progress of the work.

1. Make physical arrangements for meetings.

B. The Engineer shall

1. Preside at meetings.

2. Record the minutes; include significant proceedings and decisions.

3. Reproduce and distribute copies of minutes within 10 working days after each meeting.
   a. To participants in the meeting.
   b. To parties affected by decisions made at the meeting.

C. Representatives of the Contractor, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.

D. Attend meetings to ascertain that work is expedited consistent with Contract Documents and construction schedules.

E. Contractor to prepare agenda for meetings.

1.02 RELATED REQUIREMENTS

A. Construction Schedules are included in Section 01310.

B. Shop Drawings, Working Drawings and Samples are included in Section 01300.

C. Project Record Documents are included in Section 01720.

D. Operating and Maintenance Data is included in Section 01730.

1.03 PRE-CONSTRUCTION MEETING

A. Schedule a preconstruction meeting no later than 10 days after date of Notice to Proceed.

B. Location: A central site, convenient for all parties, designated by the Owner.

C. Attendance

1. Owner’s Representative.

2. Engineer and their professional consultants.

3. Resident Project Representative.

4. Contractor’s Superintendent.

5. Major Subcontractors.

6. Major suppliers.

7. Utilities

8. Others as appropriate.

D. Suggested Agenda

1. Distribution and discussion of:
   a. List of major subcontractors and suppliers.
   b. Projected Construction Schedules.

2. Critical work sequencing.

3. Major equipment deliveries and priorities.

4. Project Coordination.
   a. Designation of responsible personnel.

5. Procedures and processing of:
   a. Field decisions.
   b. Proposal requests.
   c. Submittals.
   d. Change Orders.
   e. Applications for Payment.

6. Adequacy of distribution of Contract Documents.

7. Procedures for maintaining Record Documents.

8. Use of premises:
   a. Office, work and storage areas.
   b. Owner's requirements.

9. Construction facilities, controls and construction aids.

10. Temporary utilities.

11. Housekeeping procedures.

1.04 PROGRESS MEETINGS

A. Schedule regular periodic meetings. The progress meetings will be held every 30 days with the first meeting 30 days after the pre-construction meeting or 30 days after the date of Notice to Proceed.

B. Hold called meetings as required by progress of the work.

C. Location of the meetings: Project field office of Contractor or Owner.

D. Attendance

1. Engineer and their professional consultants as needed.
2. Contractor's superintendent and key staff as appropriate to the agenda.
3. Subcontractors as appropriate to the agenda.
4. Suppliers as appropriate to the agenda.
5. Others as appropriate.

E. Suggested Agenda

1. Review, approval of minutes of previous meeting.
2. Review of work progress since previous meeting.
3. Field observations, problems and conflicts.
4. Problems which impede Construction Schedule.
5. Review of off-site fabrication, delivery schedules.
6. Corrective measures and procedures to regain projected schedule.
7. Revisions to Construction Schedule.
8. Progress, schedule, during succeeding work period.
9. Coordination of schedules.
10. Review submittal schedules; expedite as required.
11. Maintenance of quality standards.
12. Pending changes and substitutions.
13. Review proposed changes for:
    a. Effect on Construction Schedule and on completion date.
    b. Effect on other contracts of the project.
14. Other business.
    a. Asset management update
15. Construction schedule.
16. Critical/long lead items.

F. Attend progress meetings and is to study previous meeting minutes and current agenda items, in order to be prepared to discuss pertinent topics such as deliveries of materials and equipment, progress of the work, etc.

G. Provide a current submittal log at each progress meeting in accordance with Section 01300.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes the requirements for compiling, processing and transmitting submittals required for execution of the project.

B. Submittals are categorized into two types: Action Submittals and Informational Submittals, as follows:

1. Action Submittal: Written and graphic information submitted by the Contractor that requires the Engineer's approval. The following are examples of action submittals:
   a. Shop drawings (including working drawings, valve schedule in accordance with Section 01170, and product data)
   b. Samples
   c. Operation & maintenance manuals
   d. Site Usage Plan (Contractor's staging - including trailer siting and material laydown area)
   e. Schedule of values
   f. Payment application format

2. Informational Submittal: Information submitted by the Contractor that does not require the Engineer's approval. The following are examples of informational submittals:
   a. Shop Drawing Schedule
   b. Construction Schedule
   c. Statements of Qualifications
   d. Health and Safety Plans
   e. Construction Photography and Videography
   f. Asset Management
   g. Work Plans
   h. Maintenance of Traffic Plans
   i. Outage Requests
   j. Proposed Testing Procedures
   k. Test Records and Reports
   l. Vendor Training Outlines/Plans
   m. Test and Start-Up Reports
   n. Certifications
   o. Record Drawings
   p. Record Shop Drawings
   q. Submittals required by laws, regulations and governing agencies
   r. Submittals required by funding agencies
   s. Other requirements found within the technical specifications
   t. Warranties and Bonds
   u. As-Built Surveys
   v. Contract Close-out Documents

1.02 RELATED WORK

A. Additional requirements may be specified in the General Conditions for the Contract.

B. Additional submittal requirements may be specified in the respective technical Specification Sections.

C. Operation and Maintenance manuals are included in Section 01730.

D. Contract closeout submittals are included in Section 01700.

E. Warranties and Bonds are included in Section 01740.

F. Construction Photos are included in Section 01380.

G. Applications for Payment are included in Section 01026.

H. Construction Schedules are included in Section 01310.

I. Project Controls (Surveying) 01050.

J. Project Record Documents are included in Section 01720.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. All submittals shall be clearly identified as follows:

1. Date of Submission.

2. Project Number.

3. Project Name.

4. Contractor Identification.
   a. Contractor.
   b. Supplier.
   c. Manufacturer.
   d. Manufacturer or supplier representative.

5. Identification of the Product.

6. Reference to Contract Drawing.

7. Reference to specification section number, page and paragraph(s).

8. Reference to applicable standards, such as ASTM or Federal Standards numbers.

9. Indication of Contractor's approval.

10. Contractor's Certification statement.

11. Identification of deviations from the Contract Documents, if any.

12. Reference to previous submittal (for resubmittals).

13. Made in America (when required by the Contract).

B. Submittals shall be clear and legible, and of sufficient size for legibility and clarity of the presented data.

C. Maintain a log of all submittals. The submittal log shall be kept accurate and up to date. This log should include the following items (as applicable):

1. Description.

2. Submittal Number.

3. Date transmitted to the Engineer.

4. Date returned to Contractor (from Engineer).

5. Status of Submittal (Approved/Not Approved/etc.).

6. Date of Resubmittal to Engineer and Return from Engineer (if applicable and repeat as necessary).

7. Date material released for fabrication.

8. Projected (or actual) delivery date.

D. Numbering System. Utilize the following submittal identification numbering system:

1. The first character shall be a D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.

2. The next five digits shall be the applicable Section Number.

3. The next three digits shall be the sequential number of each separate item or drawing submitted under each Specification Section, in the chronological order submitted, starting at 001.

4. The last character shall be a letter, A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc. A typical submittal number would be as follows:
   a. D-03300-008-B.
   b. D = Shop Drawing03300 = Section for Concrete.
   c. 008 = the eighth different submittal under this Section.
   d. B = the second submission (first resubmission) of that particular shop drawing.

E. Variances

1. Notify the Engineer in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.

2. Notify the Engineer in writing, at the time of re-submittal (resubmission), of all deviations from previous submissions of that particular shop drawing, except those deviations which are the specific result of prior comments from the Engineer.

F. Action Submittals

1. Shop Drawings, Working Drawings, Product Data and Samples.
   a. Shop Drawings.
      1) Shop drawings as defined in the General Conditions, and as specified in individual Sections may include, but are not necessarily limited to, custom prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, valve schedules, wiring diagrams, coordination drawings, equipment inspection and test reports, and performance curves and certifications, as applicable to the work.
      2) Contractor shall verify all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and coordinate each item with other related shop drawings and the Contract requirements.
      3) All details on shop drawings shall clearly show the relation of the various parts to the main members and lines of the structure and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted.
      4) All shop drawings submitted by subcontractors and vendors shall be reviewed by the Contractor. Contractor shall confirm, materials, dimensions, catalog numbers, technical data and performance criteria; and shall coordinate with other related shop drawings and the Contract requirements. In addition, Contractor shall confirm existing field conditions and dimensions and assure that the submittal is coordinated and compatible with existing conditions. Submittals directly from subcontractors or vendors will not be accepted by the Engineer.
      5) The Contractor shall be responsible the accuracy of the subcontractor's or vendor's submittal; and, for their submission in a timely manner to support the requirements of the Contractor's construction schedule. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractor or vendor to correct, before submission to the Engineer. All shop Drawings shall be approved by the Contractor.
      6) Delays to construction due to the untimely submission of submittals will constitute inexcusable delays, for which Contactor shall not be eligible for additional cost nor additional contract time. Inexcusable delays consist of any delay within the Contactor's control.
      7) Submittals for equipment specified under Divisions 11, 13, 14, 15 and 16 shall include a listing of installations where identical or similar equipment manufactured by that manufacturer has been installed and in operation for a period of at least five years.
   b. Working Drawings
      1) Detailed installation drawings (sewers, equipment, piping, electrical conduits and controls, HVAC work, and plumbing, etc.) shall be prepared and submitted for

review and approval by the Engineer prior to installing such work. Installation drawings shall be to-scale and shall be fully dimensioned.

2) Piping working drawings shall show the laying dimensions of all pipes, fittings, valves, as well as the equipment to which it is being connected. In addition, all pipe supports shall be shown.
3) Equipment working drawings shall show all equipment dimensions, anchor bolts, support pads, piping connections and electrical connections. In addition, show clearances required around such equipment for maintenance of the equipment.
4) Electrical working drawings shall show conduits, junction boxes, disconnects, control devices, lighting fixtures, support details, control panels, lighting and power panels, and Motor Control Centers. Coordinate all locations with the Contract Documents and the Contractor's other working drawings.

c. Product Data
1) Product data, as specified in individual Specification Sections, include, but are not limited to, the manufacturer's standard prepared data for manufactured products (catalog data), such as the product specifications, installation instructions, availability of colors and patterns, rough-in diagrams and templates, product photographs (or diagrams), wiring diagrams, performance curves, quality control inspection and reports, certifications of compliance (as specified or otherwise required), mill reports, product operating and maintenance instructions, recommended spare parts and product warranties, as applicable.

d. Samples
1) Furnish, samples required by the Contract Documents for the Engineer's approval. Samples shall be delivered to the Engineer as specified or directed. Unless specified otherwise, provide at least two samples of each required item. Materials or equipment for which samples are required shall not be used in the work unless and until approved by the Engineer.
2) Samples specified in individual Specification Sections, include, but are not limited to: physical examples of the work (such as sections of manufactured or fabricated work), small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols, and other specified units of work.
3) Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify and Contract Requirements.
4) Approved samples not destroyed in testing shall be sent to the Engineer or stored at the site of the work. Approved samples of the hardware in good condition will be marked for identification and may be used in the work. Materials and equipment incorporated in work shall match the approved samples. Samples which fail testing or are not approved will be returned to the Contractor at his expense, if so requested at time of submission.

e. Professional Engineer (P.E.) Certification Form
1) If specifically required in any of the technical Specification Sections, submit a Professional Engineer (P.E.) Certification for each item required, using the form appended to this Section.

2. Contractor's Certification
a. Each shop drawing, working drawings, product data, and sample shall have affixed to it the following Certification Statement:

1) "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."

b. Shop drawings, working drawings, and product data sheets 11-in x 17-in and smaller shall be bound together in an orderly fashion and bear the above Certification Statement on the cover sheet. The transmittal cover sheet for each identified shop drawing shall fully describe the packaged data and include a listing of all items within the package.

3. The review and approval of shop drawings, working drawings, product data, or samples by the Engineer shall not relieve the Contractor from the responsibility for the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Engineer will have no responsibility therefor.

4. Project work, materials, fabrication, and installation shall conform to approved shop drawings (including working drawings and product data) and applicable samples.

5. No portion of the work requiring a shop drawing (including working drawings and product data) or sample shall be started, nor shall any materials be fabricated or installed before approval of such item. Procurement, fabrication, delivery or installation or products or materials that do not conform to approved shop drawings shall be at the Contractor's risk. Furthermore, such products or materials delivered or installed without approved shop drawings, or in non-conformance with the approved shop drawings will not be eligible for progress payment until such time as the product or material is approved or brought into compliance with approved shop drawings. Neither the Owner nor Engineer will be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

6. Operation and Maintenance Data
   a. Operation and maintenance data shall be submitted in assembled manuals as specified. Such manuals shall include detailed instructions for Owner personnel on safe operation procedures, controls, start-up, shut-down, emergency procedures, storage, protection, lubrication, testing, trouble-shooting, adjustments, repair procedures, and other maintenance requirements.

7. Schedule of Values
   a. On projects consisting of lump sums (in whole or in part) submit a proposed schedule of values providing a breakdown of lump sum items in to reasonably small components – generally disaggregated by building, area, and/or discipline. The purpose of the schedule of values is for processing partial payment applications. If requested by the Engineer, provide sufficient substantiation for all or some items as necessary to determine the proposed schedule of values is a reasonable representation of the true cost breakdown of the Work. The schedule of values shall not be unbalanced to achieve early payment or over-payment in excess of the value of work or any other mis-distribution of the costs. If, in the opinion of the Engineer, the schedule of values is unbalanced, Contractor shall reallocate components to achieve a balanced schedule acceptable to Engineer.

8. Payment Application Format
    a. If an application form is included in the Contract Documents, use that form unless otherwise approved by the Engineer and Owner. If an application form is not included in the Contract Documents, Contractor may propose a form for approval.

9. Site Usage
    a. Submit a proposed site staging plan, including but not limited to the location of office trailers, storage trailers and material laydown. Such plan shall be a graphic presentation (drawing) of the proposed locations; and, shall include on-site traffic modifications, and temporary utilities, as may be applicable.

G. Informational Submittals

1. Shop Drawing Schedule
    a. Prepare and submit a schedule indicating when shop drawings are required to be submitted to support the as-planned construction schedule. The submittal schedule shall allow sufficient time for preparation and submittal, review and approval, and fabrication and delivery to support the construction schedule.

2. Construction Schedule
    a. Prepare and submit construction schedules and monthly status reports as specified.

3. Statements of Qualifications
    a. Provide evidence of qualification, certification, or registration, as required in the Contract Documents, to verify qualifications of licensed land surveyor, professional engineer, materials testing laboratory, specialty subcontractor, technical specialist, consultant, specialty installer, and other professionals.
    b. Health and Safety Plans
        1) When specified, prepare and submit a general company Health and Safety Plan (HSP), modified or supplemented to include job-specific considerations.

4. Construction Photography and Videography
    a. Provide periodic construction photographs and videography as specified – including but not limited to preconstruction photographs and/or video, monthly progress photos and/or video and post-construction photographs and/or video.

5. Work Plans
    a. Prepare and submit copies of all work plans needed to demonstrate to the Owner that Contractor has adequately thought-out the means and methods of construction and their interface with existing facilities.

6. Maintenance of Traffic Plans
    a. Prepare maintenance of traffic plans where and when required by the Contract Documents and by local ordinances or regulations. If Contractor is not already knowledgeable about local ordinances and regulations regarding maintenance of traffic requirements, become familiar with such requirements and include all costs for preparation and submittal of traffic management plans and all associated costs for permits and fees to implement the traffic management plan, in the bid amount. In addition, unless a supplemental payment provision is provided in the bid form, include the cost of police attendance, when required.

7. Outage Requests
    a. Provide sufficient notification of any outages required (electrical, flow processes, etc.) as may be required to tie-in new work into existing facilities. Unless specified otherwise elsewhere, a minimum of seven calendar days' notice shall be provided.

8. Proposed Testing Procedures
    a. Prepare and submit testing procedures it proposes to use to perform testing required by the various technical specifications.

9. Test Records and Reports
    a. Provide copies of all test records and reports as specified in the various technical specifications.

10. Vendor Training Outlines/Plans
    a. At least two weeks before scheduled training of Owner's personnel, provide lesson plans for vendor training in accordance with the specification for O&M manuals.

11. Test and Start-up Reports
    a. Manufacture shall perform all pre-start-up installation inspection, calibrations, alignments, and performance testing as specified in the respective Specification Section. Provide copies of all such test and start-up reports.

12. Certifications
    a. Provide various certifications as required by the technical specifications. Such certifications shall be signed by an officer (of the firm) or other individual authorized to sign documents on behalf of that entity.
    b. Certifications may include, but are not limited to:
        1) Welding certifications and welders' qualifications
        2) Certifications of Installation, Testing and Training for all equipment
        3) Material Testing reports furnished by an independent testing firm
        4) Certifications from manufacturer(s) for specified factory testing
        5) Certifications required to indicate compliance with any sustainability or LEEDS accreditation requirements indicated in the Contract Documents

13. Record Drawings
    a. No later than Substantial Completion, submit a record of all changes during construction not already incorporated into drawings – in accordance with specification on Project Record Documents.

14. Record Shop Drawings
    a. Before final payment is made, furnish one set of record shop drawings to the Engineer. These record shop drawings shall be in conformance with the approved documents and should show any field conditions which may affect their accuracy.
    b. Submittals required by laws, regulations and governing agencies
        1) Prepare and submit all documentation required by state or local law, regulation or government agency directly to the applicable agency. This includes, but is not limited to, notifications, reports, certifications, certified payroll (for projects subject to wage requirements) and other documentation required to satisfy all requirements. Provide to Engineer one copy of each submittal made in accordance with this paragraph.

c. Submittals required by funding agencies
   1) Prepare and submit all documentation required by funding agencies. This includes, but is not limited to segregated pay applications and change orders when required to properly allocate funds to different funding sources; and certified payrolls for projects subject to wage requirements. Provide one copy of each submittal made in accordance with this paragraph to the Engineer.

15. Other requirements of the technical Specification Sections
    a. Comply with all other requirements of the technical specifications.

16. Warranties and Bonds
    a. Assemble a booklet or binder of all warranties and bonds as specified in the various technical specifications and in accordance with the specification on Warranties and Bonds; and provide two originals to the Engineer.

17. As-Built Surveys
    a. Engage the services of a licensed land surveyor in accordance with the Project Controls (Surveying) specification. Prior to Final Completion, provide an as-built survey of the constructed facility, as specified.

18. Contract Close-Out Documents
    a. Submit Contract documentation as indicated in the specification for Contract Close-out.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

A. Provide an initial submittal schedule at the pre-construction meeting for review by Owner and Engineer. Incorporate comments from Owner or Engineer into a revised submittal schedule.

B. Maintain the submittal schedule and provide sufficient copies for review by Owner and Engineer. An up-to-date submittal schedule shall be provided at each project progress meeting.

3.02 TRANSMITTALS

A. Prepare separate transmittal sheets for each submittal. Each transmittal sheet shall include at least the following: the Contractor's name and address, Owner's name, project name, project number, submittal number, description of submittal and number of copies submitted.

B. Submittals shall be transmitted or delivered directly to the office of the Engineer, as indicated in the Contact Documents or as otherwise directed by the Engineer.

C. Provide copies of transmittals forms or cover letters (without attachments) directly to the Resident Project Representative.

3.03 PROCEDURES

A. Action Submittals

1. Contractor's Responsibilities
   a. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work of other related Sections, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required). Coordinate with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. Extensions to the Contract Time will not be approved for the Contractor's failure to transmit submittals sufficiently in advance of the Work.
   b. The submittals of all shop drawings (including working drawings and product data) shall be sufficiently in advance of construction requirements to allow for possible need of re-submittals, including the specified review time for the Engineer.
   c. No less than 30 calendar days will be required for Engineer's review time for shop drawings and O&M manuals involving only one engineering discipline. No less than 45 calendar days will be required for Engineer's review time for shop drawings and O&M manuals that require review by more than one engineering discipline. Resubmittals will be subject to the same review time.
   d. Submittals of operation and maintenance data shall be provided within 30 days of approval of the related shop drawing(s).
   e. Before submission to the Engineer, review shop drawings as follows:
      1) make corrections and add field measurements, as required
      2) use any color for its notations except red (reserved for the Engineer's notations) and black (to be able to distinguish notations on black and white documents)
      3) identify and describe each and every deviation or variation from Contract documents or from previous submissions, except those specifically resulting from a comment from the Engineer on a previous submission
      4) include the required Contractor's Certification statement
      5) provide field measurements (as needed)
      6) coordinate with other submittals
      7) indicate relationships to other features of the Work
      8) highlight information applicable to the Work and/or delete information not applicable to the Work
   f. Submit the following number of copies:
      1) Shop drawings (including working drawings and product data) – Submit no fewer than six, and no more than nine; five of which will be retained by the Engineer.
      2) Samples – three
      3) Site Usage Plan – three copies
      4) Schedule of values – four copies
      5) Payment application format – four copies
   g. If Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, provide written notice thereof to the Engineer immediately; and do not release for manufacture before such notice has been received by the Engineer.
   h. When the shop drawings have been completed to the satisfaction of the Engineer, carry out the construction in accordance therewith; and make no further changes therein except upon written instructions from the Engineer.

2. Engineer's Responsibilities
   a. Engineer will not review shop drawings (including working drawings and product data) that do not include the Contractor's approval stamp and required certification statement. Such submittals will be returned to the Contractor, without action, for correction.
   b. Partial shop drawings (including working drawings and product data) will not be reviewed. If, in the opinion of the Engineer, a submittal is incomplete, that submittal will be returned to the Contractor for completion. Such submittals may be returned with comments from Engineer indicating the deficiencies requiring correction.
   c. If shop drawings (including working drawings and product data) meet the submittal requirements, Engineer will forward copies to appropriate reviewer(s). Otherwise, noncompliant submittals will be returned to the Contractor without action - with the Engineer retaining one copy.
   d. Submittals which are transmitted in accordance with the specified requirements will be reviewed by the Engineer within the time specified herein. The time for review will commence upon receipt of submittal by Engineer.

3. Review of Shop Drawings (Including Working Drawings and Product Data) and Samples
   a. The review of shop drawings, working drawings, data and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:
      1) as permitting any departure from the Contract requirements
      2) as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials
      3) as approving departures from details furnished by the Engineer, except as otherwise provided herein
   b. The Contractor remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.
   c. If the shop drawings (including working drawings and product data) or samples as submitted describe variations and indicate a deviation from the Contract requirements that, in the opinion of the Engineer are in the interest of the Owner and are so minor as not to involve a change in Contract Price or Contract Time, the Engineer may return the reviewed drawings without noting an exception.
   d. Only the Engineer will utilize the color "RED" in marking submittals.
   e. 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/CONFIRM" - This combination of codes is assigned when a confirmation of the notations and comments is 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. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.

4) "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the entire package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the Engineer within 30 calendar days of the date of the Engineer's transmittal requiring the resubmittal.
5) "NOT APPROVED" – 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.
6) "COMMENTS ATTACHED" – This code is assigned where there are comments attached to the returned submittal, which provide additional data to aid the Contractor.
7) "RECEIPT ACKNOWLEDGED (Not subject to Engineer's Review or Approval)" – This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's review and approval, and is being filed for informational purposes only. This code is generally used in acknowledging receipt of means and methods of construction work plans, field conformance test reports, and health and safety plans.

f. 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.

4. Electronic Transmission
   a. Action Submittals may be transmitted by electronic means provided the following conditions are met:
      1) The above-specified transmittal form is included.
      2) All other requirements specified above have been met including, but not limited to, coordination by the Contractor, review and approval by the Contactor, and the Contractor's Certification.
      3) The submittal contains no pages or sheets large than 11 x 17 inches.
      4) With the exception of the transmittal sheet, the entire submittal is included in a single file.
      5) The electronic files are PDF format (with printing enabled).
      6) In addition, transmit three hard-copy (paper) originals to the Engineer.
      7) The Engineer's review time will commence upon receipt of the hard copies of the submittal.
      8) For Submittals that require certification, corporate seal, or professional embossment (i.e., P.E.s, Surveyors, etc.) transmit at least two hard-copy originals to the Engineer. In addition, provide additional photocopied or scanned copies, as specified above, showing the required certification, corporate seal, or professional seal.

B. Informational Submittals

1. Contractor's Responsibilities
   a. Number of copies: Submit three copies, unless otherwise indicated in individual Specification sections

b. Refer to individual technical Specification Sections for specific submittal requirements.

2. Engineer's Responsibilities
   a. The Engineer will review each informational submittal within 15 days. If the informational submittal complies with the Contract requirements, Engineer will file for the project record and transmit a copy to the Owner. Engineer may elect not to respond to Contractor regarding informational submittals meeting the Contract requirements.
   b. If an informational submittal does not comply with the Contract requirements, Engineer will respond accordingly to the Contractor within 15 days. Thereafter, the Contractor shall perform the required corrective action, including retesting, if needed, until the submittal, in the opinion of the Engineer, is in conformance with the Contract Documents.

3. Electronic Transmission
   a. Informational submittals may be transmitted by electronic means providing all of the following conditions are met:
      1) The above-specified transmittal form is included.
      2) The submittal contains no pages or sheets large than 11 x 17 inches.
      3) With the exception of the transmittal sheet, the entire submittal is included in a single file.
      4) The electronic files are PDF format (with printing enabled).
      5) For Submittals that require certification, corporate seal, or professional embossment (i.e., P.E.s, Surveyors, etc.) transmit two hard-copy originals to the Engineer.

END OF SECTION

P.E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a professional engineer registered in the [State] [Commonwealth] of _____ and that he/she has been employed by

_____ to design
(Company Name)

_____
(Insert P.E. Responsibilities)

In accordance with Specification Section _____ for the

_____.
(Name of Project)

The undersigned further certifies that he/she has performed the said design in conformance with all applicable local, state and federal codes, rules and regulations; and, that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the

_____
(Insert Name of Owner)

or Owner's representative within seven days following written request therefor by the Owner.

_____	_____
P.E. Name	Company Name
_____	_____
Signature	Signature
_____	_____
P.E. Registration Number	Title
_____	
Address	
_____	
Address	

SECTION 01310
CONSTRUCTION SCHEDULING

PART 1 GENERAL

1.01 PROGRAM DESCRIPTION

A. Refer to JEA Front End Document Section 2.5.1, Critical Path Method (CPM) Scheduling

END OF SECTION

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SECTION 01370
SCHEDULE OF VALUES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Submit a Schedule of Values allocated to the various portions of the work, within 15 days after the effective date of the Agreement.

B. Upon request of the Engineer, support the values with data which will substantiate their correctness.

C. The accepted Schedule of Values shall be used only as the basis for the Contractor's Applications for Payment.

1.02 RELATED REQUIREMENTS

A. Application for Payment is included in Section 01026.

B. Standard General Conditions of the Construction Contract are included in the Front-End Documents provided by Owner.

1.03 FORM AND CONTENT OF SCHEDULE OF VALUES

A. Type schedule on an 8-1/2-in by 11-in or 8-1/2-in by 14-in white paper furnished by the Owner; Contractor's standard forms and automated printout will be considered for approval by the Engineer upon Contractor's request. Identify schedule with:

1. Title of Project and location.

2. Engineer and Project number.

3. Name and Address of Contractor.

4. Contract designation.

5. Date of submission.

B. Schedule shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction.

C. Identify each line item with the number and title of the respective Section.

D. For each major line item list sub-values of major products or operations under the item.

E. For the various portions of the work:

1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.

2. For items on which progress payments will be requested for stored materials, break down the value into:
   a. The cost of the materials, delivered and unloaded, with taxes paid. Paid invoices are required for materials upon request by the Engineer.
   b. The total installed value.

F. The sum of all values listed in the schedule shall equal the total Contract Sum.

1.04 SUBSCHEDULE OF UNIT MATERIAL VALUES

A. Submit a sub-schedule of unit costs and quantities for:

1. Products on which progress payments will be requested for stored products.

B. The form of submittal shall parallel that of the Schedule of Values, with each item identified the same as the line item in the Schedule of Values.

C. The unit quantity for bulk materials shall include an allowance for normal waste.

D. The unit values for the materials shall be broken down into:

1. Cost of the material, delivered and unloaded at the site, with taxes paid.

2. Copies of invoices for component material shall be included with the payment request in which the material first appears.

3. Paid invoices shall be provided with the second payment request in which the material appears or no payment shall be allowed and/or may be deleted from the request.

E. The installed unit value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01380
AUDIO VIDEO TAPING AND PHOTOGRAPHY

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials and equipment and furnish color audio videotaping of the project site as specified herein.

B. Furnish to the Owner an original and one copy of a continuous color audio video tape recording along the entire route of the proposed site location. The recording shall be taken prior to any construction activity.

C. The Owner reserves the right to reject the audio video taping because of poor quality, unintelligible audio or uncontrolled pan or zoom. Any taping rejected by the Owner shall be re-taped at no cost to the Owner. Under no circumstances shall construction begin until the Owner has received and accepted the audio video tape(s).

D. The taping shall be performed by a qualified, established audio video taping firm knowledgeable in construction practices and experienced in the implementation of established inspection procedures.

E. The Contractor shall provide a competent photographer to take construction record photographs periodically during course of the Work.

1.02 PHOTOGRAPHY/VIDEOGRAPHY REQUIRED

A. A preconstruction video is required to be taken prior to the start of construction. The preconstruction video is required to document the existing structures, equipment, existing site conditions and the existing conditions of the landscape buffer zone to establish a baseline for restoration work as required. The preconstruction video will be on DVD format and will provide the date and time of the video on the tape during playback. Two copies of the preconstruction video shall be provided to Owner, and one copy shall be provided to Engineer.

B. The Contractor shall provide land-based photographs taken on the cutoff date for each scheduled application for payment and immediately prior to initial construction.

C. The Contractor shall provide aerial photography to document the construction progress. The photographs shall be taken before the beginning of the construction, after 5-months from the date of the Notice to Proceed, and at the end of the construction. Aerial photographs shall be submitted with the application for payment. The submittal shall include three to five views in digital format.

D. For the land-based photography of construction in the project site area, provide 10 photographs with at least five different views each month taken at each stage of construction for each scheduled application for payment.

E. View and quantities required for land-based photography shall include:

1. At a minimum, views for the monthly progress photos shall document the status of:
   a. Mechanical equipment
   b. Existing facilities
   c. Electrical building, fuel tank, generator, and slabs
   d. Paving, grading, and drainage
   e. Site work
   f. Structural work
   g. Areas of construction that will be covered or buried during construction and nor visible after the completion

2. Provide four (4) CDs with each application for payment. Maintain one set of photographs with Contractor's Project Record File. Provide one set of the photographs to the Engineer, and two sets to the Owner.

F. Photographic Records

1. All photography shall be digitally produced and electronically maintained.

2. The photographer shall maintain easily accessible electronic records for the duration of the entire project and then shall convey the electronic records to the Engineer and Owner upon final acceptance of project.

3. Photographer shall agree to furnish additional prints to Engineer and Owner at commercial rates applicable at time of purchase. Photographer shall also agree to participate as required in any litigation requiring the photographer as an expert witness.

4. The photographer shall provide the electronic records of the digital photographs to Engineer and Owner with copyrights assigned to the Owner.

1.03 COSTS OF PHOTOGRAPHY

A. The Contractor shall pay the costs for specified photography and prints. Additional prints beyond those specified here shall be charged to interested party.

PART 2 PRODUCTS

2.01 PRINTS AND ELECTRONIC DELIVERY

A. No construction shall start until preconstruction photographs and video are completed and submitted to the Engineer and Owner and approved.

B. Provide properly labeled CDs with electronic records of all photographs with identification for exposure number, orientation of view, and date of exposure.

C. A digital camera with resolution of at least 8.0 mega pixels shall be used to take the construction photographs.

PART 3 EXECUTION

3.01 TECHNIQUE

A. Factual presentation

B. Correct exposure and focus

1. High resolution and sharpness

2. Maximum depth-of-field

3. Minimum distortion

3.02 VIEWS REQUIRED

A. Photograph from location to adequately illustrate condition of construction and state of progress.

1. At successive periods of photography, take at least one photograph from the same overall view as previously.

2. Consult with the Engineer at each period of photography to review proposed views required.

3.03 AUDIOVISUAL RECORDING

A. The recordings shall contain coverage of all surface features within the construction zone of influence. These features shall include, but not be limited to, all pavement, parking spaces, curbs, driveways, sidewalks, culverts, headwalls, retaining walls, landscaping, trees, and fences. Of particular concern shall be the existence or non-existence of any faults, fractures or defects.

B. Video coverage shall be limited to one side of the street at one time and shall include all surface conditions located within the zone of influence supported by appropriate audio description. Panning, zoom-in and zoom-out rates shall be sufficiently controlled to maintain a clear view of the object.

C. Accompanying the video recording of each video tape shall be a corresponding and simultaneously recorded audio recording. This audio recording, exclusively containing the commentary of the camera operator, shall assist in viewer orientation and in any needed identification, differentiation, clarification, or objective description of the features being shown in the video portion of the recording. The audio recording shall also be free from any conversation between the camera operator and any other production technicians.

D. Visibility: All recording shall be performed during times of good visibility; no recording shall be done during periods of significant precipitation, mist or fog. The recording shall only be done when sufficient sunlight is present to properly illuminate the subject and to produce sharp, bright video recordings of those subjects.

E. In order to ensure the continuity of coverage, the coverage shall consist of a single continuous unedited recording which begins at one end of the construction area.

F. The average rate of travel during a particular segment of coverage shall be directly proportional to the number, size, and value of the surface features within that construction area's zone of influence.

G. Camera Operation

1. Camera Height and Stability: When conventional wheeled vehicles are used as conveyances for the recording system, the vertical distance between the camera lens and the ground shall not exceed 10 feet. The camera shall be firmly mounted such that transport of the camera during the recording process will not cause an unsteady picture.

2. Camera Control: Camera pan, tilt, zoom-in and zoom-out rates shall be sufficiently controlled such that recorded objects shall be clearly viewed during video tape playback. In addition, all other camera and recording system controls, such as lens focus and aperture, video level, pedestal, white balance and electrical focus shall be properly controlled or adjusted to maximize picture quality.

3. Viewer Orientation Techniques: The audio and video portions of the recording shall maintain viewer orientation. To this end, overall establishing views of all visible house and business addresses shall be utilized. In areas where the proposed construction location will not be readily apparent to the video tape viewer, highly visible yellow flags shall be placed, by the Contractor, in such a fashion as to clearly indicate the proposed center line of construction.

END OF SECTION

SECTION 01410
TESTING AND TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. The Contractor shall employ and pay for the services of an Independent Testing Laboratory to perform testing specifically indicated on the Contract Documents and may at any other time elect to have materials and equipment tested for conformity with the Contract Documents. Soil and concrete testing shall be scheduled and test by the Contractor. The Owner shall provide testing for bacteriological testing through the Owner's laboratory and the Contractor shall coordinate the appropriate time to pick up samples.

1. Cooperate with the laboratory to facilitate the execution of its required services.

2. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the work of the Contract.

3. The Contractor shall submit the qualifications and experience of the proposed testing laboratory to the Owner and Engineer for approval prior to beginning any testing related work.

1.02 RELATED REQUIREMENTS

A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities.

B. Respective Sections: Certification of products.

C. Each Section listed: Laboratory tests required and standards for testing.

D. Testing Laboratory inspection, sampling and testing is required for but not limited to the following:

1. Site preparation is included in Section 02100, and in the Section 406 in JEA's Water and Sewer Standards Manual.

2. Earthwork is included in Section 02200, and in the JEA's Water and Sewer Standards Manual, Section 408.

3. Trenching, Backfilling and Compaction is included in Section 02221, and in JEA's Water and Sewer Standards Manual, Section 408.

4. Asphaltic Concrete Paving is included in Section 02740.

5. Concrete walkways and driveways are included in Section 02750.

6. Concrete and reinforcement is included in Section 03300.

7. Grout is included in Section 03600.

1.03 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

A. Laboratory is not authorized to:

1. Release, revoke, alter or enlarge on requirements of Contract Documents.

2. Approve or accept any portion of the work.

3. Perform any duties of the Contractor.

1.04 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel, provide access to work, to manufacturer's operations.

B. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.

C. Provide to the laboratory the preliminary design mix proposed to be used for concrete and other materials mixes which require control by the testing laboratory.

D. Materials and equipment used in the performance of work under this Contract are subject to inspection and testing at the point of manufacture or fabrication. Standard requirements for quality and workmanship are indicated in the Contract Documents. The Engineer may require the Contractor to provide statements or certificates from the manufacturers and fabricators that the materials and equipment provided by them are manufactured or fabricated in full accordance with the standard specifications for quality and workmanship indicated in the Contract Documents. All costs of this testing and providing statements and certificates shall be a subsidiary obligation of the Contractor, and no extra charge to the Owner shall be allowed on account of such testing and certification.

E. Furnish incidental labor and facilities:

1. To provide access to work to be tested.

2. To obtain and handle samples at the project site or at the source of the product to be tested.

3. To facilitate inspections and tests.

4. For storage and curing of test samples.

F. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.

1. When tests or inspections cannot be performed after such notice, reimburse Owner for laboratory personnel and travel expenses incurred due to Contractor's negligence.

G. Employ and pay for the services of the same or a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required for the Contractor's convenience.

H. If the test results indicate the material or equipment complies with the Contract Documents, the Owner shall pay for the cost of the testing laboratory via the testing allowance. If the tests and

any subsequent retests indicate the materials and equipment fail to meet the requirements of the Contract Documents, the Contractor shall pay for the laboratory costs directly to the testing firm or the total of such costs shall be deducted from any payments due the Contractor. Failed tests shall not be assessed to the testing allowance.

I. Provide Owner and Engineer with all testing reports

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01445
PIPELINE TESTING AND CLEANING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and test and clean all new pipelines installed under this Contract as specified herein.

1.02 RELATED WORK

A. Buried pipelines are included in Division 2, and JEA's Water and Wastewater Standards Manual (most recent edition).

B. Above grade piping and exposed pipelines are included in Division 15.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Furnish all necessary equipment and labor for cleaning and testing and chlorinating the pipelines. The procedures and methods shall be approved by the Engineer.

B. Make any taps and furnish all necessary caps, plugs, etc., as required in conjunction with testing pipelines. Furnish a test pump, gauges and any other equipment required in conjunction with carrying out the hydrostatic tests.

3.02 CLEANING PIPELINES

A. As pipe laying progresses and at the conclusion of the work, thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed.

3.03 TESTING GRAVITY PIPELINES

A. All gravity pipelines shall be tested in accordance with the JEA Water and Wastewater Standards Section 428 – IV.

3.04 TESTING PRESSURE PIPELINES

A. All pressure pipelines shall be pressure and leakage tested following the requirements in JEA Water and Wastewater Standards Manual, latest edition, Section 429 – III-9.

END OF SECTION

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SECTION 01465
EQUIPMENT TESTING AND STARTUP

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide a competent field services technician of the manufacturers of all equipment furnished under Divisions 11, 13, 15 and 16 to supervise installation, adjustment, initial operation and testing, performance testing, final acceptance testing and startup of the equipment.

B. Perform specified equipment field performance tests, final acceptance tests and startup services.

1.02 RELATED WORK

A. Operation and Maintenance Data is included in Section 01730.

B. Performance and acceptance testing and startup requirements are included in the respective sections of Divisions 11, 13, 15 and 16.

1.03 SUBMITTALS

A. Submit name, address and resume of proposed field services technicians at least 30 days in advance of the need for such services.

B. Submit, in accordance with Section 01300, detailed testing procedures for shop tests, field performance tests and final acceptance tests as specified in the various equipment sections. Submittals shall include the following:

1. Test procedures shall be submitted at least 30 days in advance of the proposed test dates and shall include at least the following information:
    a. Name, classification, model and serial number of equipment to be tested, including reference to specifications section number and title.
    b. Testing schedule of proposed dates and times for testing.
    c. Summary of power, lighting, water, etc, needs and identification of who will provide them.
    d. Outline specific assignment of the responsibilities of the Contractor and manufacturers' factory representatives or field service personnel.
    e. Detailed description of step-by-step testing requirements, with reference to appropriate standardized testing procedures and laboratory analyses by established technical organizations (e.g., ASTM, WPCF Standard Methods, etc).
    f. Samples of forms to be used to collect and record test data and to present tabulated test results.

2. Copies of test reports upon completion of specified shop, performance and acceptance tests. Test reports shall incorporate the information provided in the test procedures submittals and modified to reflect actual conduct of the tests and the following additional information:
    a. Copy of all test data sheets and results of lab analyses.
    b. Summary comparison of specified test and performance requirements vs actual test results.

c. Should actual test results fail to meet specified test and performance requirements, describe action to be taken prior to re-testing the equipment.

3. Copies of the manufacturer's field service technician's report summarizing the results of their initial inspection, operation, adjustment and pre-tests. The report shall include detailed descriptions and tabulations of the points inspected, tests and adjustments made, quantitative results obtained, suggestions for precautions to be taken to ensure proper maintenance, and the equipment supplier's Certificate of Installation in the format specified herein.

1.04 REFERENCE STANDARDS

A. American Water Works Association (AWWA)

B. ASTM International

C. Water Environment Federation (WEF)

D. Standard Methods for the Examination of Water and Wastewater (Latest Revision)

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Field service technicians shall be competent and experienced in the proper installation, adjustment, operation, testing and startup of the equipment and systems being installed.

B. Manufacturers' sales and marketing personnel will not be accepted as field service technicians unless they can prove their qualifications.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PRELIMINARY REQUIREMENTS

A. After installation of the equipment has been completed and the equipment is presumably ready for operation, before it is operated by others, the manufacturer's field service technician shall inspect, operate, test and adjust the equipment. The inspection shall include at least the following points where applicable:

1. Soundness (without crack or otherwise damaged parts).

2. Completeness in all details, as specified and required.

3. Correctness of setting, alignment and relative arrangement of various parts.

4. Adequacy and correctness of packing, sealing and lubricants.

B. The operation, testing and adjustment shall be as required to prove that the equipment has been left in proper condition for satisfactory operation under the conditions specified.

C. Upon completion of this work, the manufacturer's field service technician shall submit a signed report of the results of their inspection, operation, adjustments and tests.

3.02 WITNESS REQUIREMENTS

A. Shop tests or factory tests may be witnessed by the Owner and/or Owner's representatives, as required by the various equipment specifications.

B. Field performance and acceptance tests shall be performed in the presence of the Owner, the Owner's designed personnel and/or Owner's representatives.

3.03 STARTUP AND ACCEPTANCE OF THE PUMP STATION AND RELATED SYSTEMS

A. General Requirements

1. Successfully execute the step-by-step procedure of startup, normal operation, shutdown, and performance demonstration specified herein.

2. The startup and performance demonstration shall be successfully executed prior to Substantial Completion and acceptance by the Owner of the facility and its related systems.

3. All performance tests and inspections shall be scheduled at least 10 working days in advance or as otherwise specified with the Owner and the Engineer. All performance tests and inspections shall be conducted during the work week of Monday through Friday, unless otherwise specified.

B. Preparation for Startup

1. All mechanical and electrical equipment shall be checked to ensure that it is in good working order and properly connected. Preliminary run-ins of the pumps, and other remaining equipment shall be made. All systems shall be cleaned and purged as required. All pipes and equipment which are hydraulically checked shall be drained and returned to their original condition once the water testing is complete.

2. All instruments and controls shall be calibrated through their full range. All other adjustments required for proper operation of all instrumentation and control equipment shall be made.

3. Perform all other tasks needed for preparing and conditioning the facility for proper operation.

4. No testing or equipment operation shall take place until it has been verified by the Engineer that all specified safety equipment has been installed and is in good working order.

5. No testing or equipment operation shall take place until it has been verified by the Engineer that all lubricants, tools, maintenance equipment, spare parts and approved equipment operation and maintenance manuals have been furnished as specified.

C. Facilities Startup

1. Startup period shall not begin until all new pump station equipment has been tested as specified and are ready for operation. The Owner shall receive spare parts, safety equipment, tools and maintenance equipment, lubricants, approved operation and maintenance data and the specified operation and maintenance instruction prior to the startup with raw wastewater. All valve tagging shall also be complete prior to this startup.

2. Demonstrate a seven consecutive 24-hour day period of successful operation of the facility as a prerequisite of Substantial Completion and Acceptance. This testing will be the responsibility of the Contractor.

3. In the event of failure to demonstrate satisfactory performance of the facility on the first or any subsequent attempt, all necessary alterations, adjustments, repairs and replacements shall be made. When the facility is again ready for operation, it shall be brought on line and a new test shall be started. This procedure shall be repeated as often as necessary until the facility has operated continuously to the satisfaction of the Owner and Engineer, for the specified duration.

4. The Owner will furnish all operating personnel (other than manufacturer's or subcontractor’s service personnel) needed to operate equipment during the final test period after substantial completion; however, said personnel will perform their duties under Contractor's direct supervision. Until performance tests are completed and units and systems are accepted by the Owner as substantially complete, the Contractor shall be fully responsible for the operation and maintenance of all new facilities.

5. The Owner will provide all necessary electricity for startup. However, the Contractor shall provide all necessary personnel of the various construction trades, i.e., electricians, plumbers, etc, and field service personnel of the major equipment suppliers on an 8 hour per day basis at the facilities and on a 24 hour per day basis locally during the startup period. Major equipment suppliers shall include, but not be limited to, the following:
   a. Instrumentation and Control Equipment: unwitnessed and witnessed factory testing
   b. All Pumping Equipment
   c. Electrical Control Systems
   d. Generator Equipment
   e. HVAC and Plumbing

6. Do not, at any time, allow the facility to be operated in a manner which subjects equipment to conditions that are more severe than the maximum allowable operating conditions for which the equipment was designed.

EQUIPMENT SUPPLIER'S CERTIFICATE OF INSTALLATION

Owner _____

Project _____

Contract No. _____

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

_____
(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial no.)

_____

installed for the subject project has (have) been installed in a satisfactory manner, has (have) been tested and adjusted, and is (are) ready for final acceptance testing and operation on :

Date_____

Time_____

CERTIFIED BY: _____
(Signature of Manufacturer's Representative)

Date:_____

END OF SECTION

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SECTION 01500
TEMPORARY FACILITIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, equipment, materials, and incidentals necessary and provide separate temporary facilities for the Contractor's use as specified herein and as shown on the drawings. Temporary offices shall be established on the job site where approved or directed by the Owner, adequately furnished and maintained in a clean, orderly conditions by the Contractor. The Contractor or an authorized representative shall be present in the field office at all times while work is in progress

B. Operate and maintain temporary facilities for the duration of the project and as directed by the Owner. All cost and use charges for temporary facilities shall be included in the Contract Price.

1.02 RELATED WORK

A. Control of Work is included in Section 01046.

B. Special Provisions is included in Section 01170.

1.03 SUBMITTALS

A. Submit shop drawings and product data, in accordance with Section 01300, showing materials of construction and details of installation for:

1. Site Plan: Show the proposed locations for temporary facilities including offices, temporary utilities, storage containers/buildings, vehicle access and parking areas, material laydown and staging areas, temporary fencing, and other security measures.

2. Temporary Fence: Layout drawings which indicate dimensions, access to fire hydrants, gate locations and opening sizes, and other site-specific requirements.

3. Project Sign: Layout, graphics, and wording.

B. Submittals shall be received by the Engineer no later than the date of the Preconstruction Meeting.

1.04 QUALITY ASSURANCE

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

B. Coordinate with authorities having jurisdiction to inspect (and test if required) temporary facilities.

C. Obtain all required permits for temporary facilities.

1.05 DEFINITIONS

A. Duration of the project: The period of time from the date of the Notice to Proceed to the date of Final Completion, inclusive.

PART 2 PRODUCTS

2.01 MATERIALS

A. Temporary Fence: Fabric shall be No. 9 gauge galvanized wire woven in 2-in diamond mesh with top and bottom twisted selvage. Intermediate and terminal posts shall be galvanized steel H or pipe, minimum 2-3/8-in OD line posts, 2-7/8-in OD corner and pull posts, and 1-5/8-in OD top rails.

B. Project Sign: Plywood shall be A-A EXT-APA grade, 1-in thick. Posts and braces shall be pressure treated lumber.

2.02 EQUIPMENT

A. Fire Extinguishers: Provide portable, UL-rated with class and extinguishing agent required by locations and classes of fire exposure. Provide at least one for each trailer/office.

B. Temporary Heat: Provide vented, self-contained, liquid propane gas or fuel oil heaters with individual space thermostatic control. Equipment shall be listed and labeled for type of fuel consumed and marked for intended use.

2.03 CONTRACTOR'S FIELD OFFICE

A. Provide a temporary field office(s) for the Contractor's use for the duration of the project. An authorized representative of the Contractor shall be present at all times while the Work is in progress. Instructions received at the Contractors field office from the Engineer shall be considered delivered to the Contractor.

B. Locate field office(s) in accordance with approved shop drawings and as directed by the Owner.

C. Establish and occupy field office within 30 days of the Notice to Proceed, unless otherwise approved by the Engineer or Owner.

2.04 TEMPORARY POWER AND LIGHT

A. Contractor shall be responsible for providing temporary power until such time that JEA service can be installed. Power service for bypass pumping activities, if required, will not be provided and shall be provided by the Contractor.

B. The Contractor shall provide connections to existing facilities sized to provide service required for power and lighting. The Contractor shall pay the costs of fuel for heating.

C. The Contractor shall provide properly configured NEMA polarized outlets to prevent insertion of 110-120 Volt plugs into higher voltage outlets. For connection of power tools and equipment, provide outlets equipped with ground-fault circuit interrupters, reset button and pilot light.

D. The Contractor shall provide grounded extension cords. Use heavy duty cords where exposed to abrasion and traffic. The Contractor shall provide waterproof connectors to connect separate lengths of electric cords if more than one length is required.

E. The Contractor shall provide general service incandescent lamps as required for adequate illumination. The Contractor shall provide guard cages or tempered glass enclosures where exposed to breakage. The Contractor shall provide exterior fixtures where exposed to moisture.

2.05 WEATHER PROTECTION

A. Contractor shall furnish, install and maintain temporary heat and enclosures to provide adequate working areas for personnel during the cold weather months.

B. The Contractor shall furnish temporary heating units (UL or FM listed) to maintain reasonable temperatures within temporary enclosures.

C. Weather protection shall comply with M.G.L. Chapter 149 Section 44G.

2.06 TEMPORARY AIR, STEAM AND WATER

A. Provide all air, steam and water, including temporary piping and appurtenances required for cleaning and testing pipelines and equipment. Remove temporary piping and appurtenances upon approval of equipment being tested.

2.07 SANITARY FACILITIES

A. Provide self-contained, single occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed in a fiberglass or other approved non-absorbent shell.

2.08 CONSTRUCTION AIDS

A. Provide temporary elevators, hoists, cranes, scaffolding and platforms as necessary to perform the Work. Provide temporary stairs where ladders are not adequate. Protect permanent stairs from damage from construction operations.

2.09 TEMPORARY FENCE

A. Provide temporary fence as shown on the Drawings, as specified herein, and as the Contractor requires for site security.

1. Provide 6-ft high chain link fence with at least two vehicle and two pedestrian access gates. Gates shall be equipped with locking hardware and padlocks. Furnish two sets of keys to Engineer and Owner. Coordinate with local first responders for access during non-work hours.

2. Fence installation shall comply with ASTM F567. Post spacing shall not exceed 8-ft on center. Posts shall be set plumb in concrete footings.

3. Perform daily inspections of fence and immediately repair or replace damaged or compromised sections and as directed by the Engineer.

4. A temporary fence shall be installed prior to the removal of the existing fence. At no time shall the site note have complete fencing around the site.

2.10 WASTE MANAGEMENT

A. Provide covered dumpster, minimum 4-cubic yards, dedicated for field office waste. Provide separate covered dumpster of adequate size for construction debris. Empty dumpsters on a regular basis and as directed by the Engineer. Dumpsters shall not exceed their capacities at any time.

2.11 PROJECT SIGNS

A. Furnish and install the project signs indicated in Specification 01580. Signs shall be placed as directed by the Owner; and, shall remain maintained in good condition for the life of the construction period.

B. Remove signs at final acceptance, unless otherwise directed.

2.12 REMOVAL AND RESTORATION

A. Remove each temporary facility complete when need for its service has ended and as approved by the Owner. Coordinate removal of temporary facilities with authorities having jurisdiction.

B. Restore all improvements damaged by the installation, operation, and removal of the temporary facilities. Obtain prior approval from Owner and Engineer for restoration work. Comply with the restoration requirements of Section 01046.

END OF SECTION

SECTION 01562
DUST CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Perform dust control operations, in an approved manner, whenever necessary or when directed by the Engineer and Owner, even though other work on the project may be suspended. Dust control shall be generally accomplished by the use of water; however, the use of calcium chloride may be used when necessary to control dust nuisance. Cost of dust control shall be included in base bid price.

B. Calcium chloride shall conform to AASHTO M144, Type I except the requirements for "total alkali chlorides" and other impurities shall not apply.

C. Methods of controlling dust shall meet all air pollutant standards as set forth by Federal and State regulatory agencies.

END OF SECTION

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SECTION 01570
TRAFFIC CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish, install, operate and maintain equipment, services and personnel, with traffic control and protective devices, as required to expedite vehicular traffic flow during construction.

B. All traffic control shall be in strict accordance with the requirements of the Florida Department of Transportation (FDOT) and City of Jacksonville.

1.02 SUBMITTALS

A. The Contractor shall submit to the City of Jacksonville (agency with jurisdiction) a detailed traffic control plan, including all temporary changes in traffic patterns, detailed drawings of the required traffic control equipment, a list of street or road closures and detours, etc. for each location of work. The traffic control plans must be approved by the City of Jacksonville before any work will be allowed. The Contractor shall submit the traffic control plan for each work area at least 30 days prior to working in the area to provide time for review and comments from the City of Jacksonville. Work shall also be coordinated with the Jacksonville Sheriff Department, Fire Department and other public safety agencies.

B. The Contractor shall submit to the City of Jacksonville a notification that construction will be commencing within their right of way. The notification should be submitted in writing at least 30 days prior to commencing work in the respective agency's right of way.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TRAFFIC CONTROL

A. The Contractor shall fully implement the traffic control plan as approved by the City of Jacksonville. The traffic control devices shall be in place prior to performing any work within the roads. The Contractor shall maintain all traffic control equipment and monitor the traffic control measures. The traffic control measures shall be modified as deemed necessary by the Contractor, and City of Jacksonville. The Contractor shall fully cooperate with the City of Jacksonville Traffic Engineering officials during inspections of the traffic control measures. The Contractor shall remove temporary equipment and facilities when no longer required and restore grounds to the original or to specified conditions.

B. Night work and weekend work may be permitted by the City of Jacksonville if requested by the Contractor. The City of Jacksonville may restrict work in thoroughfares as necessary.

C. The Contractor shall notify all property owners at least 72 hours in advance of any work which will interfere with access to their residence or place of business.

D. No road shall be closed to traffic without the prior consent of the Engineer, the agency responsible for the road and the Sheriff Department. All standards of the governing agency shall be strictly followed.

3.02 CONSTRUCTION PARKING CONTROL

A. The Contractor shall control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, or construction operations.

B. The Contractor shall monitor parking of construction personnel's private vehicles, maintain free vehicular access to and through parking areas and prohibit parking on or adjacent to access roads or in not-designated areas.

END OF SECTION

SECTION 01580
PROJECT IDENTIFICATION AND INFORMATIONAL SIGNS

PART 1 GENERAL

1.01 REQUIREMENTS

A. Furnish, install and maintain project identification and informational signs.

B. Remove sign on completion of construction.

C. Allow no other signs to be displayed.

1.02 RELATED WORK

A. Finishes are provided in Division 9.

1.03 SUBMITTALS

A. Submit in accordance with the requirements of Section 01300.

1.04 INFORMATIONAL SIGNS

A. Painted signs with painted lettering, or standard products.

1. Size of signs and lettering: as required by regulatory agencies, or as appropriate to usage.

2. Colors: as required by regulatory agencies, otherwise of uniform colors throughout Project.

B. Erect at appropriate location to provide required information.

1.05 QUALITY ASSURANCE

A. Sign Painter: Professional Experience in type of work required.

B. Finishes, Painting: Adequate to resist weathering and fading for scheduled construction period.

PART 2 PRODUCTS

2.01 SIGN MATERIALS

A. Structure and Framing: May be new or used, wood or metal, in sound condition structurally adequate to work and suitable for specified finish.

B. Sign Surfaces: Exterior softwood plywood with medium density overlay, standard large sizes to minimize joints.

1. Thickness: As required by standards to span framing members, to provide even, smooth surface without waves or buckles.

C. Rough Hardware: Galvanized

D. Paint: Exterior quality, as specified in Division 9.

1. Use Bulletin colors for graphics.

2. Colors for structure, framing, sign surfaces and graphics: As selected by the Engineer.

PART 3 EXECUTION

3.01 MAINTENANCE

A. Maintain signs and supports in a neat, clean condition; repair damages to structure, framing or sign.

3.02 REMOVAL

A. Remove signs, framing, supports and foundations at completion of project.

END OF SECTION

SECTION 01600
DELIVERY, STORAGE, AND HANDLING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies the general requirements for the delivery handling, storage and protection for all items required in the construction of the work. Specific requirements, if any, are specified with the related item.

1.02 TRANSPORTATION AND DELIVERY

A. Transport and handle items in accordance with manufacturer's instructions.

B. Schedule delivery to reduce long term on-site storage prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the Engineer.

C. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.

D. Deliver products to the site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting and installing.

E. All items delivered to the site shall be unloaded and placed in a manner which will not hamper the Contractor's normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic.

F. Provide necessary equipment and personnel to unload all items delivered to the site.

G. Promptly inspect shipment to assure that products comply with requirements, quantities are correct and items are undamaged. For items furnished by others (i.e., Owner, other contractors), perform inspection in the presence of the Engineer. Notify Engineer verbally, and in writing, of any problems.

H. If any item has been damaged, such damage shall be repaired at no additional cost to the Owner.

1.03 STORAGE AND PROTECTION

A. Store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor and shall be their responsibility. Instruction shall be carefully followed and a written record of this kept by the Contractor. Arrange storage to permit access for inspection.

B. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

C. Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural, miscellaneous and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs

vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in a manner to reduce breakage, cracking and spalling to a minimum.

D. All mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) shall be stored in a weather-tight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Engineer. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer.

1. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.

2. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

3. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.

4. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

E. All paint and other coating products shall be stored in areas protected from the weather. Follow all storage requirements set forth by the paint and coating manufacturers.

END OF SECTION

SECTION 01610
MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Material and equipment incorporated into the Work:

1. Conform to applicable specifications and standards.

2. Comply with size, make, type and quality specified, or as specifically approved in writing by the Engineer.

3. Manufactured and Fabricated Products
   a. Design, fabricate and assemble in accord with the best engineering and shop practices.
   b. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.
   c. Two or more items of the same kind will be identical, by the same manufacturer.
   d. Products will be suitable for service conditions.
   e. Equipment capacities, sizes and dimensions shown or specified will be adhered to unless variations are specifically approved in writing.

4. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.02 RELATED REQUIREMENTS

A. The Contract Documents include, but are not limited to, the following related requirements:

1. Conditions of the Contract

2. Summary of Work is included in Section 01010.

3. Special Project Procedures are included in Section 01100.

4. Submittals are included in Section 01300.

5. Cleaning is included in Section 01710.

6. Operating and Maintenance Data is included in Section 01730.

7. Warranties and Bonds are included in Section 01740.

1.03 APPROVAL OF MATERIALS

A. Only new materials and equipment will be incorporated in the work. All materials and equipment furnished by the Contractor will be subject to the inspection and approval of the Engineer. No material will be delivered to the work without prior approval of the Engineer.

B. Within 30 days after the effective date of the Agreement, the Contractor will submit to the Engineer, data relating to materials and equipment he/she proposes to furnish for the work. Such data will be in sufficient detail to enable the Engineer to identify the particular product and to form an opinion as to its conformity to the specifications. The data will comply with Section 01300.

C. Facilities and labor for handling and inspection of all materials and equipment will be furnished by the Contractor. If the Engineer requires, either prior to beginning or during the progress of the work, the Contractor will submit samples of materials for such special tests as may be necessary to demonstrate that they conform to the specifications. Such samples will be furnished, stored, packed, and shipped as directed at the Contractor's expense. Except as otherwise noted, the Contractor will make arrangements for and pay for the tests.

D. The Contractor will submit data and samples sufficiently early to permit consideration and approval before materials are necessary for incorporation in the work. Any delay of approval resulting from the Contractor's failure to submit samples or data promptly will not be used as a basis of claim against the Owner or the Engineer.

E. In order to demonstrate the proficiency of workmen or to facilitate the choice among several textures, types, finishes and surfaces, the Contractor will provide such samples of workmanship or finish as may be required.

F. The materials and equipment used on the work will correspond to the approved samples or other data.

1.04 MANUFACTURER'S INSTRUCTIONS FOR INSTALLATION

A. When Contract Documents require that installation of work will comply with manufacturer’s printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two (2) copies to the Engineer.

1. Maintain one set of complete instructions at the job site during installation and until completion.

B. Handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements.

1. Should job conditions or specified requirements conflict with manufacturer’s instructions, consult with Engineer for further instructions.

2. Do not proceed with work without clear instructions.

C. Perform work in accordance with manufacturer’s instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.05 TRANSPORTATION AND HANDLING

A. Arrange deliveries of Products in accordance with construction schedules, coordinate to avoid conflict with work and conditions at the site.

1. Deliver Products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

2. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and that Products are properly protected and undamaged.

B. Provide equipment and personnel to handle Products by methods to prevent soiling or damage to Products or packaging.

1.06 STORAGE AND PROTECTION

A. The Contractor will furnish a covered, weather-protected storage structure providing a clean, dry, noncorrosive environment for all mechanical equipment, valves, and any special equipment to be incorporated into this project. Storage of equipment will be in strict accordance with the "instructions for storage" of each equipment supplier and manufacturer including connection of heaters, placing of storage lubricants in equipment, etc. The Contractor will furnish a copy of the manufacturer's instructions for storage to the Engineer prior to storage of all equipment and materials. Corroded, damaged or deteriorated equipment and parts will be replaced before acceptance of the project. Equipment and materials not properly stored will not be included in a payment estimate.

B. Store Products in accordance with manufacturer's instructions, with seals and labels intact and legible.

1. Store products subject to damage by the elements in weather tight enclosures.

2. Maintain temperature and humidity within the ranges required by manufacturer's instructions.

3. Store fabricated products above the ground, on blocking or skids, prevent soiling or staining. Cover products which are subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation.

4. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

C. All materials and equipment to be incorporated in the work will be handled and stored by the Contractor before, during and after shipment in a manner to prevent warping, twisting, bending, breaking, chipping, rusting and any injury, theft or damage of any kind whatsoever to the material or equipment.

D. Cement, sand and lime will be stored under a roof and off the ground and will be kept completely dry at all times. All structural and miscellaneous steel and reinforcing steel will be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. Beams will be stored with the webs vertical. Precast concrete beams will be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products will be handled and stored in a manner to reduce breakage, chipping, cracking and spalling to a minimum.

E. All materials which, in the opinion of the Engineer, have become so damaged as to be unfit for the use intended or specified will be promptly removed from the site of the work and the Contractor will receive no compensation for the damaged material or its removal.

F. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored Products to assure that Products are maintained under specified conditions and free from damage or deterioration.

G. Protection After Installation

1. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove covering when no longer needed.

H. The Contractor will be responsible for all material, equipment and supplies sold and delivered to the Owner under this Contract until final inspection of the work and acceptance thereof by the Owner. In the event any such material, equipment, and supplies are lost, stolen, damaged, or destroyed prior to final inspection and acceptance, the Contractor will replace same without additional cost to the Owner.

I. Should the Contractor fail to take proper action on storage and handling of equipment supplied under this Contract within seven (7) days after written notice to do so has been given, the Owner retains the right to correct all deficiencies noted in previously transmitted written notice and deduct the cost associated with these corrections from the Contractor's Contract. These costs may be comprised of expenditures for labor, equipment usage, administrative, clerical, engineering and any other costs associated with making the necessary corrections.

1.07 WARRANTY

A. For all major pieces of equipment, submit a warranty from the equipment manufacturer as specified in Section 01740.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01630
SUBSTITUTIONS AND PRODUCT OPTIONS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Furnish and install products specified, under options and conditions for substitutions stated in this Section.

B. Whenever a product, material or item of equipment is specified or described by using the name of a proprietary product or the name of a particular manufacturer or vendor, followed by the phase "or equal," the specific item mentioned shall be the basis upon which bids are to be prepared, and shall be understood as establishing the type, function, dimension, appearance and quality desired. Other manufacturer's or vendor's products not named will be considered as substitutions, provided the required information is submitted in the manner set forth in this Section and provided the substitution will not require substantial revision to the Contract Documents.

1.02 RELATED WORK

A. Bid Form is included in the Front-End Documents provided by JEA.

B. Delivery Storage and Handling is included in Section 01600.

1.03 SUBMITTAL OF LIST OF PROPOSED SUBSTITUTIONS

A. Bidders shall submit their list of proposed substitutions and the proposed monetary changes associated therewith to the Owner on the standard form provided together with their bids. The substitution submittal process shall follow the requirements identified in the JEA front end documents. The Owner will review the proposed substitutions and decide which ones are acceptable.

1.04 CONTRACTOR'S OPTIONS

A. For Products specified only by reference standard, select product meeting that standard, by any manufacturer.

B. For Products specified by naming several products or manufacturers, select any one of products and manufacturers named which complies with Specifications.

C. For products specified by naming one or more products or manufacturers and stating, "or equal," submit a request as for substitutions, for any product or manufacturer which is not specifically named.

D. For products specified by naming only one product and manufacturer, there is no option and no substitution will be allowed.

1.05 SUBSTITUTIONS

A. Submit separate request for each substitution. Support each request with:

1. Complete data substantiating compliance of proposed substitution with requirements stated in Contract Documents:
   a. Product identification, including manufacturer's name and address.
   b. manufacturer's literature; identify:
      1) Product description.
      2) Reference standards.
      3) Performance and test data.
      4) Operation and maintenance data.
   c. Samples, as applicable.
   d. Name and address of similar projects on which product has been used, and date of each installation.

2. Itemized comparison of the proposed substitution with product specified; List significant variations. Substitution shall not change design intent and shall perform equal to that specified.

3. Data relating to impact on construction schedule occasioned by the proposed substitution.

4. Any effect of substitution on separate contracts.

5. List of changes required in other work or products.

6. Accurate cost data comparing proposed substitution with product specified.
   a. Amount of any net change to Contract Sum.

7. Designation of required license fees or royalties.

8. Designation of availability of maintenance services, sources of replacement materials.

B. Substitutions will not be considered for acceptance when:

1. They are indicated or implied on shop drawings or product data submittals without a formal request from Contractor.

2. They are requested directly by a subcontractor or supplier.

3. Acceptance will require substantial revision of Contract Documents.

C. Requests for substitutions submitted after Notice of Award will not be considered unless evidence is submitted to the Engineer that all of the following circumstances exist:

1. The specified product is unavailable for reasons beyond the control of the Contractor. Such reasons shall consist of strikes, bankruptcy, discontinuance of manufacturer, or acts of God.

2. The Contractor placed, or attempted to place, orders for the specified products within 10 days after Notice of Award.

3. Request for substitution is made in writing to the Engineer within 10 days of the date on which the Contractor ascertains that he cannot obtain the item specified.

4. Complete data as set forth herein to permit complete analysis of the proposed substitution is submitted with the request.

D. The Engineer's decision regarding evaluation of substitutions shall be considered final and binding. Requests for time extensions and additional costs based on submission of, acceptance of, or rejection of substitutions will not be allowed. All approved substitutions will be incor-porated into the Agreement by Change Order.

1.06 CONTRACTOR'S REPRESENTATION

A. In making formal request for substitution, Contractor represents that:

1. He has investigated proposed product and has determined that it is equal to or superior in all respects to that specified.

2. He will provide same warranties or bonds for substitution as for product specified.

3. He will coordinate installation of accepted substitution into the Work, and will make such changes as may be required for the Work to be complete in all respects.

4. He waives claims for additional costs caused by substitution which may subsequently become apparent.

5. Cost data is complete and includes related costs under his Contract, but not:
   a. Costs under separate contracts.
   b. Engineer's costs for redesign or revision of Contract Documents.

1.07 ENGINEER DUTIES

A. Review Contractor's requests for substitutions with reasonable promptness.

B. Notify Contractor, in writing, of decision to accept or reject requested substitution.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01700
CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies administrative, verification and procedural requirements for project closeout, including but not limited to:

1. Final cleaning (Section 01710).

2. Operation, instrumentation and control adjustments (Section 13).

3. Project Record Documents (Section 01720).

4. Spare parts and maintenance materials (spare paint, lubricants, special tools) (applicable Sections in Divisions 09 through 16).

5. Record Shop Drawings (Section 01300).

6. Warranties, guarantees, and bonds (Section 01740) and applicable Sections in Technical Divisions 10 through 16.

7. Reconciliation of final accounting, final change order, final payment application and Contractor's releases.

8. As-built construction schedule (Section 01310).

9. Permit close-outs including Certificate of Occupancy or Certificate of Completion.

1.02 RELATED WORK

A. Operation and Maintenance (O&M) data and manuals (Section 01730) and applicable Sections in Technical Divisions.

B. Certified Surveyor documentation submittals (Section 01050).

1.03 CLOSEOUT PROCEDURES

A. Provide all deliverables as specified, prior to submitting the final payment application.

B. Provide submittals to Engineer that are required by governing or other authorities having applicable jurisdiction including but not limited to permit close out information, certificates of occupancy, etc.

C. Submit Application for Final Payment identifying total adjusted Contract Sum, previous payments and sum remaining due, following submittal and approval of Record Documents and Record Drawings.

D. Submit Contractor's Final Release and Release of Liens with final payment application.

1.04 FINAL CLEANING

A. Contractor to complete final cleaning prior to submittal of the final application for payment.

B. Contractor to comply with requirements as specified in Section 01710.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01710
CLEANING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Execute cleaning, during progress of the work, and at completion of the work, as required by General Conditions.

1.02 RELATED WORK

A. Standard General Conditions of the Construction Contract with Owner.

1.03 DISPOSAL AND CLEANING

A. The Contractor shall conduct cleaning and disposal operations to comply with codes, ordinances, regulations and anti-pollution laws.

PART 2 PRODUCTS

2.01 MATERIALS

A. The Contractor shall use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.

B. The Contractor shall use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.

C. The Contractor shall use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 EXECUTION

3.01 DURING CONSTRUCTION

A. The Contractor shall execute periodic cleaning to keep the work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.

B. The Contractor shall provide on-site containers for the collection of waste materials, debris and rubbish.

C. The Contractor shall remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3.02 DUST CONTROL

A. The Contractor shall clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.

B. The Contractor shall schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.03 FINAL CLEANING

A. The Contractor shall employ skilled workmen for final cleaning.

B. The Contractor shall remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels and other foreign materials from sight-exposed interior and exterior surfaces.

C. The Contractor shall wash and shine glazing and mirrors.

D. The Contractor shall polish glossy surfaces to a clear shine.

E. Ventilating Systems:

1. The Contractor shall clean permanent filters and replace disposable filters if units were operated during construction.

2. The Contractor shall clean ducts, blowers and coils if units were operated without filters during construction.

F. The Contractor shall broom clean exterior paved surfaces; rake clean other surfaces of the grounds.

G. Prior to final completion, or Owner occupancy, conduct an inspection of sight-exposed interior and exterior surfaces and all work areas, to verify that the entire work is clean.

END OF SECTION

SECTION 01720
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall keep and maintain, at the job site, a copy of contract documents, marked up to indicate all changes made during the course of a project, as specified herein.

1.02 RELATED REQUIREMENTS

A. Contract close-out submittals are included in Section 01700.

B. Warranties and bonds are included in Section 01740.

C. As-built construction schedules are included in Section 01310.

D. As-built wiring diagrams are included in Section 01730.

E. As-built surveys are included in Section 01050.

F. Record shop drawings are included in Section 01300.

G. Construction photographs are included in Section 01380.

1.03 REQUIREMENTS INCLUDED

A. Contractor shall maintain a record copy of the following documents, marked up to indicate all changes made during the course of a project:

1. Contract Drawings
2. Record Drawings
3. Specifications
4. Addenda
5. Change orders and other modifications to the contract
6. Engineer’s and Owner’s field orders or written instructions
7. Approved shop drawings, working drawings, and samples
8. Field test records
9. Construction photographs

B. Contractor shall assemble copies of the following documents for turnover to the Engineer at the end of the project, as specified.

1. Field Orders, Change Orders, Design Modifications, and RFIs
2. Field Test records
3. Permits and permit close-outs (final approvals)
4. Certificate of Occupancy or Certificate of Completion, as applicable
5. Laboratory test reports (e.g., bacteriological and primary & secondary water quality)
6. Certificates of Compliance for materials and equipment
7. Record Shop Drawings
8. Samples
9. Record Drawings and Specifications

C. RECORD DRAWINGS

1. The Contractor shall annotate (mark-up) the Contract Drawings to indicate all project conditions, locations, configurations, and any other changes or deviations that vary from the original Contract Drawings. This requirement includes, but is not limited to, buried or concealed construction, and utility features that are revealed during the course of construction. Special attention shall be given to recording the locations (horizontal and vertical) and material of all buried utilities that are encountered during construction – whether or not they were indicated on the Contract Drawings. The record information added to the drawings may be supplemented by detailed sketches, if necessary, clearly indicating, the Work, as constructed.
2. These annotated Contract Drawings constitute the Contractor's Record Drawings and are actual representations of as-built conditions, including all revisions made necessary by change orders, design modifications, requests for information and field orders.
3. Record drawings shall be accessible to the Owner and Engineer at all times during the construction period.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS AND SAMPLES

A. Store documents and samples in Contractor's field office apart from documents used for construction.

1. Provide files and racks for storage of the record documents.
2. Provide locked cabinet(s) or secure storage space for storage of samples.

B. File documents and samples in accordance with Construction Specifications Institute (CSI) format.

C. Maintain documents in a clean, dry, legible, condition and in good order. Do not use record documents for construction purposes.

D. Make documents and sample available for inspection by the Engineer or Owner at all times.

E. Up-to-date Record Drawings may be a pre-requisite of processing periodic monthly pay applications, if so specified under the section for progress payments.

3.02 MARKING METHOD

A. Use the color Red (indelible ink) to record information on the Drawings and Specifications,

B. Label each document "PROJECT RECORD" in neat large printed letters.

C. Unless otherwise specified elsewhere, notations shall be affixed to hardcopies of documents.

D. Record information contemporaneously with construction progress.

E. Legibly mark drawings with as-built information:

1. Elevations and dimensions of structures and structural elements.

2. All underground utilities (piping and electrical), structures, and appurtenances
   a. Changes to existing structure, piping and appurtenance locations.
   b. Record horizontal and vertical locations of underground structures, piping, utilities and appurtenances, referenced to permanent surface improvements.
   c. Record actual installed pipe material, class, size, joint type, etc.

3.03 RECORD INFORMATION COMPILATION

A. Do not conceal any work until the required information is acquired.

B. Drawings: Legibly mark to record actual construction.

C. Do not conceal any work until the required information is acquired.

D. Items to be recorded include, but are not limited to:

1. Location of internal utilities and appurtenances concealed in the construction – referenced to visible and accessible features.

2. Field changes of dimensions and/or details;
   a. Interior equipment and piping relocations.
   b. Architectural and structural changes, including relocation of doors, windows, etc.
   c. Architectural schedule changes.

3. Changes made by field order, change order, design modification, and RFI, and approved shop drawings.

4. Details not indicated on the original contract drawings.

5. Specifications - legibly mark each section to record: Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed, and changes made by Field Order, Change Order, RFI, and approved shop drawings.

6. Coordinates and elevations of each valve and fitting.

7. All underground duct banks with elevations and dimensions, horizontal and vertical locations of underground duct banks, and manholes along duct banks.

8. Depths of various elements of foundations in relation to finish first floor datum

9. All underground piping with elevations and dimensions. Changes to piping location. Horizontal and vertical locations of all underground utilities, valves, and appurtenances, referenced to permanent surface improvements. Actual installed pipe material, class, etc. All pipes shall be labeled using the method as per the contract drawings.

10. All underground cable elevations and horizontal locations of underground cables.

11. All existing and new structures clearly identified.

12. All elevations of new structures (including weirs) clearly indicated.

13. Architectural schedule changes according to Contractor's records and shop drawings

14. Location, elevation, and datum of Benchmark used.

15. Easements as shown on approved paving and drainage drawings.

16. Locations, elevations, sizes, types and material of the following must be accurately shown and labeled (as applicable).
    a. Manholes (including specialty lining material, pipe invert, manhole rim, and bottom elevations).
    b. Valves.
    c. Water and sewer services.
    d. Fire Hydrant and all associated structures.
    e. Fittings.

17. All water and sewer mains must be identified on the record drawings by their size, material, and DR/SDR classification. Horizontal locations and top of pipe elevations must also be labeled every 100 linear feet. **All valves shall be labeled using the method as per the contract drawings.**

18. All new hydrant locations shall be identified based upon the Florida State Plane Coordinate System.

E. Specifications - legibly mark each Section to record:

1. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually installed.

2. Changes made by Field Order, Change Order, RFI, and approved shop drawing.

F. Shop Drawings (after final review and approval):

1. Five sets of record drawings for each process equipment, piping, electrical system and instrumentation system.

3.04 SUBMITTAL

A. If specified under the section for progress payments, monthly applications for payment will be contingent upon up-to-date Record Drawings. If requested by the Engineer or Owner, Contractor shall provide a copy of the Record Drawings, or present them for review prior to processing monthly applications for payment.

B. Upon substantial completion of the WORK and prior to final acceptance, the Contractor shall finalize and deliver a complete set of Record Drawings to the Engineer conforming to the construction records of the Contractor. The set of drawings shall consist of corrected and annotated drawings showing the recorded location(s) of the Work. Unless specified otherwise elsewhere, Record Drawings shall be in the form of a set of prints with annotations carefully and neatly superimposed on the drawings in red.

C. Upon substantial completion of the Work and prior to final acceptance, the Contractor shall finalize and deliver a complete set of Record Documents to the Engineer conforming to the construction records of the Contractor. The set of documents shall consist of corrected and annotated documents showing the as-installed equipment and all other as-built conditions not indicated on the Record Drawings.

D. The information submitted by the Contractor into the Record Drawings and Record Documents will be assumed to be correct, and the Contractor shall be responsible for the accuracy of such information, and shall bear the costs resulting from the correction of incorrect data. Final Record Drawings shall be certified by a surveyor licensed in the State of Florida.

E. Delivery of Record Drawings and Record Documents to the Engineer will be a prerequisite to Final payment.

F. The Contractor shall maintain a copy of all books, records, and documents pertinent to the performance under this Agreement for a period of five years following completion of the contract.

END OF SECTION

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SECTION 01730
OPERATION AND MAINTENANCE DATA AND ASSET MANAGEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes procedural requirements for compiling and submitting operation and maintenance data required to complete the project. In addition to the requirements specified herein, Contractor operations and maintenance data shall be as required in JEA Water and Wastewater Standards – Section 445.

1.02 RELATED WORK

A. Submittals are included in Section 01300.

B. Contract closeout is included in Section 01700.

C. Warranties and Bonds are included in Section 01740.

1.03 OPERATING MANUALS

A. The Manufacturer shall provide specific operation and maintenance instructions for all electrical, mechanical, and instrumentation & controls equipment furnished under various technical specifications Sections.

B. Six complete sets of operation and maintenance manuals approved by the Engineer covering all equipment furnished under Divisions 11, 13, 15 and 16 shall be delivered at least 30 days prior to scheduled start-up directly to the Owner. One set of originals must be part of the six sets of operation and maintenance instructions required, including original manuals covering components manufactured by others.

C. An electronic copy of the manual will be provided with each hard copy submittal.

D. Separate manuals shall be provided for each type of equipment, or each Section number. Each manual shall contain the following specific requirements. Manuals that do not meet the requirements will be rejected and Equipment Supplier/Manufacturer will bear all expenses to resubmit the manual to meet the following requirements.

1. Format and Materials
    a. Binders:
        1) Commercial quality three ring binders with durable and cleanable plastic covers
        2) Maximum ring width capacity: 3 inches
        3) When multiple binders are used, correlate the data into related consistent groupings/volumes.
    b. Identification: Identify each volume on the cover and spine with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". Include the following:
        1) Title of Project.
        2) Identify the general subject matter covered in the manual.
        3) Identify structure(s) and/or location(s), of the equipment provided.
        4) Specification Section number.

c. 20 lb loose leaf paper, with hole reinforcement
d. Page size: 8-1/2 inch by 11 inch
e. Provide heavy-duty fly leafs (section separators), matching the table of contents, for each separate product, each piece of operating equipment, and organizational sections of the manual.
f. Provide reinforced punched binder tab; bind in with text.
g. Reduce larger drawings and fold to the size of text pages - but not larger than 11 inches x 17 inches - or provide a suitable clear plastic pocket (with drawing identification) for such folded drawings/diagrams.

2. Contents:
   a. A table of contents/Index, divided into section reflective of the major components provided.
   b. Specific description of each system and components
   c. Name, address, telephone number(s) and e-mail address(es) of vendor(s) and local service representative(s)
   d. Equipment Supplier/Manufacturer shall clearly strike out portions of manual that do not apply to the project. Manual will be rejected until inapplicable information is deleted and only applicable information is clearly indicated
   e. Specific on-site operating instructions (including starting and stopping procedures)
   f. Safety considerations
   g. Project specific operational procedures and recommended log sheet(s).
   h. Project specific maintenance procedures
   i. Manufacturer's operating and maintenance instructions – specific to the project
   j. Copy of each wiring diagram
   k. Copy of approved shop drawing(s) and Contractor's coordination/layout drawing(s)
   l. List of spare parts and recommended quantities
   m. Product Data: Mark each sheet to clearly identify specific products and component parts and data applicable to installation. Delete inapplicable information.
   n. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams
   o. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.
   p. Warranties and Bonds, as specified in the General Conditions
   q. Equipment attributes sheet for submittal of nameplate data
   r. Electronic copy of manual on CD

3. Transmittals
   a. Prepare separate transmittal sheets for each manual. Each transmittal sheet shall include at least the following: Contractor's name and address, Owner's name, project name, project number, submittal number, description of submittal and number of copies submitted.
   b. Submittals shall be transmitted or delivered directly to the office of the Engineer, as indicated in the Contact Documents or as otherwise directed by the Engineer.
   c. Provide copies of transmittals (only, i.e., without copies of the respective submittal) directly to the Resident Project Representative.

E. Manuals for Equipment and Systems - In addition to the requirements listed above, for each System, provide the following:

1. Overview of system and description of unit or system and component parts. Identify function, normal operating characteristics and limiting conditions. Include legible performance curves, with engineering data and tests and complete nomenclature and commercial number of replaceable parts.

2. Panelboard circuit directories including electrical service characteristics, controls and communications and color-coded wiring diagrams as installed.

3. Operating procedures: include start-up, break-in and routine normal operating instructions and sequences; regulation, control, stopping, shut-down and emergency instructions; and summer, winter and any special operating instructions.

4. Maintenance Requirements
   a. Procedures and guides for trouble-shooting; disassembly, repair, and reassembly instructions
   b. Alignment, adjusting, balancing and checking instructions
   c. Servicing and lubrication schedule and list of recommended lubricants
   d. Manufacturer's printed operation and maintenance instructions
   e. Sequence of operation by instrumentation and controls manufacturer
   f. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance

5. Control diagrams by controls manufacturer as installed (as-built)

6. Contractor's coordination drawings, with color coded piping diagrams, as installed (as-built)

7. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams. Include equipment and instrument tag numbers on diagrams.

8. List of original manufacturer's spare parts and recommended quantities to be maintained in storage

9. Test and balancing reports, as required

10. Additional Requirements as specified in individual product specification

11. Design data for systems engineered by the Contractor or its Suppliers

F. Manual for Materials and Finishes - In addition to the requirements listed above, for each material or finish, provide the following:

1. Building Products, Applied Materials and Finishes: Include product data, with catalog number, size, composition and color and texture designations. Provide information for re-ordering custom manufactured products.

2. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods and recommended schedule for cleaning and maintenance.

3. Moisture Protection and Weather Exposed Products: Include product data listing, applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance and repair.

4. Additional Requirements: As specified in individual product specifications.

G. Electronic Transmission of O&M Manuals

1. Unless otherwise approved by the Engineer, O&M manuals may not be transmitted by electronic means other than by CD-ROM or USB flash drive. Electronic O&M manuals shall meet the following conditions:
   a. The above-specified transmittal form is included.
   b. All other requirements specified above have been met, including, but not limited to, coordination by the Contractor, review and approval by the Contactor.
   c. The submittal contains no pages or sheets large than 11 x 17 inches.
   d. With the exception of the transmittal sheet, the entire submittal is included in a single file.
   e. Files are Portable Document Format (PDF) – with the printing function enabled.
   f. The Vendor provided equipment, sub-system, or system manuals shall be in PDF format, compliant with the Adobe PDF Specification Version 1.7. The manual shall be Searchable Image. The Optical Character Recognition of the image shall be at a 95% confidence level. The manuals shall be linked and bookmarked as follows:
      1) Provide links from all Table of Contents, List of Tables, List of Figures, etc., entries to the actual occurrence in the body of the manual.
      2) Create bookmarks for all linked Table of Content entries.
   g. All drawings shall be in PDF format, compliant with the Adobe PDF Specification Version 1.7. The manual shall be PDF Searchable Image. The Optical Character Recognition of the image shall be at a 95% confidence level. The drawings shall be linked as follows:
      1) External links from the Drawing Index (if it exists) to each drawing.
      2) External links from references within drawings to other drawings.
   h. All scanned manufacturer's O&M manuals must be quality checked after scanning to ensure the page are not crooked and all information is legible.

2. When electronic copies are provided, transmit two hard copy (paper) originals to the Engineer with an electronic copy on CD-ROM.

3. The electronic copy of the O&M manual shall be identical in organization, format and content to the hard copies of the manual.

4. The electronic O&M Manual shall be bookmarked identically to the paper manual table of contents to allow quick access to information. Electronic submittals that require extensive scrolling will not be accepted. The document shall be indexed and searchable.

H. Quick Reference Sheets for Equipment

1. For each item of equipment furnished under Divisions 11, 15, and 16 provide the following:
   a. A minimum of one 8 ½ x 11-inch laminated quick reference sheet. Sheets shall be three hole punched and may be double sided.
   b. Each quick reference sheet shall include the following minimum information:
      1) Safety Procedures:
         a) Brief descriptions of each piece of equipment and components;
         b) Starting and stopping procedures;
         c) Special operating instruction;
         d) Routine maintenance procedures;
         e) Calibration procedures;
         f) Pump curves;
         g) Trouble shooting procedures; and
         h) Name, address, and telephone numbers of local service representative.
   c. Provide three copies of quick reference sheets for review by the Engineer.
   d. After quick reference sheets have been approved, provide four copies of laminated quick reference sheets to the Engineer in one commercial coiled three-ring binder with durable and cleanable plastic cover.

1.04 SERVICES OF MANUFACTURERS' REPRESENTATIVE

A. A. All electrical, mechanical, and instrumentation & controls equipment furnished under various technical specifications Sections shall include the cost of a competent representative of the manufacturers of all equipment to supervise the installation, adjustment and testing of the equipment; and, to instruct the Owner's operating personnel on operation and maintenance. This supervision may be divided into two or more time periods to suit the Contractor’s schedule and/or the Owner’s personnel availability.

B. See the detailed specifications for additional requirements for furnishing the services of manufacturer's representatives.

C. The manufacturer’s representative shall certify that the installation of the equipment is satisfactory; that the unit has been satisfactorily tested; that the equipment is ready for operation; and, that the operating personnel have been suitably instructed in the operation, maintenance, care, and safe operation of the equipment. The Equipment Manufacturer’s Certificate of Installation, Testing, and Instruction attached to this Section shall be used for this certification.

D. For other materials furnished under other specification Sections, furnish the services of approved representative(s) of the manufacturer when, in the opinion of the Engineer, some evident product failure or malfunction makes such services necessary.

1.05 EQUIPMENT ATTRIBUTE INFORMATION

A. Equipment Attribute Worksheets as presented at the end of this Section shall be provided for all equipment meeting the asset definition as follows:

1. Asset Definition
   a. Maintenance is recommended

b. Assets have a value greater than $1,000
c. Assets are complete and usable, and perform a distinct function independently (i.e., they pump waste, remove solids, etc.)

B. This asset definition is intended to give a general indication of which equipment must be included in the Equipment Attribute Worksheets. The Engineer will provide the specific list of equipment that the Vendor must provide information for:

C. The information requirements are shown in detail in the table. The data requirements include nameplate data, manufacturer and supplier information, information specific to the type of equipment, and recommended preventative maintenance activities.

D. An electronic copy of the Equipment Attribute Worksheets must be delivered in Excel format and submitted to the Engineer on CD-ROM and submitted with the O&M manuals. It is not necessary to submit printed copies of the Equipment Attribute Worksheets.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

A. Operation and maintenance manuals shall be delivered directly to the office of the Engineer, as follows:

1. Provide preliminary copies of each manual to the office of the Engineer, no later than 30 days following approval of the respective shop drawings.

2. Provide final copies of each completed manual prior to testing.

3. Provide a letter that grants the Engineer and Owner to the limited right to use and reproduce each manual (in it its entirety or any portion thereof) from the respective equipment manufacturer(s). Such limited right shall allow the Engineer and Owner to use each manual or and portion thereof for:
   a. The potential assembly of a comprehensive facility operation and maintenance manual for the sole benefit of the Owner; and,
   b. Supplemental training of the Owner's personnel and operators, over and above the required vendor's training, regarding operation of the facility as a system.

B. The Engineer will review Operation and Maintenance manuals submittals for operating equipment for conformance with the requirements of the applicable specification Section. The review will generally be based on the O&M Manual Review Checklist appended to this Section.

C. If during test and start-up of equipment, any changes were made to the equipment, provide two hard copies of as-built drawings or any other amendments for insertion, by the Contractor, in the previously transmitted final manuals. In addition, provide one revised electronic version including the as-built drawings and any other amendments. The manuals shall be completed, including updates, if any, within 30 days of start-up and testing of the facility.

3.02 VENDOR TRAINING/INSTRUCTIONS (TO OWNER'S PERSONNEL)

A. Before final initiation of operation, Contractor's vendors shall train/instruct Owner's designated personnel in the operation, adjustment, and maintenance of products, equipment and systems at times convenient to the Owner.

B. Unless specified otherwise under the respective equipment specification section, vendor training/instruction shall consist of eight hours of training for each type of equipment. Such training/instruction shall be scheduled and held at times to accommodate the work schedules of Owner's personnel, including splitting the required training/instruction time into separate sessions and/or presented at reasonable times other than the Contractor's "normal working hours" or the Owner's normal day shift.

C. Use operation and maintenance manuals as basis for instruction. Train/instruct the Owner's personnel, in detail, based on the contents of manual explaining all aspects of operation and maintenance of the equipment. If the respective equipment is inter-related to the operation of other equipment, all interlock, constraints, and permissives shall be explained.

D. At least two weeks prior to the schedule for vendor training, a detailed lesson plan, representative of the material to be covered during instruction, shall be submitted to the Engineer for approval. Lesson plans shall consist of in-depth outlines of the training material, including a table of contents, resume of the instructor, materials to be covered, start-up procedures, maintenance requirements, safety considerations, and shut-down procedures.

E. Prepare and insert additional data in each Operation and Maintenance Manual when the need for such data becomes apparent during training/instruction.

F. Vendor's training/instruction will be considered acceptable based on the completed Owner's Acknowledgement of Manufacturer's Instruction as indicated on the Equipment Manufacturer's Certification of Installation, Testing, and Instruction appended to this Section.

G. Training Video

1. All equipment suppliers shall supply to the Engineer three copies of a training video specific to the equipment furnished for the project. The film shall be of a high quality, with both picture and sound.

2. The training video shall be organized so as to show and identify each element of the equipment; including a clear explanation of its function, troubleshooting criteria; disassembly and reassembly

3. Portions of the training video shall be recorded at the on-site O&M training sessions conducted by the equipment manufacturer’s representative.

4. The video shall be submitted to the Engineer for approval not less than 30 calendar days after the start-up of the equipment.

5. The video recording should be playable on VCD recorded discs using MPEG-1 video (MP3 audio) and thereby able to be replayed through Windows Media Player, QuickTime or RealPlayer on PCs and most DVD players. VCD stored on CD-ROMs have the capacity to hold up to 74/80 minutes on a 650MB/700MB CD respectively, of video with stereo

quality sound. All video and audio should be of the highest quality. All CD-OMS shall bear a label identifying the Equipment(s) trained on, general Training topic (i.e., Maintenance, Operations, Storage, or O&M, etc.), the date of the video, trainer and his affiliation (i.e. John Doe, XYZ Company), and video file one of how many on the topic (Video 1 of 2) if the video exceeds the recording time of the CD.

3.03 VIDEOGRAPHY OF VENDOR TRAINING/INSTRUCTION

A. Audio/video (A/V) record (in DVD format) training/instructions as they are being provided to the Owner's personnel. Such recording shall include the entire training/instruction session(s) as well as all questions and answers. A/V recording shall be performed by a professional organization experienced in the production of such recordings. Self-recording by the Contractor may be considered, provided that Contractor can demonstrate, in advance, proficient examples of such recordings.

B. To avoid audio problems, training/instruction shall be held in a location sufficiently removed from construction activity, insulated from the noise of construction activity, or during a time when construction activity is not occurring in the vicinity.

C. The audio portion of the A/V recording should be done with a microphone (wired or wireless) attached to the trainer/instructor to maximize the quality of speech.

D. Each A/V recording should have "chapters" to segregate the distinct portions of the training/instruction, or have visual cues at the start of a change in subject.

E. Two copies of the A/V recordings shall be submitted to the Engineer on DVD disk(s). The DVDs will become the property of the Owner.

END OF SECTION

O&M Manual Review Checklist

Submittal No.: _____
Project No.: _____
Manufacturer: _____
Equipment Submitted: _____
Specification Section: _____
Date of Submittal:

	General Data	
1.	Are the area representative's name, address, e-mail address and telephone number included?	
2.	Is the nameplate data for each component included?	
3.	Are all associated components related to the specific equipment included?	
4.	Is non-pertinent data crossed out or deleted?	
5.	Are drawings neatly folded and/or inserted into packets?	
6.	Are all pages properly aligned and scanned legibly?	
7.	Is the .PDF document bookmarked according to the table of contents?	
	Operations and Maintenance Data	
8.	Is an overview description of the equipment and/or process included?	
9.	Does the description include the practical theory of operation?	
10.	Does each equipment component include specific details (design characteristics, operating parameters, control descriptions, and selector switch positions and functions)?	
11.	Are alarm and shutdown conditions specific to the equipment provided on this project clearly identified? Does it describe possible causes and recommended remedies?	
12.	Are step procedures for starting, stopping, and troubleshooting specific to the equipment provided included?	
13.	Is a list of operational parameters to monitor and record specific to the equipment provided included?	
14.	Is a proposed operating log sheet specific to the equipment provided included?	
15.	Is a spare parts inventory list included for each component?	
16.	Is a lubrication schedule for each component specific to the equipment provided included - or does it clearly state “No Lubrication Required"?	
17.	Is a maintenance schedule for each component specific to the equipment provided included?	
18..	Is a copy of the warranty information included?	

Review Comments

Is the submittal fully approved (yes/no)? _____

If not, the following points of rejection must be addressed and require resubmittal by the Contractor:

Item No.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____

Reviewed By: _____ Date: _____

Legend

1 = OK

2 = Not Adequate

3 = Not Included

Note: This submittal has been reviewed for compliance with the Contract Documents.

Table 01730 Schedule of Assets
02605
CONCRETE DRAIN BOX
02616
12" DI PIPING & FITTINGS
16" DI PIPING & FITTINGS
20" DI FITTINGS
02622
1" PVC PIPING & FITTINGS
2" PVC PIPING & FITTINGS
3" PVC PIPING & FITTINGS
12” PVC PIPING & FITTINGS
16” PVC PIPING & FITTINGS
20" PVC PIPING & FITTINGS
IRRIGATION PIPING, FITTINGS, VALVES, AND APPURTENANCES (PER L-4)
02640
12" PLUG VALVE
16" PLUG VALVE
20" PLUG VALVE
02830
CHAIN LINK FENCE AND GATE
03480
PRECAST CONCRETE BUILDING
11148
DIESEL ENGINE DRIVEN PUMP
11306
DRY-PIT SUBMERSIBLE SOLIDS HANDLING PUMP JOCKEY NO. 1 & 2
DRY-PIT SUBMERSIBLE SOLIDS HANDLING PUMP BOOSTER NO. 1 & 2
13320
RADIO TELEMETRY SYSTEM (INCLUDING TOWER)
13321
FIBER OPTIC INTERFACE PANEL
13330
GENERATOR CONTROL PANEL
PUMP STATION CONTROL PANEL
FLOW METER PANEL
IRRIGATION CONTROL PANEL
13340
CHECK VALVE POSITION SWITCH
PRESSURE GAUGES

PRESSURE ELEMENTS
PRESSURE INDICATOR TRANSMITTER
ULTRASONIC TRANSIT TIME FLOW METER
15066
10" 316 SST PIPING & FITTINGS
12" 316 SST PIPING & FITTINGS
14” 316 SST PIPING & FITTINGS
16” 316 SST PIPING & FITTINGS
20” 316 SST PIPING & FITTINGS
15070
1" PVC PIPING & FITTINGS
2" PVC PIPING & FITTINGS
3" PVC PIPING & FITTINGS
15100
2" AIR RELEASE VALVES
3" AIR RELEASE VALVES
10” PLUG VALVE
12" PLUG VALVE
14” PLUG VALVE,
16” PLUG VALVE
20” PLUG VALVE
10” CHECK VALVE (RUBBER FLAPPER)
14” CHECK VALVE (RUBBER FLAPPER)
15140
PIPE CLAMPS, HANGERS, AND SUPPORTS
15500
HVAC CONTROLS
HVAC CONDENSOR/COMPRESSOR
HVAC AIR HANDLING UNIT
HVAC DUCTWORK
15600
FUEL STORAGE TANK FOR DIESEL ENGINE DRIVEN GENERATOR
16150
DRY-PIT SUBMERSIBLE SOLIDS HANDLING PUMP JOCKEY NO. 1 & 2 MOTORS
DRY-PIT SUBMERSIBLE SOLIDS HANDLING PUMP BOOSTER NO. 1 & 2 MOTORS
EMERGENCY DIESEL PUMP MOTOR
16191
MISCELLANEOUS ELECTRICAL EQUIPMENT (DISCONNECT SWITCHES, TRANSFORMERS ETC.)
16216
DIESEL ENGINE DRIVEN GENERATOR & AUTOMATIC TRANSFER SWITCH

16370
VARIABLE FREQUENCY DRIVE 1, 2, 3, 4
16370
ELECTRICAL PANEL BOARDS
16480
MOTOR CONTROL CENTER 1 & 2
16500
LIGHTING SYSTEM
16502
LIGHTNING PROTECTION SYSTEM

SECTION 01740
WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer Equipment Supplier/Manufacturer's standard warranties on products and special warranties.

1.02 RELATED WORK

A. General closeout requirements are included in Section 01700 Project Closeout.

B. Specific requirements for warranties for the work and products and installations that are specified to be warranted are included in the individual Sections.

1.03 SUBMITTALS

A. The individual Equipment Supplier/Manufacturer shall submit written warranties to the Owner prior to the date fixed by the Equipment for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the work, or a designated portion of the work, submit written warranties upon request of the Owner.

B. When a designated portion of the work is completed and occupied or used by the Owner, by separate agreement with the Equipment Supplier/Manufacturer (as applicable) during the construction period, submit properly executed warranties to the Owner via the Equipment within 15 days of completion of that designated portion of the Work.

C. When a special warranty is required to be executed by the Equipment Supplier/Manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner via the Equipment for approval prior to final execution.

D. Forms for special warranties are included at the end of this Section. Prepare a written document utilizing the appropriate form, ready for execution by the Contractor, or the Contractor and subcontractor, or Equipment Supplier/Manufacturer. Submit a draft to the Owner for approval prior to final execution.

E. Refer to individual Sections for specific content requirements, and particular requirements for submittal of special warranties.

F. At Final Completion the Contractor shall compile two copies of each required warranty and bond properly executed by the Equipment Supplier/Manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

G. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents and sized to receive 8-1/2-inch by 11-inch paper.

H. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the Section in which specified and the name of the product or work item.

I. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address and telephone number of the installer or Equipment Supplier/Manufacturer.

J. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS", the project title or name and the name, address and telephone number of the Equipment Supplier/Manufacturer.

K. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.04 WARRANTY REQUIREMENT

A. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

B. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The Equipment Supplier/Manufacturer is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefited from use of the work through a portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

F. The Owner reserves the right to refuse to accept work for the Project where a special warranty, certification, or similar commitment is required on such work or part of the work, until evidence is presented that entities required to countersign such commitments are willing to do so.

G. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Equipment Supplier/Manufacturer (as applicable) of the warranty on the work that incorporates the products, nor does it relieve Equipment Supplier/Manufacturer and subcontractors required to countersign special warranties with the Contractor.

1.05 MANUFACTURERS CERTIFICATIONS

A. Where required, the Contractor shall supply evidence, satisfactory to the Equipment, that the Equipment Sup Equipment Supplier/Manufacturer plier can obtain manufacturers' certifications as to the Contractor's installation of equipment.

1.06 DEFINITIONS

A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.07 EQUIPMENT WARRANTIES

A. All equipment supplied under this Contract shall be guaranteed to be free from defects in workmanship, design, and/or materials for a period of two (2) years unless otherwise specified. The period of such warranties shall start on the date the particular equipment is placed in use by the Owner and provided that the equipment demonstrates satisfactory performance during the thirty (30)-day operational period after equipment startup. If the equipment does not perform satisfactorily during the thirty (30)-day startup operational period, the start of the warranty period shall be delayed until the equipment demonstrates proper operation. Warranties and guarantees shall be indicated on the Warranty for Equipment Item form appended to this Section. The Equipment Supplier/Manufacturer shall repair or replace without charge to the Owner any part of equipment which is defective or showing undue wear within the warranty period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory; furnishing all parts, materials, labor, etc., necessary to return the equipment to its specified level.

B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the equipment(s) and the equipment and/or unit(s) restored to service at no expense to the Owner.

C. Obtain equipment warranties in accordance with Section 01740 from each of the respective Equipment Supplier/Manufacturer for all the equipment specified under Divisions 11, 13, 15 and 16 of these Specifications. The form of warranty is included at the end of this Section.

D. The Equipment Supplier/Manufacturer’s warranty period shall run concurrently with the Contractor's warranty or guarantee period. No exception to this provision shall be allowed. In the event that the Equipment Supplier/Manufacturer is unwilling to provide a two (2)-year warranty commencing at the time of Owner acceptance, obtain from the Equipment Supplier/Manufacturer a three (3)-year warranty starting at the time of equipment delivery to the job site. This three (3)-year warranty shall not relieve the Contractor of the two (2)- year warranty starting at the time of Owner acceptance of the equipment.

1.08 FINAL GUARANTEE

A. All work shall be guaranteed by the Contractor for a period of two (2) years from and after the date of acceptance of the work by the Owner.

B. If, within the guarantee period, repairs or changes are required in connection with guaranteed work, which, in the opinion of the Equipment, is rendered necessary as the result of the use of materials, equipment or workmanship which are inferior, defective, or not in accordance with the terms of the Contract, promptly upon receipt of notice from the Owner and without expense to the Owner, replace any part of equipment which is defective or showing undue wear within the warranty period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

WARRANTY FOR EQUIPMENT ITEM

LOCATION OF PROJECT:_____

OWNER:_____

PROJECT NUMBER:_____

EQUIPMENT ITEM:_____

SECTION NO. / ITEM NO.:_____

SUPPLIER/MANUFACTURER:_____

SUPPLIER/MANUFACTURER's ADDRESS: _____

SUPPLIER/MANUFACTURER'S REFERENCE NO.:_____

The undersigned guarantees that the above equipment is of good merchantable quality, free from defects in material or workmanship, fully meets the type, quality, design and performance requirements defined in the Contract Documents of the above project, and that the equipment will in actual operation satisfactorily perform the functions for which installed.

The undersigned agrees to repair, replace, or otherwise make good, any defect in workmanship or materials in the above described equipment which may develop within a period of two (2) years from the date of final acceptance by the Owner of the above-named project.

COMPANY_____

COMPANY ADDRESS_____

_____

BY_____

TITLE_____

SIGNED_____

DATE_____

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SECTION 02050
DEMOLITION AND MODIFICATIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and demolish, modify, remove and dispose of work shown on the Drawings and as specified herein.

B. Included, but not limited to, are demolition, modifications and removal of existing materials, equipment or work necessary to install the new work as shown on the Drawings and as specified herein and to connect with existing work in approved manner.

C. Demolition, modifications and removals which may be specified under other Sections shall conform to requirements of this Section.

D. Demolition and modifications include but are not limited to:

1. Yard Piping as shown on the Drawings.

E. Blasting and the use of explosives will not be permitted for any demolition work.

1.02 RELATED WORK

A. Summary of Work is included in Section 01010.

B. Submittals are included in Section 01300.

C. Construction Schedule is included in Section 01310.

D. Clearing is included in Section 02100.

E. Earthwork is included in Section 02200.

F. Environmental Protection is included in Section 01110.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, six copies of proposed methods and operations of demolition of the structures and modifications prior to the start of work. Include in the schedule the coordination of shutoff, capping and continuation of utility service as required.

B. Furnish a detailed sequence of demolition and removal work to ensure the uninterrupted progress of the Owner's operations. Sequence shall be compatible with sequence of construction and shutdown coordination requirements as specified in Section 01014.

C. Before commencing demolition work, all modifications necessary to bypass the affected structure shall be completed. Actual work shall not begin until the Engineer has inspected and approved the modifications and authorized commencement of the demolition work in writing.

1.04 JOB CONDITIONS

A. Protection

1. Execute the demolition and removal work to prevent damage or injury to structures, occupants thereof and adjacent features which might result from falling debris or other causes, and so as not to interfere with the use, and free and safe passage to and from adjacent structures.

2. Closing or obstructing of roadways, sidewalks and passageways adjacent to the work by the placement or storage of materials will not be permitted and all operations shall be conducted with a minimum interference to traffic on these ways.

3. Erect and maintain barriers, lights, sidewalk sheds and other required protective devices.

B. Scheduling

1. Carry out operations so as to avoid interference with operations and work in the existing facilities.

C. Notification

1. At least 48 hours prior to commencement of a demolition or removal, notify the Engineer in writing of proposed schedule therefor. Owner shall inspect the existing equipment and to identify and mark those items which are to remain the property of the Owner. No removals shall be started without the permission of the Engineer and Owner.

D. Conditions of Structures

1. The Owner and the Engineer assume no responsibility for the actual condition of the structures to be demolished or modified.

2. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable. However, variations within a structure may occur prior to the start of demolition work.

E. Repairs to Damage

1. Promptly repair damage caused to adjacent facilities by demolition operation when directed by Engineer and at no additional cost to the Owner. Repairs shall be made to a condition at least equal to that which existed prior to construction.

F. Traffic Access

1. Conduct demolition and modification operations and the removal of equipment and debris to ensure minimum interference with roads, streets, walks both onsite and offsite and to ensure minimum interference with occupied or used facilities.

2. Do not close or obstruct streets, walks or other occupied or used facilities without permission from the Engineer. Furnish alternate routes around closed or obstructed traffic in access ways.

1.05 RULES AND REGULATIONS

A. The Building Code of the State of Florida, shall control the demolition, modification or alteration of the existing buildings or structures.

B. No building or structure, or any part thereof, shall be demolished until an application has been filed with the Building Inspector and a permit issued. The fee for this permit shall be the Contractor's responsibility.

1.06 DISPOSAL OF MATERIAL

A. Salvageable material and equipment listed hereinafter shall become the property of the Owner. Dismantle all such items to a size that can be readily handled and deliver them to a designated storage area.

B. The following materials and items of equipment shall remain the property of the Owner and stored where directed on the site. Contractor shall coordinate with Owner for any additional materials or equipment to be salvaged. Any such material damaged due to improper handling will not be accepted and the replacement value of the material deducted from the payment to the Contractor.

1. All valves greater than 8-in diameter.

C. All other material and items of equipment shall become the Contractor's property and must be removed from the site.

D. The storage or sale of removed items on the site will not be allowed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. All materials and equipment removed from existing work shall become the property of the Contractor, except for those which the Owner has identified and marked for his/her use. All materials and equipment marked by the Owner to remain shall be carefully removed, so as not to be damaged, cleaned and stored on or adjacent to the site in a protected place specified by the Engineer or loaded onto trucks provided by the Owner.

B. Dispose of all demolition materials, equipment, debris and all other items not marked by the Owner to remain, off the site and in conformance with all existing applicable laws and regulations.

C. Pollution Controls

1. Use water sprinkling, temporary enclosures and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.
   a. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding and pollution.

b. Clean adjacent structures, facilities, and improvements of dust, dirt and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the work.

3.02 MECHANICAL REMOVALS

A. Mechanical removals shall consist of dismantling and removing of existing piping, pumps, motors, equipment and other appurtenances as specified, shown, or required for the completion of the work. It shall include cutting, capping, and plugging as required, except that the cutting of existing piping for the purpose of making connections thereto will be included under Division 15.

B. Existing process, water, chemical, gas, fuel oil and other piping not required for the new work shall be removed where shown or where it will interfere with new work. Piping not indicated to be removed or which does not interfere with new work shall be removed to the nearest solid support, capped and left in place. Chemical and fuel lines and tanks shall be purged and made safe prior to removal or capping. Where piping that is to be removed passes through existing walls, it shall be cut off and properly capped on each side of the wall.

C. When underground piping is to be altered or removed, the remaining piping shall be properly capped. Abandoned underground piping may be left in place unless it interferes with new work or is shown or specified to be removed.

D. Waste and vent piping shall be removed to points shown. Pipe shall be plugged with cleanouts and plugs. Where vent stacks pass through an existing roof that is to remain, they shall be removed and the hole in the roof properly patched and made watertight.

E. Any changes to potable water piping and other plumbing system work shall be made in conformance with all applicable codes and under the same requirements as other underground piping. All portions of the potable water system that have been altered or opened shall be pressure tested and disinfected in accordance with Section 01445 and local codes. Other plumbing piping shall be pressure tested only.

3.03 ELECTRICAL REMOVALS

A. Electrical removals shall consist of the removal of existing transformers, distribution switchboards, control panels, motors, conduits and wires, poles and overhead wiring, panelboards, lighting fixtures and miscellaneous electrical equipment all as shown on the Drawings, specified herein, or required to perform the work.

B. All existing electrical equipment and fixtures to be removed shall be removed with such care as may be required to prevent unnecessary damage, to keep existing systems in operation and to maintain the integrity of the grounding systems.

C. Conduits and wires shall be abandoned or removed where shown. All wires in abandoned conduits shall be removed, salvaged and stored. Abandoned conduits concealed in floor or ceiling slabs or in walls, shall be cut flush with the slab or wall at the point of entrance. The conduits shall be suitably plugged and the area repaired in a flush, smooth and approved manner. Exposed conduits and their supports shall be disassembled and removed from the site. Repair all areas of work to prevent rust spots on exposed surfaces.

D. Where shown or otherwise required, wiring in the underground duct system shall be removed. All such wiring shall be salvaged and stored as specified. Verify the function of all wiring before disconnection and removing it. Ducts which are not to be reused shall be plugged where they enter buildings and made watertight.

E. Where shown, direct-burial cable shall be abandoned. Such cable shall be disconnected at both ends of the run. Where it enters a building or structure the cable shall be cut back to the point of entrance. All opening in buildings for entrance of abandoned direct-burial cable shall be patched and made watertight.

F. Poles and overhead wiring shall be abandoned as shown and specified. Existing substation and poles owned by the power company will be removed by the power company. Poles not owned by the power company shall be completely removed from the site. The overhead wires shall be salvaged and stored. Perform this work after the proposed service has been completed and energized, and in accordance with the approved schedule.

G. Lighting fixtures shall be removed or relocated as shown. Fixtures not relocated shall be removed from the site. Relocated fixtures shall be carefully removed from their present location and rehung where shown.

H. Wall switches, receptacles, starters and other miscellaneous electrical equipment, shall be removed and disposed of off the site as required. Care shall be taken in removing all equipment so as to minimize damage to architectural and structural members. Any damage incurred shall be repaired.

3.04 CLEAN-UP

A. Remove from the site all debris resulting from the demolition operations as it accumulates. Upon completion of the work, all materials, equipment, waste and debris of every sort shall be removed and premises shall be left, clean, neat and orderly.

END OF SECTION

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SECTION 02100
SITE PREPARATION

PART 1 GENERAL

1.01 SITE PREPARATION, CLEAN UP, AND RESTORATION

A. As specified in the JEA Water and Wastewater Standards (January 2020 or latest), Site Preparation, Clean Up and Restoration – Section 406.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 02140
DEWATERING

PART 1 GENERAL

1.01 RELATED WORK

A. Submittals are included in Section 01300.

B. Site preparation is included in JEA's Water and Wastewater Manual, Section 406 – Site Preparation, Cleanup and Restoration, and Section 02100.

C. Excavation and Earthwork are included in JEA's Water and Wastewater Standards Manual, Section 408 – Excavation and Earthwork, and Section 02200.

D. Trenching, Backfilling and Compaction is included in JEA's Water and Wastewater Standards Manual, Section 408- Excavation and Earthwork, and Section 02221.

E. Erosion and sedimentation control are included in Section 02276.

F. Granular Materials are included in Section 02230.

G. Seeding is included in JEA's Water and Wastewater Manual Section 441 – Grassing, and Section 02932.

H. Paving is included in JEA's Water and Wastewater Manual Section 490 - Paving

1.02 SCOPE OF WORK

A. The Contractor shall design, furnish, install, operate, monitor, maintain and remove a temporary dewatering system as required and lower and control water levels at least 2 feet below subgrades of excavations and to permit construction to proceed in-the-dry.

B. The Contractor shall furnish, maintain and remove temporary surface water control measures adequate to drain and remove surface water entering excavations.

C. The Contractor shall retain the services of a professional engineer registered in the State of Florida to prepare dewatering and drainage system designs and submittals described herein.

D. Work shall include the design, equipment, materials, installation, protection, and monitoring of geotechnical instrumentation required to monitor the performance of the dewatering and drainage system as required herein.

E. The Contractor shall collect and properly dispose of all discharge water from the dewatering and drainage systems in accordance with all Federal, State and local agency requirements.

F. The Contractor shall obtain and pay for all permits required for temporary dewatering and drainage systems. Original permits shall be prominently displayed on the site prior to constructing dewatering and drainage systems.

G. The Contractor shall repair damage caused by dewatering and drainage system operations.

H. The Contractor shall perform all work in accordance with current applicable regulations and codes of all Federal, State and local agencies.

1.03 SUBMITTALS

A. The Contractor shall submit, in accordance with Section 01300, detailed plans of the proposed dewatering methods. Dewatering and drainage system designs shall be prepared by a Professional Engineer licensed in the State of Florida, and retained by the Contractor, and having a minimum of five (5) years of professional experience in the design and construction of dewatering and drainage systems.

B. The plan shall include a description of the proposed dewatering system and include the proposed installation methods to be used for dewatering and drainage system elements and for observation wells. The plan shall include equipment, drilling methods, hole sizes, filter sand placement techniques, sealing materials, development techniques, the number and location of dewatering points and observations wells, etc. Include the dewatering system design calculations in the plan.

C. Submittal will be for information only. The Contractor shall remain responsible for adequacy and safety of construction means, methods and techniques. The Contractor shall not proceed with dewatering until the plan is approved by the Engineer.

D. The Contractor shall coordinate dewatering and drainage submittals with the excavation and support of excavation submittals. The submittal shall show the areas and depths of excavation to be dewatered. Sheet piles may be used for the advantage for reducing groundwater flow into the excavation if they can be embedded in confining or semi-confining layer(s). The plan shall also include detailed plans for settlement monitoring of existing structures within 150 feet of dewatering activities before and during construction, and provisions to address settlement of existing structures, should it occur, resulting from dewatering activities.

E. The Contractor shall not proceed with any excavation or dewatering activities until the dewatering submittals have been provided to and approved by the ENGINEER and permits have been obtained.

1.04 DESIGN AND PERFORMANCE RESPONSIBILITY

A. The Contractor is responsible for the proper design and implementation of methods for controlling surface water and groundwater.

B. The primary purpose of the groundwater control system is to preserve the natural undisturbed condition of the subgrade soils in the areas of the proposed excavations. Prior to excavation, the Contractor shall lower the groundwater to at least 2 feet below the lowest excavation subgrade elevation. Additional groundwater lowering may be necessary beyond the 2-ft requirement, depending on construction methods and equipment used and the prevailing groundwater and soil conditions. The Contractor is responsible for lowering the groundwater as necessary to complete construction in accordance with the plans and specifications at no additional cost to the Owner.

C. The Contractor shall be responsible for damage to properties, buildings or structures, sewers and other utility installations, pavements and work that may result from dewatering of surface water control operations.

D. Design review and field monitoring activities by the Owner or of the Engineer shall not relieve the Contractor of his/her responsibilities for the work.

1.05 DEFINITIONS

A. Where the phrase "in-the-dry" is used in this Section, it shall be defined as an excavation subgrade where the groundwater level has been lowered to at least 2 feet below the lowest level of the excavation, is stable with no ponded water, mud, or muck, is able to support construction equipment without rutting or disturbance and is suitable for the placement and compaction of fill material, pipe or concrete foundations.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pipe for observation wells, if required, shall consist of minimum 2-in I.D., Schedule 40 PVC pipe and machine slotted PVC wellpoints, maximum slot size 0.0.010-in.

B. The Contractor shall provide piping, pumping equipment and all other materials required to provide control of surface water and groundwater in excavation, and equipment provided shall be suitable for the intended purpose.

C. The Contractor shall maintain at all sites standby pumping systems and a source of standby power.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Remove and control water during periods when necessary to properly accomplish Work.

3.02 SURFACE WATER CONTROL

A Remove surface runoff controls when no longer needed.

3.03 DEWATERING SYSTEMS

A. Provide, operate, and maintain dewatering systems of sufficient size and capacity to permit excavation and subsequent construction in dry and to lower and maintain groundwater level a minimum of 2 feet below the lowest point of excavation. Continuously maintain excavations free of water, regardless of source, until backfilled to final grade.

B. For excavations related to pipe installations, lift station, sewer, etc., dewatering systems shall include wells or well points, and other equipment and appurtenances installed outside limits of excavations and sufficiently below lowest point of excavation, or to maintain specified groundwater elevation.

C. Design and Operate Dewatering Systems:

1. To prevent loss of ground as water is removed.

2. To avoid inducing settlement or damage to existing facilities, completed work, or adjacent property.

3. To relieve artesian pressures and resultant uplift of excavation bottom.

D. Provide sufficient redundancy in each system to keep excavation free of water in event of component failure.

E. Provide 100 percent emergency power backup with automatic startup and switchover in event of electrical power failure.

F. Provide supplemental ditches and sumps only as necessary to collect water from local seeps. Do not use ditches and sumps as primary means of dewatering.

3.04 DISPOSAL OF WATER

A. Contractor shall obtain discharge permit for water disposal from authorities having jurisdiction prior to commencement of work.

B. Treat water collected by dewatering operations, as required by regulatory agencies, prior to discharge.

C. Discharge water as required by discharge permit and in manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed Work, or adjacent property.

D. Remove solids from treatment facilities and perform other maintenance of treatment facilities as necessary to maintain their efficiency.

3.05 PROTECTION OF PROPERTY

A. Make assessment of potential for dewatering induced settlement. Provide and operate devices or systems, including but not limited to reinjection wells, infiltration trenches and cutoff walls, necessary to prevent damage to existing facilities, completed Work, and adjacent property.

B. Securely support existing facilities, completed Work, and adjacent property vulnerable to settlement due to dewatering operations. Support shall include, but not be limited to, bracing, underpinning, or compaction grouting.

END OF SECTION

SECTION 02200
EXCAVATION AND EARTHWORK

PART 1 GENERAL

1.01 SITE EXCAVATION AND EARTHWORK

A. As specified in the JEA Water and Wastewater Standards (January 2020 or latest), Excavation and Earthwork – Section 408.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 02202
SUBGRADE PREPARATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes, except as elsewhere provided, subgrade preparation for under and around piping, structures, concrete slabs, driveways, and sidewalks.

1.02 REFERENCES

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

1. ASTM International (ASTM):
   a. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3 (600 kN-m/m3)).
   b. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
   c. JEA Water and Wastewater Standards (January 2015 or latest), Excavation and Earthwork – Section 408, and supplemented herein

1.03 DEFINITIONS

A. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.

B. Subgrade: Layer of existing soil after completion of clearing, grubbing, scalping of topsoil prior to placement of fill, roadway structure or base for floor slab.

C. Proof-Rolling: Testing of subgrade by rolling with loaded dump truck to locate unforeseen soft areas or unsuitable surface or near-surface soils under the supervision of the Contractor's Geotechnical Engineer.

1.04 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Sections 02100, Site Preparation; and 02200, Excavation and Earthwork, prior to subgrade preparation.

1.05 QUALITY ASSURANCE

A. Notify Engineer at least 48 hours in advance when subgrade is ready for compaction or proof-rolling or whenever compaction or proof-rolling is resumed after a period of extended inactivity.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Keep subgrade free of water, debris, and foreign matter during compaction or proof-rolling.

B. Bring subgrade to proper grade and cross-section and uniformly compact surface.

C. Do not use sections of prepared ground surface as haul roads. Protect prepared subgrade from traffic. A temporary construction roadway shall be constructed as shown on the Project Drawings.

D. Maintain prepared ground surface in finished condition until next course is placed.

E. Once final lift of subgrade is compacted, no further trenching shall be allowed for utilities or other purposes.

F. Bearing Value Requirement: The completed subgrade shall be constructed to obtain a minimum Limerock Bearing Ratio (LBR) shown in the Drawings and Specifications. The Contractor shall obtain and submit test results from an approved independent testing laboratory showing results.

3.02 COMPACTION

A. Under Earthfill: Minimum of three passes with a vibratory roller having a dynamic force of 10 tons. Compact upper 24 inches to a minimum of 95 percent compaction, as determined in accordance with ASTM D1557.

B. Under Pavement Structure, concrete pavement, Floor Slabs On Grade, or Granular Fill Under Structures: Proof roll the subgrade with at least 15 overlapping passes using a vibratory roller having a minimum dynamic force of 10 tons. After proof rolling, compact the upper 12 inches to minimum 98 percent of the Modified Proctor maximum dry density (ASTM D1557). Densities should be uniformly obtained within each lift of structural fill or backfill.

3.03 MOISTURE CONDITIONING

A. The Contractor shall be responsible to moisture condition subgrade as necessary.

3.04 TESTING

A. The Contractor shall retain an independent soil testing company to determine in-place density and moisture conditions. Testing results shall be provide to the Owner and Engineer within 24 hours of test.

B. One test per every 2,000 square feet on every lift of subgrade; or one density test per lift, whichever requires more tests.

C. Per JEA Standard Specifications, a minimum of one test per 1,000 lineal feet of roadway center line for each type of soil of completed subgrade.

D. Maintenance of completed subgrade shall be in accordance with JEA Standard Specifications. At a minimum, the Contractor shall maintain it free from ruts, depressions and any damage resulting from adverse weather conditions or from the hauling or handling of materials, equipment, tools, etc. It shall be the Contractor’s responsibility to maintain the required density until the subsequent base or pavement is in-place.

3.05 CORRECTION

A. Soft or Loose Subgrade:

1. Moisture condition and recompact, or

2. Over excavate as specified in Section 02200, Excavation and Earthwork, and replace with suitable soil.

B. Unsuitable Material as defined in JEA Standard Specifications, Section 408: Over excavate as specified in Section 02200, Excavation and Earthwork, and replace with suitable material from the excavation Fill and Backfill and recompact to acceptable compaction standards.

END OF SECTION

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SECTION 02210
SITE GRADING

PART 1 GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall perform grading Work within the limits, elevations and grades indicated on the Drawings and as specified herein.

1.02 QUALITY CONTROL

A. The site shall be graded to the required elevations. Spot elevations are shown on the Drawings and the finished surfaces shall be uniformly sloped between these locations.

B. Suitable excavated material shall be used in the formation of embankments as shown on the Drawings. The Contractor shall provide all additional fill material required to complete the embankments.

PART 2 PRODUCTS

2.01 FILL

A. Suitable fill material shall be in accordance with Structural Fill material specified in Section 02230.All fill material shall be provided by the Contractor from any excess suitable on-site material or from offsite sources, borrow areas or other sources for this material all be reviewed by the Engineer prior to use. The Contractor must determine the volume of material required for the site.

PART 3 EXECUTION

3.01 GRADING AND COMPACTION

A. Fill material shall be placed in lifts not to exceed 12-inches and compacted to a density of not less than 95 percent of maximum density at optimum moisture as determined by ASTM D 1557 (98% under structures plus a margin of 10 feet). Fill material shall be within plus or minus 2 percentage points of optimum moisture content. The minimum density acceptable at any location within the pavement subgrade shall be as shown on the plans.

3.02 FINE GRADING

A. After structures, bases and pavements are completed and the yard piping trenches backfilled, the disturbed areas of the site shall be fine graded. All construction debris, regardless of size, shall be removed. The completed surface shall be shaped and sloped to drain away from the structures. The completed surface shall be within 0.1 foot of the elevations shown on the Drawings, unless otherwise directed by the Engineer. Minor adjustments to line and grade may be required as the work progresses in order to satisfy field conditions.

END OF SECTION

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SECTION 02221
TRENCHING, BACKFILLING, AND COMPACTION

PART 1 GENERAL

1.01 TRENCH EXCAVATION AND BACKFILL

A. As specified in the JEA Water and Wastewater Standards (January 2020 or latest), Excavation and Earthwork – Section 408.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 02230
GRANULAR FILL MATERIAL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install granular fill materials as shown on the Drawings and as specified herein. Associated work includes testing, sample collection, excavation, loading, shipping, delivering, stockpiling, placement and installation of granular fill materials.

1.02 RELATED WORK

A. Dewatering and Drainage is included in Section 02140

B. Earthwork is included in Section 02200.

C. Trenching, Backfilling and Compaction is included in Section 02221.

D. Asphaltic and Rigid Concrete Pavement is included in Section 02510 and 02520.

E. Erosion and Sedimentation Control is included in Section 02276.

F. Sodding and Seeding is included in Section 02932.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, complete product data for materials specified in this Section.

1.04 REFERENCE STANDARDS

A. American Society of Testing and Materials (ASTM)

1. ASTM D422 - Standard Test Method for Particle-Size Analysis of Soils.

2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

3. ASTM D2974 - Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.

4. ASTM C33 - Standard Test Method for Concrete Aggregates.

5. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

6. ASTM D698 – Test Method for Laboratory Compaction Characteristics of Soil Using Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3)(600kN-m/m3).

B. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction and Roadway Design Standards (latest editions).

1.05 QUALITY ASSURANCE

A. Laboratory Testing

1. At least 7 days prior to the placement of any backfill or fill materials, deliver a representative sample of the proposed materials weighing at least 50 lbs to the soils testing laboratory in accordance with Section 02221.

2. Engage the soils testing laboratory to perform:
   a. Grain size analyses of the samples to determine their suita-bility for use as backfill or fill material in conformance to the materials requirements specified herein.
   b. The appropriate Proctor analyses to determine the maximum dry densities required for compaction testing as specified elsewhere in the Contract Documents.

3. Test results and determinations of suitability shall be delivered to the resident project representative no later than 3 days prior to the placement of backfill or fill materials.

PART 2 PRODUCTS

2.01 MATERIAL

A. The following materials shall be suitable excavated materials, natural mineral soils obtained from off-site sources. Backfill and Fill materials shall be free of all organic material, trash, or other objectionable materials which may be compressible or which cannot be properly compacted. Soft, wet, plastic soils which may be expansive, clay soils having a natural, in-place water content in excess of 30 percent, soils containing more than 2 percent (by weight) fibrous organic materials, and soils having a plasticity index greater than 15 shall be considered unsuitable for use as backfill and fill. Backfill and fill materials shall have a maximum of 1 percent expansion when testing is performed on a sample remolded to 95 percent of maximum dry density (per ASTM D698) at 2 percent below optimum moisture content under a 100 lbs/sq ft surcharge.

B. Structural Fill shall be sand, or gravelly sand. Material shall have a plasticity index of less than 15 and shall conform to the following gradation limits:

Sieve Size	Percent Finer By Weight
2-in	100
No. 4	20 to 70
No. 40	5 to 35
No. 200	0 to 7

C. Select Fill shall conform to the requirements of common fill except that the material shall not contain any materials larger than 1-in in largest dimension.

D. Common Fill shall not contain granite blocks, broken concrete, masonry rubble, asphalt pavement, or any material larger than 6-in in any dimension. Common Fill shall have a plasticity index of less than 15 and shall conform to the following gradation limits:

Sieve Size	Percent Finer By Weight
No. 40	75
No. 200	20

E. Crushed Stone - AASHTO #57 coarse aggregate shall be sound, durable stone, angular in shape, and free of any foreign material, structural defects and chemical decay. Crushed stone shall conform to the following gradation limits:

Sieve Size	Percent Finer By Weight
11/2-in	100
1-in	95 to 100
1/2-in	25 to 80
#4	0 to 10
#8	0 to 5

F. Pea Gravel - AASHTO #89 coarse aggregate shall be screened, uniformly rounded stone, free from sand, loam, clay, excess fines and other deleterious materials. Pea Gravel shall conform to the following gradation limits:

Sieve Size	Percent Finer By Weight
1/2-in	100
3/8-in	90 to 100
No. 4	20 to 55
No. 8	5 to 30
No. 16	0 to 10
No. 50	0 to 5

G. Granular Backfill - AASHTO #67 coarse aggregate shall be hard, durable, rounded, or sub-angular particles of proper size and gradation, and shall be free from sand, loam, clay, excess fines, and other deleterious materials. Screened gravel shall be well graded within the following limits:

Sieve Size	Percent Finer By Weight
1-in	100
3/4-in	90 to 100
3/8-in	20 to 55
No. 4	0 to 10
No. 8	0 to 5

H. Sand for concrete, grout, and masonry shall conform to ASTM C33 for fine aggregate. General purpose sand shall be Select Common Fill.

I. Lean Concrete shall be ready-mix, cast-in-place concrete conforming to the requirements of Section 03300. Minimum compressive strength shall be 2,000 psi after 7 days and 2,500 psi after 28 days.

PART 3 EXECUTION

3.01 INSTALLATION

A. See other parts of the Specifications and Drawings for where these materials should be used.

B. Sand shall be utilized and placed in areas as shown, as specified, and as may be directed by the Engineer.

C. Common fill and/or select common fill shall be used and placed in areas as shown, as specified, and as may be directed by the Engineer.

END OF SECTION

SECTION 02276
TEMPORARY EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall design, provide, maintain and remove temporary erosion and sedimentation controls as necessary.

B. Temporary erosion controls may include, but are not limited to, mulching, netting, and watering, on site surfaces and spoil and borrow are surfaces and providing interceptor ditches at ends of berms and at those locations which will provide that erosion during construction will be either eliminated or maintained within acceptable limits as established by Owner.

C. Temporary sedimentation controls include, but are not limited to, silt dams, traps, barriers and appurtenances at the foot of sloped surfaces which will provide that sedimentation pollution will be either eliminated or maintained within acceptable limits as established by Owner.

D. Contractor shall provide effective temporary erosion and sediment control measures during construction or until final controls become effective.

1.02 SUBMITTALS

A. Submit schedule for temporary erosion and sedimentation control.

PART 2 PRODUCTS

2.01 EROSION CONTROL

A. Seeding and mulching, fertilization and watering shall be in accordance with Section 570-1 through 570-3 of the FDOT Specifications.

B. Netting: Fabricated of material acceptable to Owner or Engineer.

2.02 SEDIMENTATION CONTROL

A. Netting: Fabricated of material acceptable to Owner or Engineer.

B. Filter Stone: Crushed stone conforming to FDOT Specifications.

PART 3 EXECUTION

3.01 EROSION CONTROL

A. Seeding shall be in accordance with Section 570-4 through 570-5 of the FDOT Specifications. The Contractor shall insure that all seeded areas have sustained growth prior to acceptance.

B. Mulching shall be in accordance with Section 570-4.6 of the FDOT Specifications.

C. Minimum procedures for mulching and netting are:

1. Apply mulch loosely to a thickness of between 0.75 inch and 1.5 inches.

2. Apply netting over mulched areas on sloped surfaces.

3.02 SEDIMENTATION CONTROL

A. Install and maintain silt dams, traps and barriers as shown on the approved schedule. Filter stone which is lodged shall be replaced as required.

3.03 PERFORMANCE

A. Should any of the temporary erosion and sediment control measures employed by the Contractor fail to produce results which comply with the requirements of Owner, Federal, State, and local regulatory agencies, Contractor shall immediately take whatever steps are necessary to correct the deficiency at his own expense.

END OF SECTION

SECTION 02500
SURFACE RESTORATION

PART 1 GENERAL

1.01 THE REQUIREMENT

A. Items specified in this Section include repairs to landscaped and grassed areas that may be damaged or disturbed by Contractor activities.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02210 - Site Grading

1.03 SUBMITTALS

A. The Contractor shall submit submittals for review in accordance with the Section 01300 - Submittals.

1.04 DEFINITIONS

A. The phrase “DOT Specifications” shall refer to the Florida Department of Transportation Standard Specifications for Road and Bridge Construction. The DOT Specifications are referred to herein and are hereby made a part of this Contract to the extent of such references, and shall be as binding upon the Contract as though reproduced herein in their entirety.

1.05 PROTECTION OF EXISTING IMPROVEMENTS

A. The Contractor shall be responsible for the protection of all pavements and other improvements within the work area. All damage to such improvements, as a result of the Contractor's operations, beyond the limits of the work of pavement replacement shall be repaired by the Contractor at his expense.

1.06 GUARANTEE

A. The Contractor shall guarantee all trees, ground cover or shrubs planted or replanted under this Contract for a period of one year beyond acceptance of the project. In the event that any new tree, plant or shrub dies within the guarantee period, the Contractor shall be responsible for replacement in kind. In the event that a transplanted (reused) tree dies within the guarantee period, the Contractor shall be responsible for replacement in kind, except that the maximum height of any new tree shall be eight feet as measured from the ground surface, once planted, to the top of the tree. Any vegetation replaced under guarantee shall be replaced at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 REPLACEMENT TREES, GROUND COVER AND SHRUBS

A. Replacement trees, ground cover and shrubs shall be of the same type and size and sound, healthy and vigorous, well branched and densely foliated when in leaf. They shall have healthy, well developed root systems and shall be free of disease and insect pests, eggs or larvae.

2.02 MULCH

A. Mulch shall be windproof shredded eucalyptus. Mulch shall be clean, fresh, free of branches and other foreign matter. Mulch shall be used around all shrubs, ground covers and tree trunks, and placed to a minimum depth of 2 inches extending from the tree trunk outward two feet.

2.03 GRAVEL BEDS

A. Filter Fabric: Filter fabric shall be nonwoven polyester material Trevia Type 1120 as manufactured by Hoechst Fibers Industries, or equal. Fabric weight shall be 6 ounces per square yard, puncture strength maximum 40 pounds, minimum Flux 240 gallons per minute per square foot. Fabric shall be installed in accordance with the manufacturer's recommendations, with precautions taken to avoid tearing the fabric. Fabric shall be laid in strips with a minimum overlap of one foot.

B. Limerock: Limerock shall meet ASTM A57 standards and shall be prewashed. Maximum size shall be 3/4 inches. Limerock shall be carefully placed and spread on the fabric to a minimum depth of 6 inches. Final grades and locations shall be as designated on the Drawings.

PART 3 EXECUTION

3.01 GRADING AND SODDING

A. The Contractor shall regrade the work areas disturbed by his construction activities to the existing grade prior to commencement of construction.

B. Sod shall be placed on all grassed areas disturbed by construction activities, unless otherwise indicated on the Drawings. Sodding shall be in accordance with Sections 575 and 981 of the DOT Specifications. Sod placed on slopes 3:1 (H:V) or steeper shall be staked or pinned.

C. Maintenance: Sufficient watering shall be done by the Contractor to maintain adequate moisture for optimum development of the sodded areas. Sodded areas shall receive no less than 1.5 inches of water per week.

D. Repairs to Lawn Areas Disturbed by Contractor's Operations: Lawn areas damaged by Contractor's operations shall be repaired at once by proper sod bed preparation, fertilization and resodding, in accordance with these specifications. Regardless of the condition of the lawn area (weed content etc.) prior to the Contractor working in the area, all repairs shall be made with sod.

3.02 TREES, GROUND COVER AND SHRUBS

A. Excavation and Plant Holes: Plant hole excavations shall be roughly cylindrical in shape, with the side approximately vertical. Plants shall be centered in the hole. Bottoms of the holes shall be loosened at least six inches deeper than the required depth of excavation.

B. Holes for balled and burlaped plants shall be large enough to allow at least eight inches of backfill around the earth ball. For root balls over 18 inches in diameter, this dimension shall be increased to 12 inches. Where excess material has been excavated from the plant hole, the excavated material shall be disposed of as and where directed by the Engineer.

C. Setting of Plants: When lowered into the hole, the plant shall rest on a prepared hole bottom such that the roots are level with, or slightly above, the level of their previous growth and so oriented such as to present the best appearance. The Contractor, when setting plants in holes, shall make allowances for any anticipated settling of plants.

D. Palms of the sabal species may be set deeper than the depth of their original growth, provided that the specified clear trunk height is attained.

E. The backfill shall be made with planting mixture and shall be firmly rodded and watered-in, so that no air pockets remain. The quantity of water applied immediately upon planting shall be sufficient to thoroughly moisten all of the backfilled earth. Plants shall be kept in a moistened condition for the duration of the Contract.

F. Staking and Guying: Plants shall be staked in accordance with the following provisions:

1. Small Trees: For trees and shrubs of less than one-inch caliper, the size of stakes and the method of tying shall be such as to rigidly support the staked plant against damage caused by wind action or other effects. Trees larger than one inch and smaller than one and one-half inch caliper shall be staked with a two-inch stake, set at least 24 inches in the ground and extending to the crown of the plant. The plant shall be firmly fastened to the stake with two strands of 14-gauge soft wire, enclosed in rubber hose, or other approved covering. The wire shall then be nailed or stapled to the stake to prevent slippage.

2. Medium Trees: All trees, other than palm trees, larger than one and one-half inch caliper and smaller than two and one-half inch caliper shall be staked with two or more, two-inch by two-inch stakes, eight feet long, set two feet in the ground. The tree shall be midway between the stakes and held firmly in place by two strands of 12-gauge wire, applied as specified above for single stakes. The wires shall be tightened and kept tight by twisting.

3. Large Trees: All trees, other than palm trees, larger than two and one-half inch caliper, shall be braced with three or more two-inch by four-inch wood braces, toenailed to cleats which are securely banded at two pints to the palm, at a point at least six feet above the ground. The trunk shall be padded with five layers of burlap under the cleats. Braces shall be approximately equidistantly spaced and secured underground with two-inch by four-inch by 24-inch stake pads. In firm rock soils, Number 4 steel reinforcing rods or one-half inch pipe is acceptable.

4. Palm Trees: Palm trees shall be braced with three or more two-inch by four-inch wood braces, toenailed to cleats which are securely banded at two points to the palm, at a point at least six feet above the ground. The trunk shall be padded with five layers of burlap under the cleats. Braces shall be approximately equidistantly spaced and secured underground with two-inch by four-inch by 24-inch stake pads. In firm rock soils, Number 4 steel reinforcing rods or one-half inch pipe is acceptable.

G. Pruning: All broken or damaged roots shall be cut off smoothly, and the tops of all trees shall be pruned in a manner complying with standard horticultural practice. At the time pruning is completed, all remaining wood shall be alive. All cut surfaces of one inch or more in diameter, above the ground, shall be treated with an approved commercial tree paint.

H. Maintenance: Maintenance shall begin immediately after each plant is planted and shall continue until all work under this Contract has been completed and accepted by Owner. Plants shall be watered, mulched, weeded, pruned, sprayed, fertilized, cultivated and otherwise maintained and protected. Settled plants shall be reset to proper grade position, planting saucer restored and dead material removed. Guys shall be tightened and repaired.

I. Defective work shall be corrected as soon as possible after it becomes apparent. Upon completion of planting, the Contractor shall remove excess soil and debris, and repair any damage to structures, etc., resulting from planting operations.

3.03 GRAVEL BEDS

A. Clean, grade and place geotextile prior to placing gravel in gravel beds.

END OF SECTION

SECTION 02605
PRECAST MANHOLES AND STRUCTURES

PART 1 GENERAL

1.01 PRECAST MANHOLES AND STRUCTURES

A. As specified in the JEA Water and Wastewater Standards (January 2019 or latest), Wastewater Manholes – Section 427.

PART 2 PRODCUTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 02616
DUCTILE IRON PIPE AND FITTINGS (BELOW GRADE)

PART 1 GENERAL

1.01 POTABLE WATER PIPING

A. Shall be as specified in the JEA Water and Wastewater Standards (January 2020 or latest), Potable Water Piping – Section 350.

1.02 POTABLE WATER VALVES AND APPURTENANCES

A. Shall be as specified in the JEA Water and Wastewater Standards (January 2020 or latest), Water Valves and Appurtenances – Section 351.

1.03 WASTEWATER PIPING

A. Shall be as specified in the JEA Water and Wastewater Standards (January 2020 or latest), Wastewater Force Mains – Section 429.

1.04 WASTEWATER VALVES AND APPURTENANCES

A. Shall be as specified in the JEA Water and Wastewater Standards (January 2020 or latest), Wastewater Valves and Appurtenances – Section 430.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 02622
POLYVINYL CHLORIDE PRESSURE PIPE (BELOW GRADE)

PART 1 GENERAL

1.01 POLYVINYL CHLORIDE PRESSURE PIPE (BELOW GRADE)

A. Shall be as specified in the JEA Water and Wastewater Standards (January 2020 or latest), Wastewater Force Mains – Section 429.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 02640
VALVES, HYDRANTS, AND APPURTENANCES

PART 1 GENERAL

1.01 VALVES, HYDRANTS AND APPURTENANCES

A. Shall be as specified in the JEA Water and Wastewater Standards (January 2020 or latest), Water Meters, Valves and Appurtenances – Section 351.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 02668
CONNECTIONS TO AND WORK ON THE EXISTING SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials and equipment required and maintain flow in existing drains, handle existing drain flow, construct and maintain all temporary connections and bypasses and construct the permanent connections to the new system as shown on the Drawings and as directed by the Engineer.

B. Furnish all labor, materials, equipment required and plug existing pipes if required and all additional work required.

C. Should damage of any kind occur to the existing pipes, at the Contractor's own expense and as part of the work under this Item, make repairs to the satisfaction of the Engineer.

D. Notify the Engineer immediately of any discrepancies in elevations of existing drains and manholes between those shown on the Drawings and those established during construction in order that the Engineer can make the necessary modifications.

E. All work on existing system and utilities must comply with permits

1.02 RELATED WORK

A. Excavation and backfill are included in Division 2.

B. Concrete is specified in Division 3.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 HANDLING WASTEWATER FLOWS

A. Furnish all labor, equipment and materials necessary to maintain existing flows, including temporary bypasses (if required) and all pumping of drainage that may be required to prevent backing up of drains and shall immediately cart away and remove all offensive matter at Contractor's own expense.

B. Permission will not be given to overflow, bypass, pump or by any other means convey drainage to any brook, or other water course without permission of the Engineer.

C. All procedures for maintaining flows must meet the approval of the Engineer and submit to the Engineer, for approval, a detailed written plan of all methods of flow maintenance 10 days in advance of flow interruption.

3.02 MAINTAINING WATER SERVICE

A. The Contractor shall provide all labor, equipment, and materials necessary to maintain existing service connections, including temporary bypasses (if required) and all disinfection testing that

may be required to bacteriologically clear any temporary piping and shall provide assurances that repairs for interruption of service from the temporary service are available 24 hours a day/7 days a week.

B. All procedures for maintaining service must meet the approval of the Engineer and the Owner. The Contractor shall be required to submit to the Engineer, for approval, a detailed written plan of all methods of flow maintenance ten days in advance of flow interruption.

END OF SECTION

SECTION 02730
AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 REFERENCES

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

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. T11, Standard Method of Test for Materials Finer Than 75µm (No. 200) Sieve in Mineral Aggregates by Washing.
   b. T27, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates.
   c. T89, Standard Specification for Determining the Liquid Limit of Soils.
   d. T90, Standard Specification for Determining the Plastic Limit and Plasticity Index of Soils.
   e. T96, Standard Specification for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   f. T99, Standard Specification for the Moisture-Density Relations of Soils Using a 2.5 kg (5.5 pound) Rammer and a 305 mm (12 in) Drop.
   g. T180, Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18-in) Drop.
   h. T190, Standard Specification for Resistance R-Value and Expansion Pressure of Compacted Soils.
   i. T265, Standard Method of Test for Laboratory Determination of Moisture Content of Soils.
   j. T310, Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

2. ASTM International (ASTM):
   a. C88, Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
   b. D1883, Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
   c. D2419, Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
   d. D4791, Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

3. JEA Standard Specifications.

1.02 DEFINITIONS

A. Completed Course: Compacted, unyielding, free from irregularities, with smooth, tight, even surface, true to grade, line, and cross-section.

B. Completed Lift: Compacted with uniform cross-section thickness.

C. Standard Specifications: When referenced in this section, shall mean JEA Standard Specifications.

1.03 SUBMITTALS

A. Informational Submittals:

1. Certified Test Results on Source Materials: Submit copies from commercial testing laboratory 20 days prior to delivery of materials to Project showing materials meeting the physical qualities specified.

2. Certified results of in-place density tests from independent testing agency.

PART 2 PRODUCTS

2.01 BASE COURSE

A. Limerock base course shall be minimum thickness as indicated on the Drawings with a minimum Limerock Bearing Ratio (LBR) of 100 compacted to 100 percent of the Modified Proctor maximum dry density (AASHTO T-180). Beneath the limerock base course, the subgrade materials shall be stabilized to a minimum LBR of 40 compacted to 100 percent of the Modified Proctor maximum dry density (AASHTO T-180).

B. Limerock for the base course shall be classified either as Ocala Formation or a Miami Oolite Formation limerock. Clean, hard durable, pit run gravel or crushed stone graded from coarse to fine containing enough fines to bind material when compacted. The minimum of carbonates of calcium and magnesium in the limerock material shall be 70 percent. The liquid limit shall not exceed 35 and the material shall be non-plastic. Limerock shall not contain cherty or other extremely hard pieces, lumps, balls or pockets of sand or clay size material in sufficient quantity as to be detrimental to the proper bonding, finishing or strength of the limerock base.

C. Priming: The prime coat shall be applied only when the base meets the specified density requirements and the moisture content in the top half of the base does not exceed 90 percent of the optimum moisture of the base material. At the time of priming, the base shall be firm, unyielding and in such condition that no undue distortion will occur.

2.02 SOURCE QUALITY CONTROL

A. Perform tests necessary to locate acceptable source of materials meeting specified requirements.

B. Final approval of aggregate material will be based on test results of installed materials.

C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. As specified in Section 02202, Subgrade Preparation.

B. Obtain Engineer’s acceptance of subgrade before placing base course or surfacing material.

C. Do not place base course or surfacing materials on soft, muddy, subgrade.

3.02 EQUIPMENT

A. Compaction Equipment: Adequate in design and number to provide compaction and to obtain specified density for each layer.

3.03 HAULING AND SPREADING

A. Hauling Materials:

1. Transporting limerock shall be transported to the point where it is to be used, over rock previously placed if practicable, and dumped on the end of the preceding spread. Do not haul over surfacing in process of construction.

2. Loads: Of uniform capacity.

3. Maintain consistent gradation of material delivered; loads of widely varying gradations will be cause for rejection.

B. Spreading Materials:

1. At a minimum, distribute material to provide required density, depth, grade, and dimensions with allowance for subsequent lifts.

2. Produce even distribution of material upon roadway or prepared surface without segregation.

3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading. All segregated areas of fine or course rock shall be removed and replaced with properly graded rock.

3.04 CONSTRUCTION OF COURSES

A. Untreated Aggregate Base Course:

1. Maximum Completed Lift Thickness: 4 inches. The 8-inch base shall be constructed in two courses. The thickness of the first course shall be approximately 4 inches.

2. Completed Course Total Thickness: 8 inches.

3. Spread lift on preceding course to required cross-section.

4. Lightly blade and roll surface until thoroughly compacted.

5. Add keystone to achieve compaction and as required when aggregate does not compact readily due to lack of fines or natural cementing properties, as follows:
   a. Use leveling course or surfacing material as keystone.
   b. Spread evenly on top of base course, using spreader boxes or chip spreaders.
   c. Roll surface until keystone is worked into interstices of base course without excessive displacement.
   d. Continue operation until course has become thoroughly keyed, compacted, and will not creep or move under roller.

6. Blade or broom surface to maintain true line, grade, and cross-section.

3.05 ROLLING AND COMPACTION

A. Commence compaction of each layer of base after spreading operations and continue until density of 100 percent of Modified Proctor maximum density has been achieved as determined by AASHTO T180.

B. Roll each layer of material until material does not creep under roller before succeeding layer is applied. Areas that pump or rut excessively shall be undercut and replaced with structural fill materials and recompacted.

C. Commence rolling at outer edges and continue toward center; do not roll center of road first.

D. Apply water as needed to obtain specified densities.

E. Place and compact each lift to required density before succeeding lift is placed.

F. Surface Defects: Remedy by loosening and rerolling. Reroll entire area, including surrounding surface, until thoroughly compacted. If cracks appear in the base either before or after priming, the Construction Contractor shall remove the cracks by rescarifying, reshaping, adding base materials where necessary and recompacting.

G. Finished surface shall be true to grade and crown before proceeding with surfacing. Construction Contractor shall be responsible for assuring that that completed base course are maintained with no rutting or deteriorations and that the base meets all the requirements at the time the surface course is applied.

H. Thickness Measurement: Thickness of the base shall be measured at intervals of not more than 200 feet. Measurements shall be taken at various points on the cross section, through holes not less than 3 inches in diameter. Areas that do not meet the required thickness as called for in the plans shall be scarified and rock added to a distance of 100 feet in each direction from the edge of the deficient area. The affected area shall then be brought to the required state of compaction and to the required thickness and cross section.

3.06 SURFACE TOLERANCES

A. Blade or otherwise work surfacing as necessary to maintain grade and cross- section at all times, and to keep surface smooth and thoroughly compacted.

B. Finished Surface of Untreated Aggregate Base: Within plus or minus 0.04 foot of grade shown at any individual point.

3.07 FIELD QUALITY CONTROL

A. In-Place Density Tests:

1. Provide testing laboratory at least 24 hours advance notification prior to testing.

2. Show proof that areas meet specified requirements before identifying density test locations.

3. Density Requirements: As soon as proper conditions of moisture are attained the material shall be compacted to a density not less than 98 percent of the maximum density as determined by AASHTO T-180.

4. Refer to Table 2 for minimum sampling and testing requirements for aggregate base course and surfacing.

Table 2
Minimum Sampling and Testing Requirements

Property	Test Method	Frequency	Sampling Point
Gradation	AASHTO T11 and AASHTO T27	One sample every 500 tons but at least every 4 hours of production	Roadbed after processing
Moisture Density (Maximum Density)	AASHTO T180 Method D	One test for every aggregate grading produced	Production output or stockpile
In-Place Density and Moisture Content	AASHTO T310 and AASHTO T265 for moisture content	One for each 500 ton but at least every 10,000 sq ft of area	In-place completed, compacted area

3.08 CLEANING

A. Remove excess material from the Work area. Clean stockpile and staging areas of all excess aggregate.

END OF SECTION

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SECTION 02750
CONCRETE PAVEMENT

PART 1 GENERAL

1.01 CONCRETE PAVEMENT

A. As specified in the latest Florida Department of Transportation Specifications, Cement Concrete Pavement – Section 350.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 02830
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 CHAIN LINK FENCES

A. Fencing and gates shall be as specified in the JEA Water and Wastewater Standards (January 2019 or latest), Fencing – Section 492.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 02932
SODDING AND SEEDING

PART 1 GENERAL

1.01 SODDING

A. Grassing and Sodding shall be as specified in the JEA Water and Wastewater Standards (January 2020 or latest), Grassing – Section 441.

1.02 SEEDING

A. Seeding shall be as specified in the JEA Water and Wastewater Standards (January 2020 or latest), Grassing – Section 441.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 03100
CONCRETE FORMWORK

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and design, install and remove formwork for cast-in-place concrete complete as shown on the Drawings and as specified herein.

B. Secure to forms or set for embedment all miscellaneous metal items, sleeves, reglets, anchor bolts, inserts, waterstops, and other items furnished under other Sections and required to be cast into concrete.

1.02 RELATED WORK

A. Concrete reinforcement is included in Section 03200.

B. Concrete joints and joint accessories are included in Section 03250.

C. Cast-in-place concrete is included in Section 03300.

D. Concrete finishes are included in Section 03350.

E. Grout is included in Section 03600.

F. Concrete electrical raceway encasement is included in Section 03800

G. Miscellaneous metals are furnished under Sections 05500.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:

1. Form release agent

2. Form ties

B. Review will be for appearance, performance and strength of the completed structure only. Approval by the Engineer will not relieve the Contractor of responsibility for the strength, safety or correctness of methods used, the adequacy of equipment, or from carrying out the work as shown on the Drawings and as specified herein.

C. Certificates

1. Submit completed PE Certification Form for design of formwork in accordance with Section 01300. The PE Certification Form shall be completed and stamped by a professional engineer registered in the State of Florida.

1.04 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1. ACI 301 - Specifications for Structural Concrete

2. ACI 318 - Building Code Requirements for Structural Concrete

3. ACI 347 - Guide to Formwork for Concrete

B. APA - The Engineered Wood Association (APA)

1. Material grades and designations as specified

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.01 GENERAL

A. The usage of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configurations desired.

2.02 MATERIALS

A. Forms, General

1. Make forms for cast-in-place concrete of wood, steel or other approved materials, except as specified in Paragraphs 2.02B and 2.02C.2. Construct wood forms of sound lumber or plywood free from knotholes and loose knots. Construct steel forms to produce surfaces equivalent in smoothness and appearance to those produced by new plywood panels. Design and construct all forms to provide a flat, uniform concrete surface requiring no grinding, repairs, or finishing except as specified in Section 03350.

B. Forms for Exposed Concrete

1. Make forms for all exposed and non-submerged exterior and interior concrete of new and unused Plyform exterior grade plywood panels manufactured in compliance with the APA and bearing the APA trademark. Provide B grade or better veneer on all faces to be in contact with concrete. Design and construct all forms to provide a flat, uniform concrete surface requiring no grinding, repairs, or finishing except as specified in Section 03350.

2. Provide rigid forms that will not deflect, move, or leak. Design forms to withstand the high hydraulic pressures resulting from rapid filling of the forms and heavy high frequency vibration of the concrete. Limit deflection to 1/400 of each component span. Lay out form joints in a uniform pattern.

3. Dress and match boards. Sand plywood smooth and fit adjacent panels with tight joints. Tape, gasket, plug, and/or caulk all joints and gaps in forms to provide watertight joints

that will withstand placing pressures without exceeding specified deflection limit or creating surface patterns.

4. Provide ¾-inch chamfer on all corners unless otherwise indicated.

C. Provide rustications as indicated. Mill and plane smooth moldings for chamfers and rustications. Provide rustications and chamfer strips of nonabsorbent material, compatible with the form surface and fully sealed on all sides to prevent the loss of paste or water between the two surfaces.

D. Form Release Agent. Coat all form surfaces in contact with concrete with an effective, non-staining, non-residual, water based, bond-breaking form coating unless otherwise indicated or specified. Form release agent shall not impair the bond of sealant, dampproofing or other coatings.

E. Form Ties

1. Coil and Wire Ties: Provide ties manufactured so that, after removal of the projecting part, no metal remains within 1-1/2-in of the face of the concrete. The part of the tie to be removed shall be at least 1/2-in diameter or be provided with a plastic or wooden cone at least 1/2-in diameter and 1-1/2-in long. Provide cone washer type form ties in concrete exposed to view.

2. Flat Bar Ties for Panel Forms: Provide ties that have plastic or rubber inserts with a minimum depth of 1-1/2-in and manufactured to permit patching of the tie hole.

3. Do not use common wire for form ties.

4. Alternate form ties consisting of tapered through-bolts at least 1-in in diameter at smallest end or through-bolts that utilize a removable tapered sleeve of the same minimum size may be used. Install in forms so that large end is, where applicable, on the liquid or backfilled side of the wall. Clean, fill and seal form tie hole with non-shrink cement grout to provide watertight form tie holes and make all repairs needed to make watertight.

PART 3 EXECUTION

3.01 GENERAL

A. Design, furnish, erect, shore, brace, and maintain formwork for all cast-in-place concrete including sides of footings in accordance with ACI 301, ACI 318, and ACI 347. Construct and place forms to provide concrete of the shape, lines, dimensions and appearance indicated.

B. Place molding, bevels, or other types of chamfer strips to produce blockouts, rustications, or chamfers as indicated on the Drawings or as specified herein. Provide chamfer strips at horizontal and vertical projecting corners to produce a 3/4-in chamfer. Provide rectangular moldings at locations requiring sealants where shown on the Drawings or specified herein.

C. Provide rigid forms to withstand construction loads and vibration and meeting specified deflection limits and tolerances. Construct forms so that the concrete will not be damaged by form removal.

D. Accessories which remain embedded in the concrete after formwork removal will be subject to the approval of the Engineer. Permanent embedments shall have sufficient concrete cover or be of suitable materials for the exposure condition as approved by the Engineer. Remove unsatisfactory embedded items at no additional cost to the Owner.

3.02 FORM TOLERANCES

A. Design, construct and surface forms in accordance with ACI 347 and meet the following additional requirements for the specified finishes.

B. Forms for Exposed Concrete: Edges of all form panels in contact with concrete flush within 1/8-in and forms for plane surfaces plane within 1/8-in in 4-ft. Maximum deviation of the finished surface at any point not to exceed 1/4-in from the intended surface indicated. Arrange form panels symmetrically and orderly to minimize the number of seams. Provide tight forms to prevent the passage of mortar, water, and grout.

C. Formed Surface Buried or Not Exposed to View: Class "C" Surface per ACI 347.

D. Formed Surface Including Mass Concrete, Pipe Encasement, Electrical Raceway Encasement and Other Similar Installations: No minimum requirements for surface irregularities and surface alignment. The overall dimensions of the concrete shall be plus or minus 1-in from the intended surface indicated.

3.03 FORM PREPARATION

A. Clean, repair, remove projecting nails and fill holes, and smooth protrusions on all form surfaces to be in contact with concrete before reuse. Do not reuse forms for exposed concrete unless a "like new" condition of the form is maintained that will produce surfaces equivalent in smoothness and appearance to those produced by new plywood panels.

B. Coat wood forms in contact with concrete using form release agent prior to form installation.

C. Clean steel forms by sandblasting or other method to remove mill scale and other ferrous deposits from the contact surface of all forms. Coat steel forms in contact with concrete using form release agent prior to form installation.

3.04 REMOVAL OF FORMS

A. Be responsible for all damage resulting from removal of forms and make repairs at no additional cost to the Owner. Leave in place forms and shoring for horizontal structural members in accordance with ACI 301 and ACI 347. Conform to the requirements for form removal specified in Section 03300.

3.05 INSPECTION

A. Notify the Engineer when the forms are complete and ready for inspection, at least six working hours prior to the proposed concrete placement. The Engineer will inspect the forms to ensure overall conformance with the contract documents.

B. Failure of the forms to comply with the requirements specified, or to produce concrete complying with requirements specified shall be grounds for rejection of that portion of the

concrete work. Repair or replace rejected work as directed by the Engineer at no additional cost to the Owner. Such repair or replacement shall be subject to the requirements of these Specifications and approval of the Engineer.

END OF SECTION

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SECTION 03200
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install all concrete reinforcement complete as shown on the Drawings and as specified herein, including dowels embedded into concrete for masonry.

1.02 RELATED WORK

A. Concrete formwork is included in Section 03100.

B. Concrete joints and joint accessories are included in Section 03250.

C. Cast-in-place concrete is included in Section 03300.

D. Grout is included in Section 03600.

E. Concrete electrical raceway encasement is included in Section 03800.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300 shop drawings and product data showing materials of construction and details of installation for:

1. Reinforcing steel. Drawings for fabrication, bending, and placement of concrete reinforcement shall conform to the recommendations of ACI 315 for placement drawings and as specified herein.
    a. Placement drawings. For walls, show elevations from the outside, looking towards the structure, at a minimum scale of 1/4 inch to one foot. For slabs, show top and bottom reinforcement on separate plan views, as needed for clarity. For beams and columns, show schedules with sections and/or elevations and stirrup/tie spacing. Show additional reinforcement around openings, at corners and at other locations indicated, diagrams of bent bars, arrangements and assemblies, all as required for the fabrication and placement of concrete reinforcement. Reference bars to the same identification marks shown on the bar bending details. Identify bars to have special coatings and/or to be of special steel or special yield strength.
    b. Bar bending details. Reference bars to the same identification marks shown on the placement drawings. Identify bars to have special coatings and/or to be of special steel or special yield strength.

B. Submit, in accordance with Section 01300, Test Reports of each of the following items.

1. Certified copy of mill test on each heat of each steel proposed for use showing the physical properties of the steel and the chemical analysis.

2. Welder's certification in accordance with AWS D1.4 when welding of reinforcement is indicated, specified, or approved.

1.04 REFERENCE STANDARDS

A. ASTM International (ASTM):

1. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

2. ASTM A704 - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.

3. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

4. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

B. American Concrete Institute (ACI):

1. ACI 301 - Specifications for Structural Concrete.

2. ACI 315 - Details and Detailing of Concrete Reinforcement.

3. ACI 318 - Building Code Requirements for Structural Concrete.

4. SP-66 (ACI 315) ACI Detailing Manual.

C. Concrete Reinforcing Steel Institute (CRSI):

1. Manual of Standard Practice.

D. American Welding Society (AWS):

1. AWS D1.4 Structural Welding Code - Reinforcing Steel.

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 DELIVERY, HANDLING AND STORAGE

A. Provide reinforcement free from mill scale, rust, mud, dirt, grease, oil, ice, or other foreign matter.

B. Ship and store reinforcement with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted placement drawings. Tags for ASTM A706 reinforcing and for ASTM A615 reinforcing meeting the requirements of Paragraph 2.01, C.1 shall indicate that the reinforcing is weldable.

C. Store reinforcement off the ground, protect from moisture and keep free from rust, mud, dirt, grease, oil, ice, or other injurious contaminants.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide new materials of domestic manufacture complying with the following material specifications.

B. Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60 deformed bars.

C. Deformed Concrete Reinforcing Bars required on the Drawings to be Field Bent or Welded: ASTM A706.

1. ASTM A615, Grade 60 may be substituted for ASTM A706 subject to the following:
   a. The actual yield strength of the reinforcing steel based on mill tests does not exceed the specified yield strength by more than 18,000 psi. Retests not to exceed this value by more than an additional 3,000 psi.
   b. The ratio of the actual ultimate tensile strength to the actual tensile yield strength of the reinforcement is not less than 1.25.
   c. The carbon equivalency (CE) is 0.55 percent or less.

D. Welded Steel Wire Fabric: ASTM A1064.

E. Welded Deformed Steel Wire Fabric: ASTM A1064.

F. Reinforcing Steel Accessories:

1. Plastic Protected Wire Bar Supports: CRSI Bar Supports, Class 1 - Maximum Protection.

2. Stainless Steel Protected Wire Bar Supports: CRSI Bar Supports, Class 2 - Moderate Protection with legs made wholly from stainless steel wire.

3. Precast Concrete Bar Supports: CRSI Bar Supports, Precast Concrete Bar Supports. Precast concrete blocks that have equal or greater strength than the surrounding concrete.

4. Tie Wires for Reinforcement: 16-gauge or heavier black annealed wire.

2.02 FABRICATION

A. Comply with the CRSI Manual of Standard Practice.

B. Bend bars cold. Do not straighten or rebend bars.

C. Bend bars around a revolving collar having a diameter not less than that recommended by the CRSI or ACI 318.

D. Saw cut bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded. Terminate saw cut ends in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with the CRSI Manual of Standard Practice for surface condition, bending, spacing and tolerances of placement for reinforcement. Provide the amount of reinforcing indicated at the spacing and clearances indicated on the Drawings.

B. Determine clear concrete cover based on exposure to the environment. Unless indicated otherwise on the Drawings, provide the following minimum clear concrete cover over reinforcement:

1. Concrete cast against and permanently exposed to earth: 3 inches.

2. Concrete exposed to soil, water, sewage, sludge and/or weather:
   a. Slabs (top and bottom cover), walls: 2 inches.
   b. Beams and columns (ties, spirals and stirrups): 2 inches.

3. Concrete not exposed to soil, water, sewage, sludge and/or weather:
   a. Slabs (top and bottom cover), walls, joists, shells and folded plate members: 1 inch.
   b. Beams and columns (ties, spirals and stirrups): 1-1/2 inches.

C. Coat uncoated reinforcement which will be exposed for more than 60 days after placement with a heavy coat of neat cement slurry.

D. Do not weld reinforcing steel bars either during fabrication or erection unless indicated on the Drawings or as specified herein, or unless prior written approval has been obtained from the Engineer. Remove immediately all bars that have been welded, including tack welds, without such approval. Comply with AWS D1.4 when welding of reinforcement is shown on the Drawings, specified, or approved.

E. Reinforcing steel interfering with the location of other reinforcing steel, piping, conduits or embedded items may be moved within the specified tolerances or one bar diameter, whichever is greater. Obtain the approval of the Engineer if greater displacement of bars to avoid interference is needed. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior approval of the Engineer.

F. Secure, support and tie reinforcing steel to prevent movement during concrete placement. Secure dowels in place before placing concrete.

G. Do not field bend reinforcing unless indicated or specifically authorized in writing by the Engineer. Cold-bend bars indicated or authorized to be field bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. Replace, repair by cutting out damaged bars and splicing new bars using coupling sleeves filled with ferrous material, or otherwise repair damaged reinforcing bars as directed by the Engineer at no additional cost to the Owner. Do not bend reinforcement after it is embedded in concrete unless indicated on the Drawings.

3.02 REINFORCEMENT AROUND OPENINGS

A. Provide additional reinforcing steel on each side of the opening equivalent to one half of the cross-sectional area of the reinforcing steel interrupted by the opening unless indicated otherwise on the Drawings. Extend each end of each bar beyond the edge of the opening or penetration by the tension development length for that bar size.

3.03 SPLICING OF REINFORCEMENT

A. Provide splices as shown on the Drawings and as specified herein.

B. Splices Indicated as Compression Splices: Provide lap splice of 30 bar diameters, but not less than 12 inches unless indicated otherwise on the Drawings. Base the lap splice length for column vertical bars on the bar size in the column above.

C. All Other Splices: Provide tension lap splices in compliance with ACI 318. Stagger splices in adjacent bars where possible. Provide Class B tension lap splices at all locations unless otherwise indicated.

D. Lap splices in welded wire fabric in accordance with the requirements of ACI 318 but not less than 12 inches. Tie the spliced fabrics together with wire ties spaced not more than 24 inches on center and lace with wire of the same diameter as the welded wire fabric. Offset splices in adjacent widths to prevent continuous splices.

3.04 ACCESSORIES

A. Determine, provide and install accessories such as chairs, chair bars and the like to support the reinforcement providing the spacing and clearances indicated on the Drawings and prevent its displacement during the erection of the reinforcement and the placement of concrete.

B. Use precast concrete blocks where the reinforcing steel is to be supported over soil.

C. Use plastic protected bar supports or steel supports with plastic tips where the reinforcing steel is to be supported on forms for a concrete surface that will be exposed to weather, high humidity, or liquid (including bottom of slabs over liquid containing areas). Use stainless steel protected bar supports in walls, beams and elevated slabs. Use stainless steel supports or plastic tipped metal supports in all other locations unless otherwise noted on the Drawings or specified herein.

D. Provide #5 minimum size support bars. Do not reposition upper bars in a bar mat for use as support bars.

E. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

3.05 INSPECTION

A. Notify the Engineer when the reinforcing is complete and ready for inspection, at least six working hours prior to the proposed concrete placement. Do not cover reinforcing steel with concrete until the installation of the reinforcement, including the size, spacing and position of

the reinforcement has been inspected by the Engineer and the Engineer's release to proceed with the concreting has been obtained. Keep forms open until the Engineer has completed inspection of the reinforcement.

END OF SECTION

SECTION 03250
CONCRETE JOINTS AND JOINT ACCESSORIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install accessories for concrete joints complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Concrete formwork is included in Section 03100.

B. Concrete reinforcement is included in Section 03200.

C. Cast-in-place concrete is included in Section 03300.

D. Concrete finishes are included in Section 03350.

E. Under-slab vapor retarders are included in section 03390.

F. Grout is included in Section 03600.

G. Miscellaneous metals are included in Section 05500.

H. Joint sealants are included in Section 07920.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data for:

1. Premolded joint fillers: Product data including location of use, sample, catalogue cut, technical data, storage requirements, installation instructions, and conformity to ASTM standards.

2. Preformed expansion joint material: Product data including location of use, catalogue cut, dimensions, technical data, storage requirements, installation instructions, and conformity to ASTM standards.

3. Expansion joint dowels: Product data on the complete assembly including dowel material, sizes and dimensions, coatings, expansion dowel caps, installation instructions and conformity to ASTM standards.

4. Sealant: Product data including location of use, catalogue cut, technical data, storage requirements, mixing and application instructions, and conformity to ASTM standards.

B. Certifications

1. Certify that all materials used within the joint system are compatible with each other.

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM A36 - Standard Specification for Carbon Structural Steel.

2. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

3. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

4. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

5. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.05 QUALITY ASSURANCE

A. Provide services of a manufacturer's field representative of the sealant who has performed at least five projects of similar size and complexity within the last 5 years. The field representative shall be present at the work site prior to any mixing of components to instruct on mixing, application and inspection procedures and to inspect the finish of the prepared surfaces prior to application of the sealant.

B. The manufacturer's field representative shall make at least one additional visit to the site as the work progresses and shall report on each visit to the Contractor and the Engineer, advising as to whether the application is being performed in accordance with this Section and the manufacturer's printed instructions.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver products in original, unopened containers displaying the manufacturer's label showing manufacturer name, product identification and batch number.

B. Store products as recommended by the manufacturer.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials used together in a given joint shall be compatible with one another. Coordinate selection of suppliers and products to provide compatibility. Do not use asphaltic bond breakers or asphaltic joint fillers in joints receiving sealant.

2.02 MATERIALS

A. Premolded Joint Filler

1. Premolded Joint Filler – Structures: Self-expanding cork premolded joint filler conforming to ASTM D1752, Type III. Provide 1-in thickness unless otherwise indicated on the Drawings.

B. Preformed Expansion Joint Material

1. A non-extrudable watertight strip material used to fill expansion joints between structures. The material shall be capable of being compressed at least 40 percent for 70 hours at 68 degrees F and subsequently recovering at least 20 percent of its original thickness in the first 1/2 hour after unloading. Preformed expansion joint material shall be Phyzite 380 by Chase Construction Products, Albany, NY or equal.

C. Sealant

1. Provide sealant for joints in horizontal surfaces conforming to ASTM C920, Type S or M, Grade P or NS, Class 25. Provide sealant for joints in sloping and vertical surfaces conforming to ASTM C920, Type S or M, Grade NS, Class 25. Provide Use T sealant in pedestrian and vehicular traffic areas and Use NT in non-traffic areas.

PART 3 EXECUTION

3.01 INSTALLATION

A. Construction Joints

1. Make construction joints only at locations shown on the Drawings or as approved by the Engineer. Any additional or relocation of construction joints proposed by the Contractor must be submitted to the Engineer for written approval. Do not eliminate construction joints.

2. Locate additional or relocated joints where they least impair strength of the member. In general, locate joints within the middle third of spans of slabs, beams and girders. However, if a beam intersects a girder at the joint, offset the joint a distance equal to twice the width of the member being connected. Locate joints in walls and columns at the underside of floors, slabs, beams or girders and at tops of footings or floor slabs. Do not locate joints between beams, girders, column capitals, or drop panels and the slabs above them. Do not locate joints between brackets or haunches and walls or columns supporting them.

3. Unless indicated otherwise, provide joints perpendicular to main reinforcement. Continue reinforcing steel through the joint as indicated on the Drawings.

4. At all construction joints and at concrete joints indicated on the Drawings to be "roughened", uniformly roughen the surface of the concrete to a full amplitude (distance between high and low points and side to side) of 1/4-in 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 the joints with water. After glistening water disappears, coat joints with neat cement slurry mixed to the consistency of very heavy paste. The surfaces shall receive a coating at least 1/8-in thick, scrubbed-in by means of stiff bristle brushes. Deposit new concrete before the neat cement dries.

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

B. Expansion Joints

1. Make expansion joints at locations indicated on the Drawings. Do not eliminate or relocate expansion joints.

2. Provide expansion joints 1-in in thickness unless otherwise indicated on the Drawings.

3. Do not extend through expansion joints, reinforcement or other embedded metal items that are continuously bonded to concrete on each side of joint.

4. Place joint filler over the face of the joint, allowing for sealant grooves as indicated. Butt joint filler tight against waterstop, if present. Tape all joint filler splices to prevent intrusion of mortar. Position premolded joint filler material parallel to finished surfaces. Secure the joint filler against displacement during concrete placement and consolidation. Seal expansion joints as indicated on the Drawings.

C. Sealant

1. Install sealants in clean dry recesses free of frost, oil, grease, form release agent, loose material, laitance, dirt, dust and other materials which will impair bond at the locations shown on the Drawings. Apply sealant conforming to the manufacturer's recommendations including concrete cure, temperature, moisture, mixing, primer, primer cure time, joint and recess preparation, tooling, and curing. Apply masking tape to each side of the joint prior to the installation of the sealant and remove afterwards along with any spillage to leave a sealant installation with neat straight edges.

D. Preformed Expansion Joint Material

1. Install preformed expansion joint material in conformance with the manufacturer's recommendations; including surface preparation, adhesive installation, heat welding and set time.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and install cast-in-place concrete complete as shown on the Drawings and as specified herein.

B. Furnish, as required to establish concrete mixes, all sampling and laboratory testing of products and materials performed by an independent testing laboratory engaged by and at the expense of the Contractor. Provide field sampling, testing, inspection and related laboratory tests.

1.02 RELATED WORK

A. Concrete formwork is included in Section 03100.

B. Concrete reinforcement is included in Section 03200.

C. Concrete joints and joint accessories are included in Section 03250.

D. Concrete finishes are included in Section 03350.

E. Under-slab vapor retarders are included in section 03390.

F. Grout is included in Section 03600.

G. Concrete electrical raceway encasement is included in Section 03800.

H. Miscellaneous metals are included in Section 05500.

I. Joint sealants are included in Section 07920.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, product data for:

1. Sources of cement, fly ash, aggregates, and batched concrete. Indicate name and address of mill or quarry, as applicable.

2. Air-entraining admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.

3. Water reducing admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.

4. Sheet curing material. Product data including catalogue cut, technical data and conformity to ASTM standard.

5. Safety Data Sheets (SDS) for all concrete components and admixtures.

6. High-range water-reducing admixture (plasticizer). Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range and conformity to ASTM standards. Identify proposed locations of use.

7. Liquid membrane forming curing compound. Product data including catalogue cut, technical data, storage requirements, product life, application rate and conformity to ASTM standards. Identify proposed locations of use.

B. Test Reports

1. Aggregates: Conformance to ASTM standards, including sieve analysis, mechanical properties, deleterious substance content, and mortar bar expansion test results.

2. Cement and fly ash: Conformance to ASTM standards, including chemical analysis and physical tests.

3. Concrete mixes: For each formulation of concrete proposed for use, submit constituent quantities per cubic yard, water cementitious ratio, air content, concrete slump, type and manufacturer of cement and type and manufacturer of fly ash. Provide either Paragraph a. or b., below, for each mix proposed.
   a. Standard deviation data for each proposed concrete mix based on statistical records. Provide the following for each strength data point used in the calculation of the standard deviation for determination of the minimum required average strength:
      1) Date of sampling and name of testing laboratory.
      2) Name of concrete batch plant.
      3) Water cementitious ratio.
      4) Slump of batch.
      5) Air content of batch.
      6) Compressive strengths of all cylinders tested at that age in that batch.
      7) If available, temperature and unit weight of batch.
      8) Provide data from projects not more strictly controlled than outlined in these specifications. Provide summary sheet showing all pertinent data and the computation of the standard deviation.
   b. Water cementitious ratio curve for concrete mixes based on laboratory tests. Provide average cylinder strength test results at 7, 14, and 28 days for laboratory concrete mix designs.

C. Certifications

1. Certify that admixtures used in the same concrete mix are compatible with each other and the aggregates.

2. Certify that the Contractor is not associated with the independent testing laboratory proposed for use by the Contractor nor does the Contractor or officers of the Contractor's organization have a beneficial interest in the laboratory.

3. Certificate of conformance for concrete production facilities from the NRMCA.

D. Qualifications

1. Independent Testing Laboratory
   a. Name and address
   b. Names and positions of principal officers and the name, position, and qualifications of the responsible registered professional engineer in charge.
   c. Listing of technical services to be provided. Indicate external technical services to be provided by other organizations.
   d. Names and qualifications of the supervising laboratory technicians.
   e. Statement of conformance provided by evaluation authority defined in ASTM C1077. Provide report prepared by evaluation authority when requested by the Engineer.
   f. Submit as required above for other organizations that will provide external technical services.

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

2. ASTM C33 - Standard Specification for Concrete Aggregates.

3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.

6. ASTM C138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.

7. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete

8. ASTM C150 - Standard Specification for Portland Cement

9. ASTM C156 - Standard Test Method for Water Retention by Liquid Membrane-Forming Curing Compound for Concrete

10. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete

11. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

12. ASTM C192 - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.

13. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

14. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.

15. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

16. ASTM C311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for use in Portland Cement Concrete.

17. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.

18. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

19. ASTM C1017 - Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete.

20. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

21. ASTM C1260 - Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).

22. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.

B. American Concrete Institute (ACI).

1. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.

2. ACI 232.2R - Use of Fly Ash in Concrete.

3. ACI 304R - Guide for Measuring, Mixing, Transporting and Placing Concrete.

4. ACI 304.2R - Placing Concrete by Pumping Methods.

5. ACI 305R - Hot Weather Concreting.

6. ACI 306R - Cold Weather Concreting.

7. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.

C. National Ready Mixed Concrete Association (NRMCA)

1. Quality Control Manual, Section 3 - Certification of Ready Mixed Concrete Production Facilities.

D. Truck Mixer Manufacturers Bureau (TMMB)

1. TMMB 100 - Truck Mixer, Agitator and Front Discharge Concrete Carrier Standards.

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Comply with ACI 318 and other stated specifications, codes and standards. Apply the most stringent requirements of other stated specifications, codes, standards, and this Section when conflicts exist.

B. Independent testing laboratory shall meet the requirements of ASTM E329 and ASTM C1077 and be acceptable to the Engineer. Laboratories affiliated with the Contractor or in which the Contractor or officers of the Contractor's organization have a beneficial interest are not acceptable.

C. Use only one source of cement and aggregates for the project. Provide concrete uniform in color and appearance.

D. At least ten working days before the first concrete placement hold a preconstruction meeting to review the requirements for concrete placement, waterstop placement, jointing, concrete curing, hot weather concreting, cold weather concreting and finishing. Review, with the attendance of the plasticizer manufacturer, the properties and techniques of batching and placing concrete containing high-range water-reducing admixture. Notify all parties involved, including the Engineer, of the meeting at least ten working days prior to its scheduled date. Prepare an agenda for the meeting. Take meeting minutes and distribute to all attendees.

E. If, during the progress of the work, it is impossible to secure concrete of the specified workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the specified properties. Make all changes so ordered at no additional cost to the Owner.

F. If, during the progress of the work, the materials from the sources originally accepted change in characteristics, make, at no additional cost to the Owner, new acceptance tests of materials and establish new concrete mixes with the assistance of an independent testing laboratory.

G. Provide all field testing and inspection services and related laboratory tests. Methods of testing shall comply with the latest applicable ASTM methods. The following items shall be tested to verify conformity with this Section.

1. Concrete placements - compressive strength (cylinders), compressive strength (cores), temperature, slump, and air content.

2. Other materials that may require field testing.

H. Provide laboratory tests of samples of constituents and of concrete as-placed. All materials incorporated in the work shall conform to accepted samples.

1.06 DELIVERY, STORAGE AND HANDLING

A. Cement: Store in weathertight buildings, bins or silos to provide protection from dampness and contamination and to prevent warehouse set.

B. Aggregate: Arrange and use stockpiles to prevent segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding three feet in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregate.

C. Sand: Arrange and use stockpiles to prevent contamination. Allow sand to drain to a uniform moisture content before using. Do not use frozen or partially frozen sand.

D. Admixtures: Store in closed containers to prevent contamination, evaporation or damage. Provide agitating equipment to uniformly disperse ingredients in admixture solutions which tend to separate. Protect liquid admixtures from freezing and other temperature changes which could adversely affect their characteristics.

E. Fly Ash or Ground Granulated Blast Furnace Slag: Store in weathertight buildings, bins or silos to provide protection from dampness and contamination.

F. Sheet Curing Materials: Store in weathertight buildings or off the ground and under cover.

G. Liquid Membrane Forming Curing Compounds: Store in closed containers.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service.

2.02 MATERIALS

A. Materials shall comply with this Section and any applicable State or local requirements.

B. Cement: Domestic portland cement conforming to ASTM C150. Cement shall be low alkali cement. Do not use air entraining cements. Cement brand must be approved by the Engineer and one brand shall be used throughout the work. Provide the following type(s) of cement:

1. Class A Concrete - Type II with the addition of fly ash resulting in C3A being below 8 percent of total cementitious content, Type III limited to 8 percent C3A.

2. Class E Concrete - Type II with the addition of fly ash resulting in C3A being below 5 percent of total cementitious content, Type III limited to 5 percent C3A or Type V.

C. Aggregates:

1. Fine Aggregate: Washed inert natural sand conforming to ASTM C33.

2. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to ASTM C33. Grading requirements as listed in ASTM C33, Table 3 for the specified coarse aggregate size number listed in Table 1 herein. Limits of deleterious substances and

physical property requirements as listed in ASTM C33, Table 4 for severe weathering regions. Do not use coarse aggregates known to be deleteriously reactive with alkalis in cement.

3. The fine and coarse aggregates used shall not cause expansion of mortar bars greater than 0.1 percent in 16 days when tested in accordance with ASTM C1260 and using the cement proposed for the project. If aggregates proposed for use do not meet this requirement, then satisfy either a. or b. below.
   a. Total equivalent alkali content of the cement used shall not exceed 0.60 percent as provided in the Optional Chemical Requirements of ASTM C150.
   b. The fine and coarse aggregates used shall not cause expansion of mortar bars greater than 0.1 percent in 16 days when tested in accordance with ASTM C1260 and using the cement and fly ash or ground granulated blast furnace slag proposed for the project. The proportions of the cement-fly ash mix shall be the same as those proposed for the project.

D. Water: Potable water free of oil, acid, alkali, salts, chlorides (except those attributable to drinking water), organic matter, or other deleterious substances.

E. Admixtures: Use admixtures free of chlorides and alkalis (except for those attributable to drinking water). The admixtures shall be from the same manufacturer when it is required to use more than one admixture in the same concrete mix. Use admixtures compatible with the concrete mix including other admixtures.

1. Air Entraining Admixture: Conforming to ASTM C260. Proportion and mix in accordance with manufacturer's recommendations.

2. Water Reducing Admixture: Conforming to ASTM C494, Type A. Proportion and mix in accordance with manufacturer's recommendations.

3. High-Range Water-Reducing Admixtures (Plasticizer): Conforming to ASTM C494, Type F or ASTM C1017, Type I resulting in non-segregating plasticized concrete with little bleeding and with the physical properties of low water/cementitious ratio concrete. The treated concrete shall be capable of maintaining its plastic state in excess of 2 hours. Proportion and mix in accordance with manufacturer's recommendations.

4. Do not use admixtures causing retarded or accelerated setting of concrete without written approval from the Engineer. Use retarding or accelerating water reducing admixtures when so approved.

F. Supplementary Cementitious Materials

1. Fly Ash: Class F fly ash complying with ASTM C618, including the requirements of Table 1 but with the Loss on Ignition (LOI) limited to 3 percent maximum and the optional physical requirements of Table 3. Test in compliance with ASTM C311 with a minimum of one sample weighing four pounds taken from each 200 tons of fly ash supplied for the project.

G. Sheet Curing Materials: Waterproof paper, polyethylene film or white burlap-polyethylene sheeting, all conforming to ASTM C171.

H. Liquid Membrane-Forming Curing Compound. Compound conforming to ASTM C309, Type 1-D (clear or translucent with fugitive dye) and containing no wax, paraffin, or oil. Curing compounds shall be non-yellowing and have a unit moisture loss no greater than 0.039 gm/cm2 at 72 hours as measured by ASTM C156. Curing compound shall comply with Federal, State and local VOC limits.

2.03 MIXES

A. An independent testing laboratory engaged by and at the expense of the Contractor shall establish concrete mixes and perform all sampling and laboratory testing of products and materials.

B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce placeable, durable concrete conforming to these specifications. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing free water to collect on the surface.

C. Base concrete mixes on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if not available, develop concrete mixes by laboratory tests using the materials proposed for the work.

1. For concrete mixes based on standard deviation data of prior mixes, submit standard deviation data of prior mixes with essentially the same proportions of the same constituents in accordance with ACI 318 and based on the modification factors for standard deviation tests contained in ACI 318.

2. For concrete mixes developed by laboratory testing, base cementitious content of the concrete on curves showing the relation between water cementitious ratio and 7, 14 and 28 day compressive strengths of concrete made using the proposed materials. Determine curves by four or more points, each representing an average value of at least three test specimens and one water-cementitious ratio at each age. Provide curves with a range of values sufficient to yield the desired data, including the compressive strengths specified, without extrapolation. The cementitious content of the concrete mixes to be used, as determined from the curve, shall correspond to the required average compressive strength in Table 5.3.2.2 of ACI 318. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content specified in Table 1.

D. Test the fly ash and concrete mixture to provide test data confirming that the fly ash or ground granulated blast furnace slag in combination with the cement to be used meets all strength requirements and is compatible with the other concrete additives.

E. Test aggregates for potential alkali reactivity in accordance with ASTM C1260. If initial testing indicates aggregates are not potentially reactive repeat test at 3 month intervals.

F. Compression Tests: Provide testing of the proposed concrete mixes to demonstrate compliance with the compression strength requirements in conformity with the provisions of ACI 318.

G. Entrained air, as measured by ASTM C231, shall be as shown in Table 1.

1. If the air entraining agent proposed for use in the mix requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in the admixture submittal specified under Paragraph 1.03.

H. Slump of the concrete as measured by ASTM C143, shall be as shown in Table 1. If a high-range water-reducing admixture (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 7 to 10-in.

I. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of the other admixture(s).

J. Where Type III cement is approved for use, the concrete shall conform to Table 1 except that the design strength shall be attained at 7 days.

TABLE 1

Class	Design Strength 1	Cement 2	Fine Aggregate 3	Coarse Aggregate 3	Cementitious Content 4
A	2500	Type II	Sand	57 (9)	440
B	3000	Type II	Sand	57	480
D1	4000	Type II	Sand	467	540
D2	4000	Type II	Sand	57	560
D3	4000	Type II	Sand	67	590

Class	W/C Ratio 5	SCM 6	AE Range 7	WR 8	HRWR 10	Slump Range Inches
A	0.62 max.	Yes	3.5 to 5	Yes	No	1-4
B	0.54 max.	Yes	3.5 to 5	Yes	No	1-3
D1	0.44 max.	Yes	3.5 to 5	Yes	No	3-5
D2	0.44 max.	Yes	3.5 to 5	Yes	No	3-5
D3	0.44 max.	Yes	3.5 to 5	Yes	No	3-5

TABLE NOTES:

1. Minimum compressive strength in psi at 28 days

2. ASTM designation in ASTM C150

3. Size Number in ASTM C33

4. Minimum cementitious content in lbs per cubic yard (where fly ash is used cementitious content is defined as cement content plus fly ash content)

5. W/C is Maximum Water Cementitious ratio by weight

6. Supplementary Cementitious Material (SCM) fly ash content in the range of 20-25 percent of the total cement content plus fly ash content, by weight.

7. AE is percent air entrainment

8. WR is water reducing admixture

9. Except as specified in Section 03800 for concrete electrical raceway encasement

10. HRWR is high-range water-reducing admixture

PART 3 EXECUTION

3.01 MEASURING MATERIALS

A. Provide concrete composed of portland cement, fly ash, fine aggregate, coarse aggregate, water and admixtures as specified and produced by a plant complying with ACI 318 and ASTM C94. Batch all constituents, including admixtures, at the plant. High-range water reducing admixtures may be added in the field.

B. Measure materials for batching concrete by weighing in conformity with and within the tolerances given in ASTM C94 except as otherwise specified. Use scales last certified by the local Sealer of Weights and Measures within one year of use.

C. Weigh cement and fly ash in individual weigh batchers that are separate and distinct from the weigh batchers used for other materials. When cement and fly ash or ground granulated blast furnace slag are weighed in a cumulative weigh batcher, the cement shall be weighed first.

D. Measure the amount of free water in fine aggregates within 0.5 percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record the number of gallons of water as-batched on printed batch tickets.

E. Dispense admixtures either manually using calibrated containers or measuring tanks, or by means of an automatic dispenser approved by the manufacturer of the specific admixture.

1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.

2. Inject multiple admixtures separately during the batching sequence.

3.02 MIXING AND TRANSPORTING

A. Provide ready-mixed concrete produced by equipment complying with ACI 318 and ASTM C94 and produced by a plant certified by the NRMCA. Do not hand-mix. All truck mixers shall carry a rating plate conforming to TMMB 100. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.

B. Transport ready-mix concrete to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.

C. Keep the water tank valve on each transit truck locked at all times. Any addition of water must be directed by the Engineer. Incorporate water directed to be added by additional mixing of at least 50 revolutions at mixing speed after the addition of all water. Meter all added water and show the amount of water added on each delivery ticket.

D. Comply with ACI 318 and ASTM C94 for all central plant and rolling stock equipment and methods.

E. Select equipment of size and design to provide continuous flow of concrete at the delivery end. Use metal or metal-lined non-aluminum discharge chutes with slopes not exceeding one vertical to two horizontal and not less than one vertical to three horizontal. Chutes more than 20-ft long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.

F. Do not retemper (mix with or without additional cement, aggregate, or water) concrete or mortar which has partially hardened.

G. Handle concrete from mixer to placement providing concrete of specified quality in the placement area and not exceeding the maximum time interval specified in Paragraph 3.02 I.4. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required to avoid excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms. Remix for a minimum of 5 minutes prior to discharge or testing.

H. Furnish a delivery ticket for ready mixed concrete to the Engineer as each truck arrives. Provide a printed record of the weight of cement and each aggregate as batched individually on each ticket. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Indicate for each batch the weight of fine and coarse aggregate, cement, fly ash or ground granulated blast furnace slag, and water, moisture content of fine and coarse aggregate at time of batching, and types, brand and quantity of each admixture, the quantity of concrete delivered, the time any water is added and the amount, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of transit mix truck.

I. Temperature and Mixing Time Control

1. In cold weather (see Paragraph 3.07D) maintain the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms as indicated in Table 3.

2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.

3. In hot weather (see Paragraph 3.07E), cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. Well-crushed ice may be substituted for all or part of the mixing water.

4. 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 the values shown in the following TABLE 2:

TABLE 2

AIR OR CONCRETE TEMPERATURE (WHICHEVER IS HIGHER)	MAXIMUM TIME
(27 Degree C) 80 Degree F to 90 Degree F (32 Degree C)	45 minutes
(21 Degree C) 70 Degree F to 79 Degree F (26 Degree C)	60 minutes
(5 Degree C) 40 Degree F to 69 Degree F (20 Degree C)	90 minutes

5. 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.

3.03 INSPECTION AND COORDINATION

A. Batching, mixing, transporting, placing and curing of concrete shall be subject to the inspection of the Engineer at all times. Advise the Engineer of readiness to proceed at least six working hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing and the alignment, cleanliness and tightness of formwork. Do not place concrete without the inspection and acceptance of the Engineer.

3.04 EMBEDDED ITEMS

A. Secure to forms as required or set for embedment as required, all miscellaneous metal items, sleeves, reglets, anchor bolts, anchors, inserts and other items furnished under other Sections and required to be embedded into concrete. Set and secure such items in the locations and alignments needed so they are not displaced by concrete placement.

B. Clean embedded items free of rust, mud, dirt, grease, oil, ice, or other contaminants which would reduce or prevent bonding with concrete.

C. Coat or isolate all aluminum embedments to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.

D. Do not embed piping in concrete unless shown on the Drawings or approved by the Engineer.

E. Do not embed electrical conduits in concrete unless shown on the Drawings or approved by the Engineer.

F. Fabricate piping and conduit such that the cutting, bending, or relocation of reinforcing steel is not required. Pipes and conduits embedded within a slab or wall (other than those merely passing through) shall satisfy the following, unless otherwise shown on the Drawings or approved:

1. Maximum outside dimension of pipe or conduit shall not be greater than one third the overall thickness of the slab or wall.

2. Spacing of pipes or conduits shall be greater than or equal to three diameters or widths on center.

G. Close open ends of piping, conduits, and sleeves embedded in concrete with caps or plugs prior to placing concrete.

H. Ensure all specified tests and inspections on embedded piping are completed and satisfactory before starting concrete placement. Ensure all mechanical or electrical tests and inspections are completed and satisfactory prior to starting concrete placement. Do not place concrete until unsatisfactory items and conditions have been corrected.

I. Position embedded anchor bolts using templates.

J. Check location, alignment, and support of anchor bolts, piping, electrical conduits, and other items which will be fully or partially embedded in concrete before depositing concrete. Correct mislocated and misaligned items and secure items which have become loose before depositing concrete.

K. Correct all embedded items not installed in the location or alignment needed or displaced by concrete placement at no additional cost to the Owner.

3.05 CONCRETE APPEARANCE

A. Remix concrete showing either poor cohesion or poor coating of the coarse aggregate with paste. Reject remixed concrete showing either poor cohesion or poor coating of the coarse aggregate with paste. Make, at no additional cost to the Owner, changes in the concrete mix design for future deliveries only by adjusting one or more of the following if the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finishability are observed:

1. The gradation of aggregate.

2. The proportion of fine and coarse aggregate.

3. The percentage of entrained air, within the allowable limits.

B. Provide concrete having a homogeneous structure which, when hardened, will have the specified strength, durability and appearance. Provide mixtures and workmanship such that concrete surfaces, when exposed, will require no finishing except as specified in Section 03350.

3.06 PLACING AND COMPACTING

A. Placing

1. Verify that all formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Remove ice, standing water, dirt, debris, and other foreign materials from forms and exposed joint surfaces. Confirm that reinforcement and other embedded items are securely in place. Have a worker at the location of the placement who can check that reinforcement and embedded items remain in designated locations and alignments while concrete is being placed. Sprinkle semi-porous subgrades or forms to eliminate suction of water from the mix. Do not place concrete on frozen subgrade, snow, or ice.

2. Deposit concrete as near its final position as possible to prevent segregation due to rehandling or flowing. Place concrete continuously at a rate that allows the concrete previously placed to be integrated with fresh plastic concrete. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials or on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.

3. Pumping of concrete will be permitted. Use a mix design and aggregate sizes chosen for pumping and submit for approval. Do not use pipelines made of aluminum or aluminum alloy. When concrete is pumped, slump will be determined at point of truck discharge and air content will be determined at point of placement.

4. Remove temporary spreaders from forms when the spreader is no longer needed. Temporary spreaders may remain embedded in concrete only when made of galvanized steel or concrete and if prior approval has been obtained.

5. Do not place concrete for supported elements until concrete previously placed in the supporting element has attained design strength.

6. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms to bring the full surface of the mortar against the form. Prevent the formation of surface voids.

7. Slabs
    a. After bulkheads, screeds and jointing materials have been positioned, place concrete continuously between joints beginning at a bulkhead, edgeform, or corner. Place each batch into the edge of the previously placed concrete to avoid stone pockets and segregation.
    b. Avoid delays in placement. If there is a delay in placement, spade and consolidate the concrete placed after the delay at the edge of the previously placed concrete to avoid cold joints. Bring concrete to correct level and strike off with a straightedge. Use bullfloats or darbies to smooth the surface, leaving it free of humps or hollows.
    c. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow one hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep the top surface of the wall moist to prevent cold joints.

8. Formed Concrete
    a. Place concrete in forms using tremie tubes taking care to prevent segregation. Maintain bottom of tremie tubes in contact with the concrete already placed. Do not permit concrete to drop freely more than 4-ft. Place concrete for walls in 12-in to 24-in lifts, keeping the surface horizontal. If a high-range water-reducing admixture is used do not permit concrete to drop freely more than 15-ft; maximum lift thickness not to exceed 7-ft.

9. Bollards
    a. Conform to requirements specified above for formed concrete and completely fill pipe with concrete as indicated.

B. Compacting

1. Consolidate concrete by vibration and puddling, spading, rodding or forking so that concrete is completely worked around reinforcement, embedded items and openings and into corners of forms. Continuously perform puddling, spading, rodding and forking along with vibration of the placement to eliminate air or stone pockets which may cause honeycombing, pitting or planes of weakness.

2. Compact all concrete with mechanical vibrators. Do not order concrete until vibrators (including standby units in working order) are on the job.

3. Use mechanical vibrators having a minimum frequency of 8000 vibrations per minute. Insert vibrators and withdraw at points from 18-in to 30-in apart. Vibrate sufficiently at each insertion to consolidate concrete, generally from 5 to 15 seconds. Do not over vibrate so as to segregate. Keep standby vibrators on the site during concrete placing operations.

4. Concrete Slabs: Vibration for concrete slabs less than 8-in thick shall be by vibrating screeds. Vibration for concrete slabs 8-in and thicker shall be by internal vibrators and (optionally) with vibrating screeds. Place vibrators into concrete vertically. Do not lay vibrators horizontally or lay over.

5. Walls and Columns: Use internal vibrators (rather than form vibrators) unless otherwise approved by the Engineer. In general, for each vibrator needed to melt down (level) the batch at the point of discharge, one or more additional vibrators must be used to densify, homogenize and perfect the surface. Insert vibrators vertically at regular intervals, through the fresh concrete and slightly into the previous lift, if any.

6. Amount of Vibration: Use vibrators to consolidate properly placed concrete. Do not use vibrators to move or transport concrete in the forms. Continue vibration until:
   a. Frequency of vibrator returns to normal.
   b. Surface appears liquefied, flattened and glistening.
   c. Trapped air ceases to rise.
   d. Coarse aggregate has blended into surface, but has not disappeared.

3.07 CURING AND PROTECTION

A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.

B. Curing Methods

1. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain a temperature of at least 50 Degrees F at the concrete surface for a minimum of seven days after placement. Use the following curing methods as specified:
   a. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling or covered with saturated burlap. Begin water curing as soon as concrete attains an initial set and maintain water curing 24 hours a day. Do not permit the surface of the concrete to dry out at any time during the curing period. Temperature of curing water shall be within 20 Degrees F of the concrete temperature.
   b. Sheet Material Curing: Cover entire surface with sheet material. Anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.

c. Liquid Membrane Curing: Apply over the entire concrete surface except as follows. Curing compound shall NOT be placed on any concrete surface where additional concrete or grout is to be placed, where concrete sealers or surface coatings are to be used, or where the concrete finish requires an integral floor product. Apply curing compound as soon as the free water on the surface has disappeared and no water sheen is visible, but not after the concrete is dry or when the curing compound can be absorbed into the concrete. Apply in compliance with the manufacturer's recommendations.

2. Specified applications of curing methods:
   a. Slabs for Liquid Retaining Structures: Water curing only.
   b. Slabs on Grade and Footings (not used to retain liquids): Water curing or sheet material curing or liquid membrane curing.
   c. Structural Slabs (other than Liquid Retaining Structures): Water curing or liquid membrane curing.
   d. Horizontal Surfaces which will Receive Additional Concrete, Coatings, Grout or Other Material that Requires Bond to the substrate: Water curing.
   e. Formed Surfaces: None if nonabsorbent forms are left in place seven days. Water curing if absorbent forms are used. Water curing if forms are removed prior to seven days. Sheet cure or liquid membrane cure if forms are removed prior to seven days. Exposed horizontal surfaces of formed walls or columns shall be water cured for seven days or until next placement of concrete is made.
   f. Surfaces of Concrete Joints: Water curing or sheet material curing.

3. Curing time may be reduced to 3 days for concrete placement using Type III cement when approved by the Engineer.

C. Protect finished surfaces and slabs from the direct rays of the sun to prevent checking and crazing.

D. Cold Weather Concreting

1. For this Specification, "cold weather" is defined as a period when for more than three successive days, the average daily outdoor temperature drops below 40 degrees F. Calculate average daily temperature as the average of the highest and the lowest temperature during the period from midnight to midnight.

2. Batch, deliver, place, cure and protect concrete during cold weather in compliance with the recommendations of ACI 306R and the additional requirements of this Section.

3. Review the cold weather concreting plan at the preconstruction meeting. Include the methods and procedures for use during cold weather including the production, transportation, placement, protection, curing and temperature monitoring of the concrete and the procedures to be implemented upon abrupt changes in weather conditions or equipment failures.

4. The minimum temperature of concrete immediately after placement and during the protection period shall be as indicated in Table 3. The temperature of the concrete in place and during the protection period shall not exceed these values by more than 20 degrees F. Prevent overheating and non-uniform heating of the concrete.

TABLE 3

Concrete Temperatures Minimum
Dimension of Section

	< 12-in	12 to 36-in
Min. conc temp:	55 Degree F	50 Degree F

5. Protect concrete during periods of cold weather to provide continuous warm, moist curing (with supplementary heat when required by weather conditions) for a total of at least 350 degree-days of curing.
   a. Degree-days are defined as the total number of 24 hour periods multiplied by the weighted average daily air temperature at the surface of the concrete (e.g., 7 days at an average 50 degrees F = 350 degree-days).
   b. To calculate the weighted average daily air temperature, sum hourly measurements of the air temperature in the shade at the surface of the concrete taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.

6. Do not use salt, manure or other chemicals for protection.

7. At the end of the protection period, allow the concrete to cool gradually to the ambient temperature. If water curing has been used, do not expose concrete to temperatures below those shown in Table 3 until at least 24 hours after water curing has been terminated and air dry concrete for at least 3 days prior to first exposure to freezing temperatures.

8. During periods not defined as cold weather, but when freezing temperatures are expected or occur, protect concrete surfaces from freezing for the first 24 hours after placing.

E. Hot Weather Concreting

1. For this Specification, "hot weather" is defined as any combination of high air temperatures, low relative humidity and wind velocity which produces a rate of evaporation as estimated in ACI 305R, approaching or exceeding 0.2 pounds per square foot per hour (lb/sq ft/hr).

2. Batch, deliver, place, cure and protect concrete during hot weather in compliance with the recommendations of ACI 305R and the additional requirements of this Section.
   a. Temperature of concrete being placed shall not exceed 90 degrees F. Maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall not cause loss of slump, flash set or cold joints.
   b. Promptly deliver concrete to the site and promptly place the concrete upon its arrival at the site, not exceeding the maximum time interval specified in Paragraph 3.02I.4. Provide vibration immediately after placement.
   c. The Engineer may direct the Contractor to immediately cover concrete with sheet curing material.

3. Review the hot weather concreting plan at the preconstruction meeting. Include the methods and procedures for use during hot weather including production, placement, and curing.

3.08 REMOVAL OF FORMS

A. Do not remove forms before the concrete has attained a strength of at least 70 percent of its specified design strength for beams and slabs and at least 30 percent of its specified design strength for walls and vertical surfaces, nor before reaching the following number of day-degrees of curing (whichever is the longer):

TABLE 4

Forms for	Degree Days
Beams and slabs	500
Walls and vertical surfaces	100

(See definition of degree-days in Paragraph 3.07D).

B. Do not remove shores until the concrete has attained at least 70 percent of its specified design strength and also sufficient strength to support safely its own weight and the construction live loads upon it.

C. In cold weather, when temperature of concrete exceeds ambient air temperature by 20 Degrees F at the end of the protection period, loosen forms and leave in place for at least 24 hours to allow concrete to cool gradually to ambient air temperature.

3.09 FIELD AND LABORATORY TESTS

A. Take field control cylinder specimens during the progress of the work, in compliance with ASTM C31. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than one set per day, nor less than one set for each 100 cu yds of concrete nor less than one set for each 5,000 sq ft of surface area for slabs or walls. Specimens shall be formed in 6-in diameter by 12-in long non-absorbent cylindrical molds.

1. A "set" of test cylinders shall consist of five cylinders: one to be tested at seven days, one to be tested at 14 days, and two to be tested and their strengths averaged at 28 days. The fifth may be used for a special test at 3 days or to verify strength after 28 days if 28 day test results are low.

2. When the average 28 day compressive strength of the cylinders in any set falls below the required compressive strength or below proportional minimum seven-day or 14-day strengths (where proper relation between seven, 14 and 28 day strengths have been established by tests), change proportions, cementitious content, or temperature conditions to achieve the required strengths at no additional cost to the Owner.

B. Provide four firmly braced, insulated, heated, closed wooden curing boxes, each sized to hold ten specimens, complete with cold weather temperature and hot weather temperature control thermostat for initial curing and storage from time of fabrication until shipment to the testing lab. Protect the specimens against injury or loss through construction operations. Furnish material and labor required for the purpose of taking concrete cylinder samples.

C. Test slump immediately prior to placing the concrete. Test shall be made in accordance with ASTM C143. When concrete is pumped, slump will be determined at point of truck discharge. If the slump is outside the specified range, the concrete will be rejected.

D. Test for air content shall be conducted on a fresh concrete sample. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173. If aggregates with high absorptions are used, the latter test method shall be used. When concrete is pumped, air content will be determined at point of placement.

3.10 FIELD CONTROL

A. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. The results of tests on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work. The right of the Engineer to take such cores shall not be construed as creating any obligation to take such cores, and not exercising this right to do so shall not relieve the Contractor from meeting the requirements of these Specifications.

B. Cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding and such incidental equipment as may be required. Repair all core holes with non-shrink grout as specified in Section 03600. The work of cutting, testing and repairing the cores will be at the expense of the Contractor if defective work is uncovered. If no defective work is found, such cost will be at the expense of the Owner.

3.11 FAILURE TO MEET REQUIREMENTS

A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, the Engineer may require changes in proportions or materials, or both, to apply to the remainder of the work in accordance with Paragraph 1.05E. Furthermore, the Engineer may require additional curing on those portions of the structure represented by the test specimens which fall below the values given in Table 1. The cost of such additional curing shall be at no additional cost to the Owner. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer may require strengthening or replacement of those portions of the structure which fail to develop the required strength. Coring and testing and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be at no additional cost to the Owner. In such cases of failure to meet strength requirements the Contractor and Owner shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in C94 is the Contractor.

B. When the tests on control specimens of concrete fall below the required strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39. In cases where tests of cores fall below the values given in Table 1, the Engineer, in addition to other recourses, may require load tests on any one of the slabs and beams in which such concrete was used. Test need not be made until concrete has aged 60 days. The Engineer may require strengthening or replacement of those portions of the structure which fail to develop the required strength. All coring and testing and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be at no additional cost to the Owner.

C. Should the strength of test cylinders fall below 60 percent of the required minimum 28 day strength, the concrete shall be rejected and shall be removed and replaced at no additional cost to the Owner.

3.12 PATCHING AND REPAIRS

A. It is the intent of these Specifications to require quality work including forming, mixture and placement of concrete and curing so completed concrete surfaces will require no patching or repairs.

B. As soon as the forms have been stripped and the concrete surfaces exposed: remove fins and other projections; fill recesses left by the removal of form ties; and repair surface defects which do not impair structural strength. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.

C. Immediately after removal of forms remove tie cones and metal portions of ties as specified in Section 03100. Fill holes promptly upon stripping as follows: Moisten the hole with water, followed by a 1/16-in brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form of a spider web. Trowel smooth with heavy pressure. Avoid burnishing.

D. When filling tie cone holes and patching or repairing exposed surfaces use the same source of cement and sand as used in the parent concrete. Adjust color to match by addition of white cement. Rub lightly with a fine carborundum stone at an age of one to five days if necessary to bring the surface down with the parent concrete. Do not damage or stain the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.

E. Defective concrete and honeycombed areas: Chip down square and at least 1-in deep to sound concrete with hand chisels or pneumatic chipping hammers. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded in the parent concrete. If honeycomb exists around reinforcement, chip to provide a clear space at least 3/8-in wide all around the steel. For areas less than 1-1/2-in deep, the patch may be made in the same manner as described above for filling form tie holes, care being exercised to use adequately dry (non-trowelable) mixtures and to avoid sagging. Thicker repairs will require build-up in successive 1-1/2-in layers on successive days, each layer being applied (with slurry, etc.) as described above.

F. For very heavy (generally formed) patches, the Engineer may order the addition of pea gravel to the mixture and the proportions modified as follows:

Material	Volumes	Weights
Cement	1.0	1.0
Sand	1.0	1.0
Pea Gravel	1.5	1.5

G. The Contractor may use a pre-packaged patching compound, such as: Poly-Patch by Euclid Chemical Company; Sikatop 122 Plus by Sika Chemical Corporation or equal only if approved by the Engineer for use and for color match.

3.13 SCHEDULE

A. The following (Table 5) are the general applications for the various concrete classes and design strengths:

TABLE 5

Class	Design Strength (psi)	Description
A	2,500	Concrete fill, concrete fill for bollards, electrical raceway encasement and pipe encasement.
B	3,000	Where specified or noted.
D1	4,000	Structural concrete foundation mats and slabs 16-in and greater in thickness.
D2	4,000	Except as noted above for Class E1 concrete: Structural concrete greater than 10-in in thickness including slabs on grade, grade beams, and all other structural concrete greater than 10-in in thickness.
D3	4,000	Structural concrete 10-in or less in thickness including slabs on grade, and all other structural concrete 10-in or less in thickness.

END OF SECTION

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SECTION 03350
CONCRETE FINISHES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and finish cast-in-place concrete surfaces as specified herein and as indicated on the Drawings.

1.02 RELATED WORK

A. Concrete and finishing for walkway and pavements is included in Division 2.

B. Concrete formwork is included in Section 03100.

C. Patching and repair of defective and honeycombed concrete is included in Section 03300.

D. Under-slab vapor retarders are included in section 03390.

E. Grout is included in Section 03600.

F. Painting, toppings and special surfaces are included in Division 9.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:

1. Concrete sealer. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations and Material Safety Data Sheet. Also submit confirmation that the sealer is compatible with additionally applied coatings.

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 RESPONSIBILITY FOR CHANGING FINISHES

A. The surface finishes specified for concrete to receive coatings or other finish materials are those required for the proper application of the products specified under other Sections. Where products different from those specified are approved for use determine if changes in finishes are required and provide the proper finishes to receive these products.

B. Perform changes in finishes made to accommodate products different from those specified at no additional cost to the Owner. Submit the proposed new finishes to the Engineer for approval.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cementitious and component materials required for finishing concrete surfaces: As specified in Section 03300.

B. Concrete sealer: "Kure-N-Seal", by BASF Building Systems or equal acrylic sealer.

PART 3 EXECUTION

3.01 FORMED SURFACES

A. Form removal: Conform to Sections 03100 and 03300.

B. Do not damage edges or obliterate the lines of chamfers, rustications or corners when removing the forms or doing any other work adjacent thereto.

C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.

D. Off-Form Finish

1. Remove fins and other projections and fill tie cones and defects as specified in Section 03300.

E. Rubbed Finish

1. Immediately upon stripping forms and before concrete changes color, carefully remove all fins with a hammer. While the surface is still damp apply a thin coat of medium consistency neat cement slurry using bristle brushes to provide a bonding coat within all pits, air holes or blemishes in the parent concrete. Do not coat large areas of the surface with this slurry.

2. Before the slurry dries or changes color, apply a dry (almost crumbly) grout consisting of one volume cement to 1-1/2 volumes of clean masonry sand having a fineness modulus of approximately 2.25 and complying with the gradation requirements of ASTM C144. Apply grout uniformly using damp (neither dripping wet nor dry) pads of coarse burlap approximately 6-in square used as a float. Scrub grout into the pits and air holes to provide a dense mortar in the imperfections to be patched.

3. Allow the mortar to partially harden for one or two hours depending upon the weather. If the air is hot and dry, keep the surface damp during this period using a fine, fog spray. When the grout has hardened sufficiently so it can be scraped from the surface with the perpendicular edge of a steel trowel without damaging the grout in the small pits or holes, cut off all grout that can be removed with a trowel. Grout allowed to remain on the surface too long will get too hard and will be difficult to remove.

4. Allow the surface to dry and rub it vigorously with clean dry burlap to completely remove any dried grout. No visible film of grout should remain after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Do not leave grout

on surfaces overnight. Allow grout to dry after it has been cut off with the trowel so it can be wiped off clean with the burlap.

5. On the day following the repair of pits, air holes and blemishes, the surfaces again shall be wiped off clean with dry, used pieces of burlap containing old hardened mortar which will act as a mild abrasive. After this treatment, there shall be no built-up film remaining on the parent surface. If, however, a built-up film remains, use a fine abrasive stone to remove all such material without breaking through the surface film of the original concrete. Scrub lightly to remove excess material without working up a lather or mortar or changing the texture of the concrete.

6. Follow the final bagging or stoning operation with a thorough wash-down with stiff bristle brushes to remove extraneous materials from the surface. Spray the surface with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after the application of the repair grout.

7. The Rubbed Finish application may be deleted by the Engineer if the unfinished concrete surface is of superior quality and without surface voids.

3.02 FLOORS AND SLABS

A. Consider the potential for longer setting time in concrete containing fly ash or ground granulated blast furnace slag.

B. Compact with internal vibrators as specified in Section 03300 and screed to the established grades. Provide floors and slabs level with a tolerance of 1/8-in when checked with a 12-ft straightedge, except where drains occur, in which case pitch floors to drains as indicated. Failure to meet either of above shall be cause for removal, grinding, or other correction as directed by the Engineer, at no additional cost to the Owner.

C. Following screeding as specified above, float the slabs as approved by the Engineer. Continue floating operation until sufficient mortar is brought to the surface to fill all voids. Test the surfaces with a straightedge to detect high and low spots which shall be eliminated. Do not overwork the concrete as evidenced by excess water and fine material on the surface.

D. Do not use "jitterbugs" or other special tools designed for the purpose of forcing the coarse aggregate away from the surface and allowing a layer of mortar to accumulate on any slab finish. Do not dust surfaces with dry materials. Round off all edges of slabs and tops of walls with a steel edging tool. Use steel edging tool with radius of 1/4-in for all slabs subject to wheeled traffic.

E. Measure floor flatness the day after a concrete floor is finished and before the shoring is removed, in order to eliminate any effects of shrinkage, curling and deflection. A 12-ft long straightedge shall be supported at each end with steel gauge blocks whose thickness are equal to tolerance specified. Floor surface shall not have crowns so high as to prevent 12-ft straightedge from resting on the two end blocks, nor low spots so low that a third block of twice the tolerance in thickness can pass under the supported straightedge. Compliance with the designated limits in four of five consecutive measurements will confirm compliance, unless obvious faults are observed. A check for adequate slope and drainage will also be made to confirm compliance.

F. Descriptions

1. Steel Trowel Finish. Finish by screeding and floating with straightedges to bring the surfaces to the elevations indicated. While the concrete is still green, but sufficiently hardened to bear a person's weight without deep imprint, the surface shall be wood floated to a true, even plane with no coarse aggregate visible. Apply sufficient pressure on the wood floats to bring moisture to the surface. After surface moisture has disappeared, hand steel trowel to produce a smooth, impervious surface, free from trowel marks. Trowel the surface again for the purpose of burnishing. The final troweling shall produce a ringing sound from the trowel. Do not use dry cement or additional water in troweling.

2. Wood Float Finish. Finish by screeding with straightedges to bring the surfaces to the elevations indicated. Use a wood float to compact and seal surface. Remove all laitance and leave a clean surface.

3. Light Broomed Finish. Steel trowel finish the concrete, as specified above but omit the final troweling and finish the surface by drawing a fine-hair broom lightly across the surface. Broom in the same direction and parallel to expansion joints, or in the case of inclined slabs, perpendicular to the slope, or except as directed otherwise.

4. Broomed Finish. Steel trowel finish the concrete, as specified above but omit the final troweling. While the concrete is still soft enough, finish the surface with a stiff coarse fiber broom to produce the pattern and depth of scoring as approved by the Engineer.

5. Power Machine Finish. In lieu of hand steel trowel finishing, an approved power machine for finishing concrete floors and slabs may be used in accordance with the directions of the machine manufacturer and as approved by the Engineer. Do not use a power machine until the concrete has attained the necessary set to allow finishing without introducing high and low spots in the slab. Hand steel trowel the areas of slabs not accessible to power equipment. Provide a final steel troweling done by hand over all areas.

G. Concrete Sealer

1. Prepare and seal surfaces as follows:
   a. Finish concrete as specified in the preceding paragraphs and in accordance with the Schedule of Finishes in Paragraph 3.05 below.
   b. Newly Placed Concrete: Surface must be sound and properly finished. Surface is application-ready when it is damp but not wet and can no longer be marred by walking workers.
   c. Newly-Cured Bare Concrete: Level any spots gouged out by trades. Remove all dirt, dust, droppage, oil, grease, asphalt and foreign matter. Cleanse with caustics and detergents as required. Rinse thoroughly and allow to dry so that surface is no more than damp, and not wet.
   d. Existing Concrete: Restore surface soundness by patching, grouting, and filling cracks and holes. Surface must also be free of any dust, dirt and other foreign matter. Use power tools and/or strippers to remove any incompatible sealers or coatings. Cleanse as required, following the procedure indicated under cured concrete.
   e. Application: Apply sealer so as to form a continuous, uniform film by spray, soft-bristle pushbroom, long-nap roller, lambswool applicator, or ordinary garden-type sprayers.

f. For curing only, two coats are required. Apply first coat evenly and uniformly as soon as possible after final finishing at the rate of 200 to 400 sq ft per gallon. Apply second coat when all trades are completed and structure is ready for occupancy at the rate of 400 to 600 sq ft per gallon.

g. To seal and dustproof, two coats are required. For sealing new concrete, both coats shall be applied full-strength. On aged concrete, when renovating, dustproofing and sealing, the first coat should be thinned 10 to 15 percent with reducer per manufacturer's directions.

3.03 APPROVAL OF FINISHES

A. All concrete surfaces, when finished, will be inspected by the Engineer.

B. Refinish or rework unsatisfactory finishes until approved by the Engineer, at no additional cost to the Owner.

C. Hardened unsatisfactory finishes will require removal, grinding, or other appropriate correction approved by the Engineer, at no additional cost to the Owner.

3.04 SCHEDULE OF FINISHES

A. Finish concrete in the various specified manners either to remain as natural concrete or to receive an additional applied finish or material under another Section. Where products different from those specified are approved for use comply with the requirements of Paragraphs 1.05A and 1.05B.

B. Finishes to the base concrete for the following conditions shall be as scheduled below and as further specified herein:

1. Exposed exterior concrete excluding slabs and walking surfaces - Rubbed finish. (Rub open tank walls above and to 1-ft below normal water line).

2. Concrete for exterior on stairs and other horizontal areas - Broomed finish, non-slip.

3. Exposed interior concrete including underside slabs, beams and stairs and sides of openings, beams and stairs - Rubbed finish.

4. Concrete for interior walking surfaces excluding stairs - wood float finish.

5. Concrete for interior stairs and metal pan stairs - Light broomed finish, non-slip.

6. Walls of open topped tanks - Rubbed finish above and to 1-ft below normal water line. Off-form finish from 1-ft below normal water line to base of wall.

7. Concrete stairs, landings and platforms below normal water level in liquid retaining structures - Broomed finish, non-slip.

8. Tops of curbs and pads - Steel trowel finish.

9. Concrete on which liquids flow or are contained - Steel troweled finish.

10. Concrete not exposed in the finished work and not scheduled to receive an additional applied finish or material - Off-form finish at vertical surfaces, consolidate and screed to grade at horizontal surfaces.

11. Concrete to receive dampproofing - Off-form finish.

12. Concrete to receive capillary waterproofing - Off-form finish at vertical and overhead surfaces, light broomed finish at horizontal surfaces.

13. Concrete to receive cementitious slurry waterproofing - Off-form finish at vertical surfaces, light broomed finished horizontal surfaces.

14. Concrete to receive paint - Rubbed finish.

15. Concrete to receive floor sealer - See Paragraph 3.02G above.

16. Concrete to receive seamless flooring - Once-over steel trowel finish.

17. Concrete to receive ceramic and quarry tile - Broomed finish as approved.

18. Concrete to receive vinyl and rubber surfacing and carpet - Steel trowel finish.

19. Concrete to receive rubberized asphalt sheet membrane waterproofing - Wood float finish at horizontal surfaces, rubbed finish at vertical surfaces.

20. Concrete to receive roof insulation - Consolidate, screed and wood float to required grades.

END OF SECTION

SECTION 03390
UNDER-SLAB VAPOR RETARDERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and design and deliver under-slab vapor retarders for the Project as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Cast-In-Place Concrete is included in Section 03300.

1.03 SUBMITTALS

A. Submit in accordance with Section 03100.

B. Product Data: For each type of product indicated.

C. Material Certificates: For under-slab vapor retarders.

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM E 1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs

2. ASTM E 1745 - Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

B. Where reference is made to one of the above or other referenced standards, the revisions in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain under-slab vapor retarders from single source.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle under-slab vapor retarders to prevent bending and damage.

PART 2 PRODUCTS

2.01 UNDER-SLAB VAPOR RETARDERS

A. Under-Slab Vapor Retarders: ASTM E 1745, Class A, except with maximum perm rating of 0.01. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
b. Grace Construction Products, W. R. Grace & Co.; Florprufe 120.
c. Meadows, W. R., Inc.; Perminator 15 mil.
d. Or equal.

2. Thickness: Minimum 15 mils.

B. Accessories: Seam tape and mastic materials approved in writing by the manufacturer for use with under-slab vapor retarder.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 UNDER-SLAB VAPOR RETARDERS

A. Under-Slab Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturers recommended tape.

END OF SECTION

SECTION 03480
PRECAST CONCRETE BUILDING

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 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals necessary and install the precast concrete building and appurtenances as shown on the Drawings and specified herein.

B. All openings, sleeves, sealing elements, door, and appurtenances in the precast building shall be part of the work of this Section. Provide skip trowel exterior.

C. The building shall be a prefabricated, reinforced, modular concrete building.

1.3 RELATED REQUIREMENTS:

A. Concrete is included in Division 3.

B. FRP Liner Panel for interior walls is included in Division 6.

C. Rigid Insulation for interior walls and ceilings is included in Division 7.

D. FRP Doors and Aluminum frames is included in Division 8.

E. Non-structural Metal Framing for attachment of insulation and FRP panels to interior walls is included in Division 9.

F. HVAC work is included in Division 15.

G. Electrical work is included in Division 16.

1.4 SUBMITTALS

A. Submit, in accordance with Section 01300, complete sets of shop drawings showing details of fabrication and installation of all materials and equipment furnished.

B. Shop drawings for the precast reinforced concrete building shall include dimensioning, details of construction, reinforcing, joints, structural design criteria, opening and door location and detail, and heating and ventilating equipment details. No materials shall be fabricated or shipped prior to approval of the shop drawings by the Engineer.

C. Prior to fabrication and construction of the concrete foundation, submit for review a table sealed by the professional responsible for the design of the precast concrete building indicating vertical (upward and downward) and horizontal (inward and outward) reactions in pounds per foot at all walls for all individual load components (including, but not limited to, dead, live, collateral, wind, and seismic loads) and for all required load combinations per the building code.

D. Submit shop drawings and product data for all appurtenances including door and hardware, louver, fan, and heating equipment.

E. Submit structural design calculations and drawings for the precast reinforced concrete building for record purposes. The calculations will not by the Engineer.

F. The structural drawings and calculations shall be prepared and stamped by a professional engineer registered in the State of Florida.

1.5 QUALITY ASSURANCE

A. The building covered by this Section is intended to be the product of a well-established firm with experience in the manufacture of the particular structure specified.

B. If required by the Engineer, the manufacturer shall provide satisfactory evidence of installations of similar structures which have been in service for a minimum of five years.

C. The quality of all materials, the process of manufacture, and the finished structure shall be subject to inspection and approval by the Engineer, or other representative of the Owner. Such inspection may be made at the place of manufacture or after delivery, or at both places, and the materials shall be subject to rejection at any time on account of failure to meet any of the specified requirements even though samples may have been accepted as satisfactory at the place of manufacture. All materials which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted by the Engineer or removed and replaced, entirely at the Contractor's expense.

1.6 DELIVERY, STORAGE, AND HANDLING

A. All handling, loading, shipping, lifting and installation of the building shall be performed in strict accordance with the manufacturer's written instructions, which shall accompany the building.

B. The Contractor shall require the manufacturer to assume responsibility for packing to prevent transit and handling damage to the concrete.

1.7 REGULATORY REQUIREMENTS

A. Provide products, materials and assemblies, including anchorage, proposed for the work of this Section that comply with project specific calculated design pressures and the Florida Building Code, including wind-borne debris region requirements. Provide products designed by the Manufacturer and installed by the Contractor to meet these requirements.

1. Provide products that conform to the project design pressures in the components and cladding table on the structural drawings. Where a conflict occurs between the requirements of this Specification and the Florida Building Code, the more stringent requirement shall apply.

B. Provide documentation that the Florida Building Code compliance for the products, materials and assemblies, including anchorage specified in this Section have been incorporated into the Work. Demonstrate code compliance with the Florida Building Code, using one of the methods outlined in Chapter 9N-3 of the Florida Administrative Code, Department of Community Affairs, Florida Building Commission, Product Approval documentation.

PART 2 - PRODUCTS

2.1 PRECAST REINFORCED CONCRETE BUILDING

A. The building shall be of reinforced concrete Model Easi-Set as manufactured by Easi-Set Worldwide Concrete Systems Inc., or approved equal. The minimum inside dimensions, headroom requirements and minimum thickness of concrete shall be as indicated in this Section.

B. All precast concrete shall have a minimum compressive strength of 5000 psi at 28 days. Water shall be kept to a minimum to obtain concrete which is as dense and watertight as possible. The maximum water content shall be 6 gallons per 94-lb sack and the minimum cement factor shall be 6.0 sacks per cubic yard.

C. All reinforcement shall be as specified in Section 03300 except that for precast concrete the minimum cover shall be 3/4-in for walls and 1-1/2-in for slabs.

D. The building shall have exterior dimensions of 15-ft-1 in wide by 39-ft-1 in long with an exterior height of 12-ft. Interior dimensions shall be a minimum of 14-ft by 38-ft-0-in with a minimum clear height of 11-ft-0-in.

E. Design Criteria:

1. The precast concrete building shall conform to ACI 318.
2. When the design yield strength fy for tension reinforcement exceeds 40,000 psi the "Z" values referred to in ACI 318 shall not exceed 115 ksi. The calculated flexural stress in reinforcement under service loads "FS" shall not be greater than 50 percent of the specified yield strength fy.
3. The precast reinforced concrete building elements shall be designed to support the loads indicated on the Structural Drawings and as required by the latest edition of the Florida Building Code.
4. All members and connections providing resistance to lateral wind and/or seismic forces shall be designed and detailed. Metal connecting members, if used, shall be of stainless steel or galvanized construction.

F. Roof

1. Roof panel shall have a peak in center of 15-foot direction, as shown on the drawings, and shall slope ½” to each side. The roof shall extend a minimum of 3” beyond the wall panel

on each side and have a turndown design which extends 1/2” below the top edge of the wall panels to prevent water migration into the building along top of wall panels. Roof shall also have an integral architectural ribbed edge.

2. Post-tensioning Strand: 41K Polystrand CP50, .50, 270 KSI, 7-wire strand, greased plastic sheath, (ASTM A416), roof sections to be post-tensioned by a single, continuous tendon. Said tendon shall form a substantially rectangular configuration having gently curving corners and a corner where the tendon members are anchored. Tendons shall be greased and enclosed within a sheath.
3. Roof panels shall be post-tensioned together in field after grout keyway is filled and has cured to required PSI strength. There will be a minimum of two post-tensioning cables connecting roofs together to provide watertight joint.

G. Panel Connections: All panels shall be securely fastened together with 1/4" thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A283, Grade C and hot dipped galvanized after fabrication. All fasteners to be 1/2" diameter bolts complying with ASTM A307 for low-carbon steel bolts. Cast-in anchors used for panel connections to be Dayton-Superior #F-63. All inserts for corner connections must be bolted directly to form before casting panels. No floating-in of connection inserts shall be allowed. Wall panels shall be connected to floor slab with 4" expansion anchors by Manufacturer.

H. Caulking: All joints between panels shall be caulked on the exterior and interior surface of the joints. Caulking shall be SIKAFLEX-1A elastic sealant. Exterior caulk joint to be 3/8" x 3/8" square so that sides of joint are parallel for correct caulk adhesion. Back of joint to be taped with bond breaking tape to ensure adhesion of caulk to parallel sides of joint and not the back.

I. Roof and walls shall be insulated with rigid insulation to provide minimum R-value as indicated on drawings. Interior wall insulation shall be covered with a fire protective barrier, meeting building code requirements and providing an approved interior finish per drawings.

J. All building panels shall be analyzed by accepted engineering principles. The openings shall be completely framed as required to carry the full design loads to the supporting wall or slab. The base slabs shall be fully reinforced on both faces and the minimum reinforcing shall be No. 4 at 12-in E.F.E.W. Additional reinforcing shall be provided around all openings.

2.2 BUILDING FINISHES

A. Interior of building panels: Smooth steel form finish on all interior panel surfaces.

B. Interior walls and ceilings shall be insulated with 2 1/2"-inches of rigid polystyrene board insulation with Z style furring strips.

C. Interior walls shall be finished with smooth fiberglass reinforced plastic wall panels.

D. The exterior of the building shall be finished with manufacturer’s standard broom finish. The exterior shall be painted with a standard 10-year warranty masonry paint. The color shall be selected from the manufacturers standard color cards at time of shop drawing approval.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The building shall be placed level and located as shown on the Drawings. Confirm the exact location with the Engineer prior to excavation for the sub-base.

B. All steel surfaces to come in contact with concrete shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.

END OF SECTION

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SECTION 03600
GROUT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install grout complete as shown on the Drawings and as specified herein.

B. Perform all sampling and furnish all testing of materials and products by an independent testing laboratory acceptable to the Engineer but engaged by and at the expense of the Contractor.

1.02 RELATED WORK

A. Concrete formwork is included in Section 03100.

B. Concrete reinforcement is included in Section 03200.

C. Concrete joints and joint accessories are included in Section 03250.

D. Cast-in-place concrete is included in Section 03300.

E. Miscellaneous metals are included in Section 05500.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of surface preparation, mixing and installation for:

1. Commercially manufactured non-shrink cementitious grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to the specified ASTM standards, and Material Safety Data Sheet.

2. Commercially manufactured non-shrink epoxy grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to the specified ASTM standards, and Material Safety Data Sheet.

3. Cement grout. Include the type and brand of cement, the gradation of fine aggregate, product data on any proposed admixtures and the proposed grout mix.

B. Certifications

1. Certify that the Contractor is not associated with the independent testing laboratory, nor does the Contractor or its officers have a beneficial interest in the laboratory.

C. Qualifications

1. Submit documentation that grout manufacturers have a minimum of 10 years experience in the production and use of the grouts proposed.

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM C33 - Standard Specification for Concrete Aggregates

2. ASTM C150 - Standard Specification for Portland Cement

3. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes

4. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures

5. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

6. ASTM E329 - Standard specification for agencies engaged in the testing and/or inspection of materials used in construction

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Grout manufacturers shall have a minimum of 10 years experience in the production and use of the type of grout proposed.

2. Independent testing laboratory shall meet the requirements of ASTM E329 and ASTM C1077 and be acceptable to the Engineer. Laboratories affiliated with the Contractor or in which the Contractor or officers of the Contractor's organization have beneficial interest are not acceptable.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers and printed instructions.

B. Store materials in full compliance with the manufacturer's recommendations. 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 at no additional cost to the Owner.

D. Deliver non-shrink cementitious grout as a pre-portioned blend in prepackaged mixes requiring only the addition of water.

E. Deliver non-shrink epoxy grout as a pre-proportioned, prepackaged, three component system requiring only mixing as directed by the manufacturer.

1.07 DEFINITIONS

A. Non-shrink Grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state and bonds to a clean base plate.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of a manufacturer's name and product or catalog number is for the purpose of establishing the standard of quality desired.

B. Like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.02 MATERIALS

A. Non-shrink Cementitious Grout

1. Non-shrink cementitious grouts: Conform to ASTM C1107. Grouts shall be portland cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents and require only the addition of water. Non-shrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.
   a. General purpose non-shrink cementitious grout: Conform to the standards stated above. SikaGrout 212 by Sika Corp.; Set Grout by BASF Building Systems; NS Grout by The Euclid Chemical Co.; Five Star Grout by Five Star Products, Inc., or equal.

B. Non-shrink Epoxy Grout

1. Non-shrink epoxy grout: Grout shall be pre-proportioned, prepackaged, three component, 100 percent solids system consisting of epoxy resin, hardener and blended aggregate. It shall have a compressive strength of 10,000 psi in 7 days when tested in conformity with ASTM C579 and have a maximum coefficient of thermal expansion of 30 x 10-6 in/in/degrees F when tested in conformity with ASTM C531. Masterflow 648 CP by BASF Building Systems; Five Star HP Epoxy Grout by Five Stars Products, Inc; Sikadur 42 Grout-Pak by Sika Corp.; E3-G Epoxy Grout by the Euclid Chemical Co. or equal.

C. Water

1. Potable water free of oil, acid, alkali, salts, chlorides (except those attributable to drinking water), organic matter, or other deleterious substances.

PART 3 EXECUTION

3.01 PREPARATION

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

B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, dust, grease, oil, form release agent, laitance and paints and free of all loose material or foreign matter which may affect the bond or performance of the grout.

C. Roughen concrete surfaces by chipping, sandblasting, or other dry mechanical means to bond the grout to the concrete. Remove loose or broken concrete. 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 oilless type or equipped with an oil trap in the airline to prevent oil from being blown onto the surface.

D. Remove all loose rust, oil or other deleterious substances which may affect the bond or performance of the grout from metal embedments or bottom of baseplates prior to the installation of the grout.

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

F. Non-shrink epoxy grouts do not require saturation of the concrete substrate. Do not wet concrete surfaces to receive non-shrink epoxy grout. Surfaces in contact with epoxy grout shall be completely dry before grouting.

G. Provide forms for grout. Line or coat forms with release agents recommended by the grout manufacturer. Provide forms anchored in place and shored to resist the forces imposed by the grout and its placement.

1. Forms for all grout other than concrete grout shall be designed to allow the formation of a hydraulic head and shall have chamfer strips built into forms.

H. Level and align the structural or equipment bearing plates in accordance with the structural requirements or the recommendations of the equipment manufacturer, as applicable.

I. Support equipment during alignment and installation of grout by shims, wedges, blocks or other approved means. The shims, wedges and blocking devices shall be prevented from bonding to the grout by bond breaking coatings and removed after grouting unless otherwise approved by the Engineer. Grout voids created by the removal of shims, wedges and blocks.

3.02 INSTALLATION - GENERAL

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

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

C. Maintain temperatures of the base plate, supporting concrete, and grout between 40 and 90 degrees F during grouting and for at least 24 hours after placement, until grout compressive strength reaches 1000 psi or as recommended by the grout manufacturer, whichever is longer. Do not allow differential heating or cooling of baseplates and grout during the curing period.

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

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

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

3.03 INSTALLATION - NON-SHRINK CEMENTITIOUS GROUTS

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

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

C. Placements greater than 3-in in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.

D. Provide forms as specified in Paragraph 3.01G. Place grout into the designated areas and prevent segregation and entrapment of air. Do not vibrate grout to release air or to consolidate the material. Fill all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes and vent holes as necessary.

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

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

G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement, until grout compressive strength reaches 1000 psi or as recommended by the manufacturer, whichever is longer. Saturate the grout surface by use of saturated burlap bags, soaker hoses or ponding. Provide sunshades. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

3.04 INSTALLATION – NON-SHRINK EPOXY GROUTS

A. Mix in accordance with manufacturer's recommendations. Mix full batches only, to maintain proper proportions of resin, hardener and aggregate. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not overmix. Do not entrain air bubbles by mixing too quickly.

B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 or above 90 degrees F.

C. Place grout rapidly and continuously to avoid cold joints. Place grout in lifts in accordance with manufacturer's recommendations.

D. Provide forms as specified in Paragraph 3.01G. Place grout into the designated areas and prevent entrapment of air. Fill all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes and vent holes as necessary.

E. Minimize "shoulder" length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.

F. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.

G. Epoxy grouts are self-curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placement, until grout compressive strength reaches 1000 psi or as recommended by the manufacturer, whichever is longer.

H. Provide grout control joints as indicated on the Drawings.

3.05 SCHEDULE

A. The following list indicates where the particular types of grout are to be used:

1. General purpose non-shrink cementitious grout: Use at all locations where non-shrink grout is indicated on the Drawings, except for base plates greater in area than 3-ft wide by 3-ft long.

2. Non-shrink epoxy grout: Use at all locations specifically indicated on the Drawings to receive non-shrink epoxy grout.

END OF SECTION

SECTION 03800
CONCRETE ELECTRICAL RACEWAY ENCASEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install concrete encasement around underground electrical raceways as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Excavation, backfilling, fill and grading are included in Division 2.

B. Concrete formwork is included in Section 03100.

C. Concrete joints and joint accessories are included in Section 03250.

D. Cast in place concrete is included in Section 03300.

E. Furnishing and installing electrical conduit is included in Division 16.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement, lime, aggregate and all other concrete components shall be as specified in Section 03300 except that aggregate size shall not exceed 3/8-in. Concrete shall have a minimum compressive strength at 28 days of 2500 psi.

PART 3 EXECUTION

3.01 GENERAL

A. Concrete shall conform to the requirements Section 03300 and as specified herein.

B. Provide not less than 4-in of concrete between the outside of a raceway and the earth. Provide not less than 2-in of concrete between adjacent raceways. Form as specified in Section 03100 for buried concrete.

C. All raceway concrete placements shall be continuous between manholes or handholes and between manholes or handholes and structures.

D. Encasements shall be reinforced as and where indicated on the Drawings.

E. Encasements shall be laid in trenches on mats of screened gravel not less than 6-in thick.

F. The minimum cover for raceway banks shall be 24-in.

END OF SECTION

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SECTION 05500
MISCELLANEOUS METALS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install all miscellaneous metal complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Concrete joint accessories are included in Section 03250.

B. Equipment anchor bolts are included in the respective Sections of Divisions 11 and 15.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:

1. Shop drawings, showing sizes of members, method of assembly, anchorage and connection to other members.

B. Samples:

1. Submit samples as requested by the Engineer during the course of construction.

C. Design Data:

1. Submit calculations or test data demonstrating that the railing, equipment, and anchorage will resist the loads specified in the Florida Building Code at the post spacing provided. Calculations shall be stamped by a professional engineer registered in the State of Florida.

2. Submit calculations demonstrating that all anchors have been designed in accordance with the governing building code. All anchors into concrete shall be designed in accordance with ACI 318.

3. Submit manufacturer’s specifications and data including recommended design values and physical characteristics for expansion anchors and adhesive anchor system.

D. Certificates:

1. Submit certification that the railing system is in compliance with OSHA requirements the Florida Building Code.

2. Submit current International Code Council (ICC) Evaluation Service Reports for expansion anchors and adhesive anchor system, for installation into cracked concrete or masonry, as applicable, indicating conformance with current ICC ES Acceptance Criteria.

1.04 REFERENCE STANDARDS

A. Aluminum Association (AA):

1. AA M31C22A41:
   a. M31: Mechanical Finish, Fine Satin.
   b. C22: Finish, Medium Matte.
   c. A41: Clear Anodic Coating, Class I.

B. American Concrete Institute (ACI):

1. ACI 318 - Building Code Requirements for Structural Concrete.

2. ACI-CRSI Adhesive Anchor Installer Certification.

C. ASTM International (ASTM):

1. ASTM A36 - Standard Specification for Carbon Structural Steel.

2. ASTM A48 - Standard Specification for Gray Iron Castings.

3. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

4. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.

5. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

6. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

7. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Plate, Sheet, and Strip Pressure Vessels.

8. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.

9. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 Psi Tensile Strength.

10. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

11. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

12. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

13. ASTM A536 - Standard Specification for Ductile Iron Castings.

14. ASTM A570 - Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

15. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

16. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

17. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.

18. ASTM B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

19. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

20. ASTM F594 - Standard Specification for Stainless Steel Nuts.

21. ASTM F1554 -Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

22. ASTM F2329 - Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon Screws, Washers, Nuts, and Special Threaded Fasteners.

D. American Institute of Steel Construction (AISC):

1. Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design.

E. American Welding Society (AWS):

1. AWS D1.1 - Structural Welding Code - Steel.

2. AWS D1.2 - Structural Welding Code - Aluminum.

3. AWS D1.6 - Structural Welding Code - Stainless Steel.

F. Occupational Safety and Health Administration (OSHA).

G. International Code Council Evaluation Services (ICC ES):

1. AC01 - Expansion Anchors in Masonry Elements.

2. AC58 - Adhesive Anchors in Masonry Elements.

3. AC193 - Mechanical Anchors in Concrete Elements.

4. AC308 - Post-Installed Adhesive Anchors in Concrete Elements.

H. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. General:

1. The work of this Section shall be completely coordinated with the work of other Sections. Verify, at the site, both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.

2. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.

3. Drilled-in anchors including expansion anchor and adhesive anchor system, shall be installed by a contractor with at least five years of experience performing similar installations.

4. All welding shall be performed by qualified welders and shall conform to the applicable AWS welding code. Welding of steel shall conform to AWS D1.1 and welding of aluminum shall conform to AWS D1.2 and welding of stainless steel shall conform to AWS D1.6.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.

B. Store materials on skids and not on the ground and block up so that they will not become bent or otherwise damaged. Handle materials with cranes or derricks. Do not dump material off cars or trucks nor handle in any other way that will cause damage.

C. Repair items that have become damage or corroded to the satisfaction of the Engineer prior to incorporating them into the work.

1.07 PROJECT/SITE REQUIREMENTS

A. Field measurements shall be taken at the site, prior to fabrication of items, to verify or supplement indicated dimensions and to ensure proper fitting of all items.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service.

2.02 MATERIALS

A. Unless otherwise noted, materials for miscellaneous metals shall conform to the following standards:

1. Structural Steel:	Wide flange shapes: ASTM A992.
2. Other shapes; plates; rods and bars:	ASTM A36.
3. Structural Steel Tubing:	ASTM A500, Grade B.
4. Welded and Seamless Steel Pipe:	ASTM A501 or ASTM A53, Type E or S, Grade B Schedule 40. Use standard malleable iron fittings, galvanized for exterior work.
5. Steel Sheets:	ASTM A1008.
6. Gray Iron Castings:	ASTM A48, Class 35.
7. Ductile Iron Castings:	ASTM A536, Grade 65-45-12.
8. Aluminum Extruded Pipe:	ASTM B429, Alloy 6063 T6 and Alloy 6061 T6 as indicated.
9. Aluminum Extruded Shapes:	ASTM B221, Alloy 6061 T6.
10. Aluminum Sheet and Plate:	ASTM B209, Alloy 6061 T6.
11. Stainless Steel Plates, Sheets, and Washers:	
a. Exterior, Submerged or Industrial Use:	ASTM A240, Type 316 (Type 316L for welded components).
b. Interior and Architectural Use:	ASTM A240, Type 304.
12. Stainless Steel Shapes and Bars:	
a. Exterior, Submerged or Industrial Use:	ASTM A276, Type 316 (Type 316L for welded components).
b. Interior and Architectural Use:	ASTM A276, Type 304.
13. Stainless Steel Bolts	ASTM F593, Type 316.
14. Stainless Steel Nuts:	ASTM F594, Type 316.
15. Carbon Steel Bolts and Studs:	ASTM A307, Grade A (hot dip galvanized nuts and washers where noted).
16. High Strength Steel Bolts, Nuts and washers:	ASTM A325 (mechanically galvanized per ASTM B695, Class 50, where noted)
a. Elevated Temperature Exposure:	Type I.
b. General Application:	Type I or Type II.

17. Galvanizing:	ASTM A123, Zn w/0.05 percent minimum Ni.
18. Galvanizing, hardware:	ASTM A153, Zn w/0.05 percent minimum Ni.
19. Galvanizing, anchor bolts:	ASTM F2329, Zn w/0.05 percent minimum Ni.
20. Welding electrodes, steel:	AWS A5.1 E70xx.

2.03 ANCHORS, BOLTS AND FASTENING DEVICES

A. Unless otherwise noted, anchor bolts shall be ASTM F1554, Grade 36. Provide standard headed bolts with heavy hex nuts and Grade A washers. Where galvanized anchor bolts are shown or specified, provide standard headed bolts with heavy hex nuts and Grade A washers, all galvanized in accordance with ASTM F2329.

B. Unless otherwise noted, bolts for the connection of carbon steel or iron shall be steel machine bolts; bolts for the connection of galvanized steel or iron shall be galvanized steel or stainless steel machine bolts; and bolts for the connection of aluminum or stainless steel shall be stainless steel machine bolts.

C. Unless otherwise noted, expansion anchors shall be zinc plated carbon steel wedge type anchors complete with nuts and washers. Type 316 stainless steel wedge type anchors shall be used where they will be submerged or exposed to the weather or where stainless steel expansion anchors are shown or specified. When the length or embedment of the bolt is not noted on the Drawings, provide length sufficient to place the wedge and expansion cone portion of the bolt at least 1-in behind the concrete reinforcing steel. Anchors shall meet ICC ES AC01 or ICC ES AC193. Expansion anchors shall be Hilti, Kwik-Bolt TZ; Simpson Strong-Tie 2 Strong Bolt Wedge Anchor; Powers Power-Stud+ SD1 (Powers Power-Stud+ SD6 for stainless steel) or equal. Unless otherwise noted, anchorage designs shown on the Drawings are based on Hilti Kwik-Bolt TZ.

D. Adhesive anchor system, for fastening to solid concrete substrate, shall be a system manufactured for the installation of post installed studs including anchoring hardware and chemical dispenser. Injection adhesive shall be a two-component epoxy system including a hardener and a resin, furnished in pre-measured side-by-side cartridges which keep the two components separate. Side-by-side cartridges shall be designed to accept a static mixing nozzle which thoroughly blends the two components and allows injection directly into the drilled hole. Provide zinc plated carbon steel or Type 316 stainless steel stud assemblies as indicated on the Drawings consisting of an all-thread anchor rod with nut and washer. Adhesive anchor system shall meet ICC ES AC308. All holes shall be hammer drilled. Adhesive anchor system shall be Hilti HIT-RE 500 V3; Simpson Strong Tie SET-XP; ITW Ramset Red Head Epcon G5; or equal. Unless otherwise noted, anchorage designs shown on the Drawings are based on Hilti HIT- RE 500 V3.

E. Automatic end welded headed anchor studs shall be flux ended studs made from cold drawn steel, ASTM A108 Grades C-1010 through C-1020. Headed anchor studs shall be Nelson, H4L Headed Concrete Anchors or equal.

F. Machine bolts and nuts shall conform to Federal Specification FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers and related appurtenances shall be Type 316 stainless steel.

G. Toggle bolts shall be Hilti, Toggler Bolt or equal.

2.04 MISCELLANEOUS ALUMINUM

A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Welding shall be on the unexposed side as much as possible in order to prevent pitting or discoloration of the aluminum exposed surface. Provide holes for temporary field connections and for attachment of the work of other trades.

C. Miscellaneous aluminum items shall include: beams, angles, closure angles, grates, hatches, floor plates, stop plates, stair nosings and any other miscellaneous aluminum called for on the Drawings and not otherwise specified.

D. Aluminum diamond plate and floor plate shall have a minimum thickness of 3/8-in. Frames and supports shall be of aluminum construction. Fastening devices and hardware shall be Type 316 stainless steel. Plates shall have a mill finish.

E. Aluminum nosing at concrete stairs shall be Wooster Products, Inc.; Alumogrit Treads, Type 116; similar by Barry Pattern and Foundry Co.; Andco or equal. Furnish with wing type anchors and flat head stainless steel machine screws, 12-in on center. Nosing shall also be used at concrete ladder openings. Nosing shall a single piece for each step extending to within 3-in at each side of stair or full ladder width. Set nosing flush with stair tread finish at concrete stairs. Furnish treads with heavy duty protective tape cover.

F. Aluminum as specified on the Drawings shall be given an anodic oxide treatment in accordance with the AA M31C22A41. Other aluminum items shall have a cleaned and degreased mill finish.

2.05 MISCELLANEOUS STEEL

A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where

least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Provide holes for temporary field connections and for attachment of the work of other trades.

C. Miscellaneous steel items shall include: beams, angles, lintels, metal stairs, support brackets, base plates for other than structural steel or equipment, closure angles, bridge crane rails, monorail hoist beams, holddown straps and lugs, door frames, splice plates, subframing at roof openings and any other miscellaneous steel called for on the Drawings and not otherwise specified.

D. Structural steel angle and channel door frames shall be galvanized. Frames shall be fabricated with not less than three anchors on each jamb.

E. Steel pipe pieces for sleeves, lifting attachments and other functions shall be Schedule 40 pipe unless otherwise shown on the Drawings. Wall and floor sleeves, of steel pipe, shall have welded circumferential steel waterstops at mid-length.

F. All steel finish work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust and foreign matter and shall be given one shop coat of primer compatible with the finish coat after fabrication but before shipment. Paint shall be omitted within 3-in of proposed field welds. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces.

G. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Coating shall be not less than 2 oz/sq ft of surface.

2.06 MISCELLANEOUS STAINLESS STEEL

A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Provide holes for temporary field connections and for attachment of the work of other trades.

C. Miscellaneous stainless steel items shall include: beams, angles, bar racks and any other miscellaneous stainless steel called for on the Drawings and not otherwise specified.

2.07 CASTINGS

A. Casting shall be of good quality, strong, tough, even-grained, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Castings shall be thoroughly cleaned and will be subjected to a hammer inspection in the field by the Engineer. All matching surfaces shall be machined to a true plane

surface to allow contact surfaces to seat at all points without rocking. Allowances shall be made in the patterns so that the thickness specified shall not be reduced in obtaining finished surfaces. Castings will not be acceptable if the actual weight is less than 95 percent of the theoretical weight computed from dimensions. The Contractor shall provide facilities for weighing castings in the presence of the Engineer.

B. Frames, covers, cast grates and trench drains for structures shall be gray iron castings except as otherwise specified or indicated on the Drawings. Sizes shall be as shown on the Drawings. Covers shall have letters "WATER," "SANITARY SEWER," or DRAIN," as applicable, embossed on top.

C. Frames and covers for installation in slabs shall be heavy duty, R-6099 Series as manufactured by Neenah Foundry Co., or equal.

D. Electrical and telephone manhole and handhole frames and covers shall be ductile iron castings. The covers shall be watertight. Covers shall have the word "ELECTRIC," "HIGH VOLTAGE," "LOW VOLTAGE," "SIGNAL," "TELEPHONE," as applicable, embossed on or cast into the top in letters 2-in high. The clear opening shall be 36-in unless otherwise indicated on the Drawings.

E. Trench drains shall be of the length shown on the Drawings and shall be heavy duty, R-4990 Series with a "Type A" cover as manufactured by Neenah Foundry Co. or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install all items except those to be embedded in concrete or other masonry which shall be installed under Division 3 and Division 4 respectively. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown. Fastening to wood plugs in masonry will not be permitted.

B. Abrasions in the shop primer shall be touched up immediately after erection. Areas left unprimed for welding shall be painted with primer after welding.

C. Zinc coating which has been burned by welding, abraded, or otherwise damaged shall be cleaned and repaired after installation. The damage area shall be thoroughly cleaned by wire brushing and all traces of welding flux and loose or cracked zinc coating removed prior to painting. The cleaned area shall be painted with two coats of zinc oxide-zinc dust paint conforming to the requirements of Military Specifications MIL-P-15145. The paint shall be properly compounded with a suitable vehicle in the ratio of one part zinc oxide to four parts zinc dust by weight.

D. Specialty products shall be installed in accordance with the manufacturer's recommendations.

E. Expansion anchors shall be checked for tightness a minimum of 24 hours after initial installation.

F. Install adhesive anchor system in strict compliance with the manufacturer's recommendations, including drill bit diameter, surface preparation, temperature, moisture conditions, injection and installation of bolts. Use oil free compressed air to blast out loose particles and dust from the

drilled holes. Studs must be clean and free of dirt, oil, grease, ice or other material which would reduce bond.

G. Headed anchor studs shall be welded in accordance with manufacturer's recommendations.

H. All railings shall be erected to line and plumb.

I. All steel surfaces that come into contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.

J. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.

K. Where aluminum contacts masonry or concrete, apply a heavy coat of approved alkali resistant paint to the masonry or concrete.

L. Where aluminum contacts wood, apply two coats of aluminum metal and masonry paint to the wood.

M. Between aluminum gratings, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-in thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

END OF SECTION

SECTION 06640
PLASTIC PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic sheet paneling.

B. Related Requirements:

1. Section 03480 "Precast Concrete Building" for locations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For plastic paneling, in manufacturer's standard sizes.

1.4 QUALITY ASSURANCE

A. Testing Agency: Acceptable to authorities having jurisdiction.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319.

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

    a. Crane Composites, Inc.
    b. Glasteel.
    c. Marlite.
    d. Parkland Plastics, Inc.

2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 200 or less.
    b. Smoke-Developed Index: 450 or less.

3. Nominal Thickness: Not less than 0.075 inch.
4. Surface Finish: Smooth.
5. Color: As selected by Engineer from manufacturer's full range.

2.3 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, and caps as needed to conceal edges.

1. Color: Match panels.

B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.

C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

D. Adhesive: As recommended by plastic paneling manufacturer.

E. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07920 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

B. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

D. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.

1. Mark plumb lines on substrate at panel joint locations for accurate installation.
2. Locate panel joints to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive. Do not fasten through panels.

D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

F. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.

G. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

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SECTION 07210
THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board.

B. Related Requirements:

1. Section 03480 “Precast Concrete Building” for location.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

B. Extruded Polystyrene Board, Type X: ASTM C578, Type X, 15-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.

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

a. Dow Chemical Company (The).
b. MBCI.
c. Owens Corning.

2.2 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

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SECTION 07920
JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Butyl joint sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Engineer from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.

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

a. Pecora Corporation.
b. Sika Corporation; Joint Sealants.
c. The Dow Chemical Company.

2.3 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

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

a. BASF Corporation.
b. Bostik, Inc.
c. Pecora Corporation.
d. Sherwin-Williams Company (The).
e. Sika Corporation; Joint Sealants.
f. Tremco Incorporated.

B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.

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

a. BASF Corporation.
b. Pecora Corporation.
c. Sherwin-Williams Company (The).

C. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. LymTal International Inc.

2.4 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.

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

a. Bostik, Inc.
b. Pecora Corporation.

2.5 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

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

a. Alcot Plastics Ltd.
b. BASF Corporation.
c. Construction Foam Products; a division of Nomaco, Inc.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces

1. Joint Locations:

    a. Isolation and contraction joints in cast-in-place concrete slabs.
    b. Joints between plant-precast architectural concrete paving units.
    c. Joints between different materials listed above.
    d. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, M, P, 50, T, NT.
3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

    a. Construction joints in cast-in-place concrete.
    b. Joints between plant-precast architectural concrete units.
    c. Joints between different materials listed above.
    d. Perimeter joints between materials listed above and frames of doors.
    e. Control and expansion joints in ceilings.
    f. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

    a. Isolation joints in cast-in-place concrete slabs.
    b. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, P, 25, T, NT.
3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Joints on underside of plant-precast structural concrete beams and planks.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

E. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:

a. Aluminum thresholds.
b. Sill plates.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

END OF SECTION

SECTION 08220
FIBERGLASS REINFORCED PLASTIC DOORS AND ALUMINUM FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes fiberglass reinforced plastic (FRP) doors and aluminum frames.

B. Related Requirements:

1. Section 08710 "Door Hardware" for door hardware for hollow-metal doors.

1.3 COORDINATION

A. Coordinate anchorage installation for fiberglass reinforced plastic (FRP) doors and aluminum frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and materials thicknesses.
3. Frame details for each frame type, including dimensioned profiles and material thicknesses.

4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

C. Samples: For fiberglass reinforced plastic (FRP) doors and frames with factory-applied color finishes.

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
   a. Provide sample which indicate gloss level.

2. Fabrication: Prepare Samples approximately 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:
   a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing and louvers if applicable.
   b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing hollow metal construction and glazing if applicable.

D. Product Schedule: For fiberglass reinforced plastic (FRP) doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

E. Regulatory Approvals: Provide copy of current, valid statewide product approval for product, material or system as shown on the drawings and as specified in this Section, in accordance with Rule 9N-3. Product approval shall be for the specific manufacturer, product type, model or style, and the State Approval Number.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of fiberglass reinforced plastic (FRP) doors and frames, for tests performed by a qualified testing agency.

B. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver fiberglass reinforced plastic (FRP) doors and frames in manufacturer's original unopened packaging. Mark and remove damaged materials from the project site. Where materials are covered by a referenced specification, label the package with the specification number, type, and class, as applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

B. Storage:

1. Protect materials against moisture absorption and contamination or other damage.
2. Store all materials on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer.
3. Do not store materials in buildings under construction until concrete, mortar, and plaster work is finished and dry.
4. Do not store materials outdoors.
5. Do not store materials in contact with other materials that might cause staining, denting, or other surface damage.

C. Handling:

1. Prevent damage to corners, edges and ends of materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials.

1.8 REGULATORY REQUIREMENTS

A. Provide products, materials and assemblies, including anchorage, proposed for the work of this Section that comply with project specific calculated design pressures and the Florida Building Code, including wind-borne debris region requirements. Provide products designed by the Manufacturer and installed by the Contractor to meet these requirements.

1. Provide products that conform to the project design pressures in the components and cladding table on the structural drawings. Where a conflict occurs between the requirements of this Specification and the Florida Building Code, the more stringent requirement shall apply.

B. Provide documentation that the Florida Building Code compliance for the products, materials and assemblies, including anchorage specified in this Section have been incorporated into the Work. Demonstrate code compliance with the Florida Building Code, using one of the methods outlined in Chapter 9N-3 of the Florida Administrative Code, Department of Community Affairs, Florida Building Commission, Product Approval documentation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Alloy for Frames: ASTM B 221 / ASTM B 221M, alloy 6063-T5 for extrusions; ASTM B 209 / B 209M, alloy and temper best suited for aluminum sheets and strips.

B. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

C. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Special-Lite.
2. Or equal products not accepted for this item.

2.3 DOORS

A. Non-Rated Openings: Provide the following:

1. Face Sheets - Seamless fiberglass reinforced polyester plastic, 0.120-in thick.
2. Internal Stiles and Rails - Structural fiberglass reinforced plastic with solid polymer corner reinforcement.
3. Core - Polyurethane, 1-1/2-inches thick, U factor - 0.14 deg Btu/F x h x sq. ft..
4. Hardware Reinforcement - Solid polymer.
5. Intermediate Framing - Supply structural FRP as and where required for door integrity.
6. Chemically weld entire door.
7. Polyester gel-coat entire door following hardware machining, 15 mils plus/minus 3 mils dry film thickness.

B. Exterior Door Model SL-17, Full Flush.

2.4 FRAMES

A. Aluminum Framing: ASTM B 221, with alloy and temper required to suit structural and finish requirements, and not less than 0.062 inch thick.

B. Door Frames: Extruded aluminum, reinforced for hinges, strikes, and closers.

C. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted and mitered connections.

D. Factory prepare aluminum frames to receive templated mortised hardware; include cutouts, reinforcements, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 08710 "Door Hardware."

2.5 FASTENERS

A. Stainless steel fasteners, 300 Series as approved, shall be used for frame assembly and for all other fasteners.

2.6 PERFORMANCE REQUIREMENTS

A. Air Infiltration: When tested in accordance with ASTM E283, air infiltration is not to exceed 0.06 cubic feet per minute per square foot of fixed area at a test pressure of 6.24 pounds per square foot at 50 mile per hour wind.

B. Water Penetration: When tested in accordance with ASTM E331, no water penetration is allowed, at a pressure of 8 pounds per square foot of fixed area.

C. Provisions for Thermal Movement: Design doors and frames to provide for expansion and contraction of the component parts caused by an ambient temperature range of minus 0 to 100 degrees F causing buckling, opening of joints, overstressing of fasteners, or other harmful effects.

2.7 FABRICATION

A. FRP Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.

2. Vertical Edges for Single-Acting Doors: Provide beveled or square edges at manufacturer's discretion.

3. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.

4. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.

B. Aluminum Frames: Extruded aluminum shapes with contours approximately as indicated. Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 12 inches on center. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically.

1. Construction: Thermally broken at exterior locations.

C. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.8 FRP FINISH

A. Manufacturer’s standard pebble texture through color, from manufacture’s full range of colors

2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that wall thickness does not exceed standard tolerances allowed by throat size of indicated aluminum frame.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. Install aluminum frames plumb, rigid, properly aligned, and securely fastened in place; according to manufacturer's written instructions.

B. Install frame components in the longest possible lengths with no piece less than 48 inches; components 96 inches or shorter shall be one piece.

1. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
2. Secure clips to extruded main-frame components and not to snap-in or trim members.
3. Do not leave screws or other fasteners exposed to view when installation is complete.

C. Fit and hang door in accordance with clearances specified below:

1. Clearance Tolerances:

a. Jambs and Head: Plus 1/8-inch or minus 1/16-inch.
b. Pairs of Doors: Plus 1/8 inch or minus 1/16-inch.
c. Bottom of Door and Top of Threshold: Maximum (3/8-inch.
d. Bottom of Door and Top of finish floor (No Threshold: Maximum 3/4-inch.

3.4 ADJUSTING

A. Inspect installation, correct misalignments, and tighten loose connections.

B. Doors: Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly and lubricate as recommended by manufacturer.

C. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended in writing by frame manufacturer and according to AAMA 609 & 610.

D. Touch Up: Repair marred surfaces to blend inconspicuously with adjacent unrepaired surface so touchup is not visible from a distance of 48 inches as viewed by Engineer. Remove and replace doors and frames with damaged finish that cannot be satisfactorily repaired.

END OF SECTION

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SECTION 08710
DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Related Requirements:

1. Section 08220 “Fiberglass Reinforced Plastic Doors and Aluminum Frames”

1.3 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.

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.

B. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:

a. Identification number, location, hand, fire rating, size, and material of each door and frame.
b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
e. Fastenings and other installation information.
f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
g. Mounting locations for door hardware.
h. List of related door devices specified in other Sections for each door and frame.

C. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and Architectural Hardware Consultant.

B. Product Certificates: For each type of electrified door hardware.

1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.

C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final door hardware and keying schedule.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Engineer, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

a. Exit Devices: Two years from date of Substantial Completion.
b. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of door hardware from single manufacturer and complying with JEA Facilities Standards.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

A. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

B. Accessibility Requirements: For door hardware on doors in an accessible route, comply with Florida Building Code, Accessibility.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
3. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
4. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 SCHEDULED DOOR HARDWARE

A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.

1. Door hardware is scheduled in Part 3.

2.4 HINGES, GENERAL

A. Quantity: Provide the following, unless otherwise indicated:

1. Two Hinges: For doors with heights up to 60 inches.
2. Three Hinges: For doors with heights 61 to 90 inches.
3. Four Hinges: For doors with heights 91 to 120 inches.
4. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

C. Hinge Weight: Provide Heavy-weight hinges.

D. Hinge Base Metal: Stainless steel, with stainless-steel pin.

E. Hinge Corners: Square.

F. Fasteners: Stainless steel

2.5 HINGES

A. Hinges: BHMA A156.1.

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

a. Hager Companies.
b. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.6 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
2. Deadbolts: Minimum 1-inch bolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:

1. Levers:

a. "Lustra," by Corbin Russwin; an ASSA ABLOY Group company (LSA). Or approved equal not acceptable for this item.
b. Satin Stainless Steel US32D (BHMA 630) finish.

2. Lockset Designs: Provide designs that match those scheduled.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

2.7 DOOR BOLTS

A. Bolt Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Mortise Flush Bolts: Minimum 3/4-inch throw.

B. Dustproof Strikes: BHMA A156.16, Grade 1.

C. Manual Flush Bolts: BHMA A156.16, Grade 1; designed for mortising into door edge.

1. Manufacturers: Provide products by one of the following:

a. Hager Companies (HAG).
b. IVES Hardware; Allegion, plc (IVS).
c. Rockwood Manufacturing Company (RM).
d. Or equal.

2.8 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices: BHMA A156.3, Grade 1 Heavy Duty Mortise Lock Exit Device.

B. Construction:

1. Chassis shall be heavy duty cast design with one piece drawn nonferrous removable covers matching the material of the push and mounting rails.
2. Mounting rails shall be formed from a solid single piece of stainless steel, brass or bronze no less than 0.072” thick.
3. Push rails shall be constructed of 0.062” thick material in the same manner as the mounting rail. Painted or anodized aluminum shall not be considered heavy duty and are not acceptable.
4. Provide protective Lexan touchpad on the exit device push rail to prevent scratches and serve as a visible guide to the user.
5. Metal end caps shall be formed from the same base metal as the push and mounting rails.

C. Exit devices shall have a maximum of 3-inch projection from the face of the door in the non-dogged. When in the dogged position, the device shall have no more than a 2-1/8" projection from the door face.

D. The design of the exit device shall eliminate the necessity of removing the device from the door for standard maintenance or keying changes.

E. The device chassis shall be mounted and operable without the need of the rails or the chassis cover.

F. Trim shall be through-bolted.

G. Devices shall be available with matching trim for both wide and narrow stile doors, including electrified functions when required.

H. Exit device operating lever trim shall withstand 1000 inch pounds of torque without allowing access.

I. Lever trim shall be available in architectural finishes and designs to match that of the locksets specified.

2.9 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable.

C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.10 KEYING

A. Keys: Patented Corbin Russwin Master Keying System

1. Stamping: Permanently inscribe each key with a visual key control number and include the notation "DO NOT DUPLICATE."

2. Quantity: In association with Owner requirements, determined at keying conference, provide up to the following maximum number of keys.

a. Cylinder Change Keys: Three.
b. Master Keys: Five.
c. Grand Master Keys: Five.
d. Great-Grand Master Keys: Five.

2.11 OPERATING TRIM

A. Operating Trim: BHMA A156.6; aluminum unless otherwise indicated.

2.12 SURFACE CLOSERS

A. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.

B. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Provide products by one of the following:

   a. LCN Closers; Allegion, plc (LCN).
   b. Norton Door Controls; an ASSA ABLOY Group company (NDC).
   c. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
   d. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).
   e. Or equal.

2.13 PROTECTIVE TRIM UNITS

A. Size: 1-1/2 inches less than door width on push side and 1/2 inch less than door width on pull side, by height specified in door hardware sets.

B. Fasteners: Manufacturer's standard machine or self-tapping screws.

C. Metal Protective Trim Units: BHMA A156.6; beveled top and 2 sides; fabricated from the following material:

1. Material: 0.050-inch-thick stainless steel.
2. Manufacturers: Provide products by one of the following:

   a. Hager Companies (HAG).
   b. IVES Hardware; Allegion, plc (IVS).
   c. Rockwood Manufacturing Company (RM).
   d. Or equal.

2.14 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

2.15 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

B. Maximum Air Leakage: When tested according to ASTM E283 with tested pressure differential of 0.3-inch wg, as follows:

1. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
2. Gasketing on Double Doors: 0.50 cfm per foot of door opening.

2.16 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.17 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Engineer.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:

a. Wood or Machine Screws: For the following:

1) Hinges mortised to doors or frames.
2) Strike plates to frames.
3) Closers to doors and frames.

b. Steel Through Bolts: For the following unless door blocking is provided:

1) Surface hinges to doors.
2) Closers to doors and frames.
3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.18 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.
2. Furnish permanent cores to Owner for installation.

E. Key Control System:

1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
2. Key Lock Boxes: Install where indicated or approved by Engineer to provide controlled access for fire and medical emergency personnel.
3. Key Control System Software: Set up multiple-index system based on final keying schedule.

F. Boxed Power Supplies: Locate power supplies as indicated. Verify location with Engineer.

1. Configuration: Provide one power supply for each door opening with electrified door hardware.

G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 07920 "Joint Sealants."

H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication,

cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.8 DEMONSTRATION

A. Engage Installer to train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.9 DOOR HARDWARE SCHEDULE

1. HW 1 (Locked Door with Exit Device)

3	Hinges	BB1199, 4-1/2 x 4-1/2	US32D	Hager
1	Exit Device	ED5200S	US32D	Corbin Russwin
1	Cylinder	ML20606 NAC Series	US26D	Corbin Russwin
1	Closer	281 Series with heavy duty arm	US26D	Sargent
1	Overhead Stop and Holder:	1ADJ-026	US26D	Rixson
1	Kick Plate	K1050, stainless, 8” high 4BE	US32D	Rockwood
1	Door Bottom	314CN		Pemko
1	Threshold	2005AT		Pemko
1	Gasketing	290AV (coordinate head w/closer)		Pemko

2. HW 2 (Double Door with Exit Device on Active Leaf)

6	Hinges	BB1199, 4-1/2 x 4-1/2	US32D	Hager
1	Exit Device	ED5200S	US32D	Corbin Russwin
1	Cylinder	ML20606 NAC Series	US26D	Corbin Russwin
1	Closer	281 Series with heavy duty arm	US26D	Sargent
2	Overhead Stop and Holder:	1ADJ-026	US26D	Rixson
1	Kick Plate	K1050, stainless, 8” high 4BE	US32D	Rockwood
1	Door Bottom	314CN		Pemko
1	Threshold	2005AT		Pemko
1	Gasketing	290AV (coordinate head w/closer)		Pemko

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SECTION 09221
NON-STRUCTURAL METAL FRAMING

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. Non-load-bearing steel framing systems for interior partitions.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized unless otherwise indicated.

B. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-steel thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

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

a. ClarkDietrich.
b. MarinoWARE.
c. MRI Steel Framing, LLC.

2.2 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8-inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.3 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Install studs so flanges within framing system point in same direction.

C. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

D. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 07210 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION

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SECTION 09901
SHOP PRIMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes shop primers not included in other sections.

B. Related Requirements:

1. Division 9 for field applied painting.
2. Other specifications that reference this specification for primers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include written statement, or published product data, that the confirms that the shop primer materials are compatible with the finish and field coatings.

B. Samples: For each exposed product.

1.4 QUALITY ASSURANCE

A. Compatibility of Coating Systems: Shop priming with primers that are guaranteed, in writing, by the manufacturer to be compatible with field applied and other coatings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Submerged Surfaces: Shop primer for ferrous metals which will be in contact with water being treated, either submerged or which are subject to splash action or which are specified to be considered submerged service:

1. Shop Prime Coat: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer):

a. TNEMEC: Series 1 Omnithane.

b. Carboline: Carboguard 561.
c. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
d. PPG PMC: Durathane MCZ 97-679 Series or PPG PMC Amerlock 400.
e. Or equal.

B. Non-Submerged Surfaces: Shop primer for ferrous metals which will not be in contact with water being treated, not submerged and not subject to splash action:

1. Shop Prime Coat: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer):

a. TNEMEC: Series 1 Omnithane.
b. Carboline: Carboguard 561.
c. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
d. PPG PMC: Durathane MCZ 97-679 Series or PPG PMC Amercoat 68HS.
e. Or equal.

C. Submerged Surfaces:

1. Shop Prime Coat for Ductile Iron Pipe: (Epoxy, Polyamidoamine Shop Primer):

a. TNEMEC: Series N140 Pota-Pox-Plus.
b. Carboline: Carboguard 561.
c. Sherwin-Williams Company (The): Macropoxy 5500.
d. PPG PMC: Aquapon HB Potable Water Epoxy Coating 95-132 Series or PPG PMC Amerlock 2 Epoxy.
e. Or equal.

2. Shop Prime Coat for Ferrous Metal Surfaces: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer):

a. TNEMEC: Series 1 Omnithane.
b. Carboline: Carboguard 561.
c. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
d. PPG PMC: Durathane MCZ 97-679 Series.
e. Or equal.

D. Non-Primed Surfaces - Gears, bearings surfaces and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during all periods of storage and erection and shall be satisfactory to the Engineer up to the time of the final acceptance test.

E. Compatibility of Coating Systems - Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with their corresponding primers and finish coats specified in Section 09902 for use in the field and which are recommended for use together.

PART 3 - EXECUTION

3.1 APPLICATION

A. Surface Preparation and Priming

1. Non-submerged components scheduled for priming, as defined above, shall be blast cleaned in accordance with SSPC-SP 6/NACE No. 3, immediately prior to priming. Submerged components scheduled for priming, as defined above, shall be blast cleaned in accordance with SSPC-SP 10/NACE No. 2, immediately prior to priming. Consult manufacturer regarding required surface profiles.
2. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.
3. Shop prime in accordance with approved manufacturer's recommendations.

B. Non-Primed Surfaces

1. Apply approved coating per manufacturer's recommendations.

3.2 FABRICATED ITEMS

A. All items to be shop primed shall be blast cleaned as specified for applicable service prior to priming. If, in the opinion of the Engineer, any prime coating that has been improperly applied or if material contrary to this Section has been used, that coating shall be removed by abrasive blasting to white metal and reprimed in accordance with this Section.

B. All shop prime coats shall be of the correct materials and applied in accordance with this Section. Remove any prime coats not in accordance with this Section by blast cleaning and apply the specified prime coat at no additional cost to the Owner.

C. Shop primed surfaces shall be cleaned thoroughly and damaged or bare spots prepared as approved and retouched with the specified primer before the application of successive paint coats in the field.

D. Shop finish coats, if proposed and allowed, shall be equal in appearance and protection quality to a field applied finish coat. If, in the opinion of the Engineer, a shop finish coat system does not give the appearance and protection quality of other work of similar nature, prepare the surfaces and apply the coat or coats of paint as directed by the Engineer to accomplish the desired appearance and protection quality. Submit to the Engineer substantial evidence that the standard finish is compatible with the specified finish coat.

E. Properly protect the shop prime and finish coats against damage from weather or any other cause.

F. Wherever fabricated equipment is required to be blast cleaned, protect all motors, drives, bearings, gears, etc., from the entry of grit. Equipment found to contain grit shall be promptly and thoroughly cleaned.

END OF SECTION

SECTION 09902
PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following substrates:

1. Concrete.
2. Steel and iron.
3. Bituminous-coated surfaces.

B. Section includes painting all exposed structural and miscellaneous steel; chemical tanks and systems; mechanical and electrical equipment; sluice gates, operators and posts; conveying systems, pipe, fittings and valves; electrical conduit and appurtenances; new CMU walls; exposed interior ducts; all as specified in the attached painting schedules and all other work obviously required to be painted unless otherwise specified. Minor items not mentioned in the schedule of work shall be included in the work of this Section where they come within the general intent of this Section as stated herein.

C. Paint items noted in “Painting Schedule.”

D. Provide vinyl film letters and numbers for markings as specified.

E. Paint items noted in other Specification Sections as having factory finish and other factory finished items are obviously not field painted.

F. Paint all factory finish painted items replaced, repaired or damaged during construction.

G. The various Sections are responsible, as stated in each, for preparation and field touch-up of abrasions, welds and damaged primed areas of primed or galvanized components after erection.

H. The following items will not be painted:

1. Concrete except where specified above and scheduled to be painted and seamless flooring.
2. Stainless steel louvers, doors and frames.
3. Finish hardware.
4. Non-ferrous metals and stainless steel, unless specifically noted otherwise.
5. Factory pre-finished architectural components.

6. Packing glands and other adjustable parts and name plates of mechanical equipment.
7. Parts of buildings not exposed to sight, unless specifically noted otherwise.
8. Maintenance equipment
9. Plumbing fixtures.
10. Mechanical, HVAC, Plumbing and Electrical equipment which has been finished painted in the factory as specified in Divisions 15 and 16.

I. Related Requirements:

1. Valve identification is included in Divisions 15.
2. Shop priming of equipment and piping (except copper piping) are specified in Section 09901 – "Surface Prep and Shop Prime Painting" and included in the respective Section with the item to be primed.
3. Section 05500 "Miscellaneous Metals" for shop priming metal fabrications.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 QUALITY ASSURANCE

A. Shop Primers, specified in Section 09901 "Surface Prep and Shop Prime Painting," and other Sections are required to be certified by the manufacturer of the field applied painting manufacturer to be compatible with the materials specified in this section.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide products by one of the following:

1. The Sherwin Williams Company (SW)
2. Or equal products not accepted for this item.

2.2 MATERIALS

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Provide products of same manufacturer for each coat in a coating system.

B. Use paint materials without adulteration and mixed, thinned and applied in strict accordance with manufacturer's directions for the applicable materials and surface.

C. Colors: As selected by Engineer from manufacturer's full range.

2.3 COLOR CODING FOR PIPES AND EQUIPMENT

A. The color code establishes, defines and assigns a definite color for each process system. Paint all elements which are an integral part of the system, that is originating from the equipment and/or supplying the equipment, between and up to but not including the fixed flanges nor the flexible conduit connections on the equipment. Paint valves and fittings in the color of the main body of the pipe.

B. All pipes and equipment shall be painted with final coat color selected by the Engineer and shall be treated as an integral part of the Contract.

C. All hanger saddles and pipe support floor stands shall be painted the same color and with the same paint as the pipe it supports. Hanger rods and hanger rod connections to building structure shall be painted to match the color of the wall or ceiling to which it is attached.

2.4 LETTERING OF TITLES

A. Indicate the name of the materials in each pipeline and alongside this an arrow indicating the direction of flow of fluids on each pipe system. Locate the titles shall not more than 26 feet apart and directly adjacent to each side of any wall the pipeline breaches, adjacent to each side of the valve regulator, flowcheck, strainer cleanout and all pieces of equipment.

B. Identify titles by the identity of the contents with complete name at least once in each space through which it passes and thereafter by generally recognized abbreviations, letters or numerals as approved. Place identification title locations in general they shall be placed where the view is unobstructed and on the two lower quarters of pipe or covering where they are overhead. Title to be clearly visible from operating positions and adjacent to all control valves.

C. Die cut numbers and letters from 3.5 mil vinyl film and pre-space them on carrier tape. Protect adhesive and finish surface with one piece removable liners. Use white or black to provide high contrast to the substrate color.

D. Letter size shall be as indicated in the following table:

OUTSIDE DIAMETER OF PIPE OR COVERING	SIZE OF LEGEND LETTERS
3/4-in to 1-1/4-in	1/2-in
1-1/2-in to 2-in	3/4-in
2-1/2-in to 6-in	1-1/2-in
8-in to 10-in	2-1/2-in
Over 10-in	3-in

E. Use Type B ASI/2 by ASI Sign Systems; Architectural Graphics Inc. or equal. Provide Optima Bold, upper case letter type. Use Grid 2 spacing. Match arrow to letter type and size. Follow the instructions of the manufacturer in respect to storage, surface preparation and applications of letters.

2.5 TITLES FOR EQUIPMENT

A. Provide titles consisting of vinyl film as specified above on all equipment using 1-in high Optima Bold upper case, Grid 2 spacing. Use white or black to provide high contrast to the substrate color. Use titles shown on mechanical drawings for bidding purposes. Mount titles at eye level on machines or at the upper most broad vertical surface of low equipment. Where more than one piece of the equipment item to be titled exists, number the items consecutively as indicated on the mechanical drawings or as directed by the Engineer; for example, Pump No. 1, Pump No. 2, etc. Titles shall be composed in more than one line if required and justified on the left-hand side.

2.6 TESTING EQUIPMENT

A. Furnish wet and dry film thickness gauges, electronic moisture meter and all other equipment required by the Engineer for inspection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Concrete: 12 percent.

B. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer. but not less than the following:

1. SSPC-SP 2.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Engineer, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 PAINTING SCHEDULE

A. Dry Film Thickness (DFT) for each paint product is not part of paint schedule. Submit both the Wet Film Thickness (WFT) and DFT for each product as part of submittal process. Apply paint and coating products to comply with manufacturer's DFT thickness and application recommendations in the approved submittal.

3.7 The following types of paints by The Sherwin Williams Company (SW) have been used as a basis for the paint schedule; use one of these paints or equal:

A. Epoxy:

1. SW: Macropoxy 646, B58 Series.

B. Waterborne Cementitious Acrylic: Result in pinhole free surface.

1. SW: Cement-Plex 875, B42 Series.

C. High-Build Acrylic Polyurethane Enamel:

1. SW: Acrolon 218 HS, B65 Series.

D. High Heat Silicone Aluminum (to 600 degrees F):

1. SW: Heat-Flex Hi-Temp 1000 Aluminum, B59-820 Series.

E. Tie Coat, Low VOC, Epoxy:

1. SW: Macropoxy 646, B58 Series.

F. Acrylic Latex Emulsion, Eggshell Finish:

1. SW: DTM Primer/Finish, B66 Series.

G. Vinyl Acrylic Surface Sealer:

1. SW: Prep-Rite 200 Primer, B28 Series.

H. The following surfaces shall have the types of paint scheduled below applied at the dry film thickness (DFT) in mils per coat as recommended by manufacturer:

1. Exterior non- submerged ferrous metals (except first coat-hollow metal-pressed metal work):

a. First Coat: On properly prepared unprimed metal or for touch-up:

1) SW: Macropoxy 646, B58 Series.

b. Second Coat:

1) SW: Macropoxy 646, B58 Series.

c. Third Coat:

1) SW: Acrolon 218 HS, B65 Series.

2. Interior non-submerged concrete scheduled for painting:

a. First and Second Coats:

1) SW: Macropoxy 646, B58 Series.

3. Interior non-submerged ferrous metals (except first coat of previously painted metal work), on properly prepared unprimed metal or for touch-up:

a. First Coat:

1) SW: Macropoxy 646, B58 Series.

b. Second and Third Coats:

1) SW: Macropoxy 646, B58 Series.

4. Submerged ferrous metals and ferrous metals subject to submersion or splashing. Surface shall be lightly sanded or abraded before application of first field coat.

a. First and Second Coats:

1) SW: Macropoxy 646, B58 Series.

5. Hot Ferrous Metal Surfaces:

a. First and Second Coats:

1) SW: Heat-Flex Hi-Temp 1000 Aluminum, B59-820 Series, Aluminum.

END OF SECTION

SECTION 10520
FIRE PROTECTION SPECIALITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes portable, fire extinguishers and mounting brackets for fire extinguishers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles and finishes for fire extinguisher and mounting brackets.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.

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

a. Amerex Corporation.
b. JL Industries, Inc.; a division of the Activar Construction Products Group.
c. Larsens Manufacturing Company.
d. Potter Roemer LLC; a Division of Morris Group International.
e. Pyro-Chem; Tyco Fire Suppression & Building Products.

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

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

a. Amerex Corporation.
b. JL Industries, Inc.; a division of the Activar Construction Products Group.
c. Larsens Manufacturing Company.
d. Potter Roemer LLC; a Division of Morris Group International.
e. Pyro-Chem; Tyco Fire Suppression & Building Products.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Engineer.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

C. Verify that each fire extinguisher is present at Substantial Completion. Replace missing fire extinguishers with new to match specified product at no additional cost to District.

END OF SECTION

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SECTION 11148
DIESEL ENGINE DRIVEN PUMP

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required, complete and ready for operation and field test, one self-contained, automatic, self-priming centrifugal sewage pumps including its respective drives and controls as specified herein and as required in JEA's Water and Wastewater Standards – Section 470 (January 1, 2020 or latest edition).

1.02 SUBMITTALS

A. Submit, in accordance with Section 01300, copies of all materials required to establish compliance with this Section. Submittals shall include the following:

1. Pump
   a. Name of manufacturer
   b. Type and model
   c. Rotative speed
   d. Size of discharge and suction pipe
   e. Weight of pump
   f. Data on shop painting
   g. Data on the characteristics and performance of the pump. Data shall include guaranteed performance curves, based on actual shop tests on similar units, which show that they meet the specified requirements for head, capacity, efficiency, NPSHR, and brake horsepower.

2. Engine
   a. Name of manufacturer
   b. Type and model
   c. Size, liters
   d. Rated HP @ rpm
   e. Cooling system
   f. Electrical:
      1) Battery capacity, amp/hr
      2) Alternator, rating, amp

3. Weatherproof Enclosure
   a. Size, length, width

B. Submit description of factory test plan including test procedures and equipment.

C. Submit for approval results of factory testing and field testing.

D. A list of the manufacturer's recommended spare parts to be supplied with the manufacturer's current price for each item. Include gaskets, packing, etc. on the list. List bearings by the bearing manufacturer's numbers only.

E. Operation and Maintenance Data

1. Complete operating and maintenance instructions shall be furnished for all equipment included under this Section as provided in Section 01730. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include troubleshooting data and full preventative maintenance schedules and complete spare parts lists with ordering information.

1.03 REFERENCE STANDARDS

A. JEA's Water and Wastewater Standards – Section 470 (January 1, 2020 or latest edition)

B. ASTM International

C. American Gear Manufacturers Association (AGMA)

D. American National Standards Institute (ANSI)

E. American Bearing Manufacturers Association (ABMA)

F. National Electrical Manufacturers Association (NEMA)

G. Hydraulic Institute Standards

H. American Welding Society (AWS)

I. Occupational Safety and Health Administration (OSHA)

J. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 QUALITY ASSURANCE

A. All equipment included in this Section shall be furnished by or through a single manufacturer who shall be responsible for the design, coordination, and the satisfactory performance of all the components, including the pump, engine, enclosure and accessories.

B. All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as practicable. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided.

C. Equipment specified under this Section shall be suitable for outdoor operation.

1.05 DELIVERY, STORAGE AND HANDLING

A. The equipment shall be new at the time of delivery and shall not have been used by the Contractor for any construction operations.

B. Refer to Section 01600 for additional delivery, storage and handling requirements.

1.06 MAINTENANCE

A. A complete set of special tools necessary for operation and maintenance of the equipment shall be provided. All tools shall be premium quality and furnished in labeled heavy-duty tool boxes.

B. Pump

1. Two sets of shaft seals (complete unit)

C. Engine

1. One set of air filters

2. One set of belts

3. Two fuel filters

4. Two oil filters

D. Tools and spare parts shall be furnished in accordance with Section 01170.

1.07 MANUFACTURER SERVICES INCLUDING OPERATING INSTRUCTIONS

A. Installation Inspection and Startup:

1. The Contractor shall include in his bid price the services of a Manufacturer’s factory representative who has complete knowledge of proper operation and maintenance shall be provided to instruct representatives of the Owner and the Engineer on proper operation and maintenance. This work may be conducted in conjunction with the inspection of the installation and start-up. If there are difficulties in operation of the equipment because of the Manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. The listed service requirements are exclusive of travel time, and shall not limit or relieve the Contractor of the obligation to provide sufficient service necessary to place the equipment in satisfactory and functioning condition. Also refer to requirements in PART 3 of this Section.

2. Installation inspection: Complete review of installation in accordance with Section 01465. Provide written certification that the installation is complete and operable in all respects, and that no conditions exist which may affect the warranty. The Manufacturer shall supply the installation inspection services of an experienced Manufacturer’s factory representative to verify the proper pump installation. Qualified supervisory services, including Manufacturers' Factory representatives, shall be provided to ensure that the installation is done in a manner fully approved by the Manufacturer. The Manufacturer's factory representative shall specifically approve the installation and alignment of the pump with the motor, the grouting, and the alignment of the connecting piping and the installation of the field installed packing or mechanical seal. If there are difficulties in the start-up or operation of the equipment due to the Manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. Services of the Manufacturer’s factory representative and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.
   a. Minimum time on-site shall be one 8-hour day.

3. Start-Up: Provide written report, summarizing test procedures, tested and measured variables (flow rates, total heads, shaft-speed, vibration measurements, etc.):
   a. Minimum time on-site shall be one 8-hour day.

B. Training:

1. Field instruction on operation and maintenance of the equipment, including start-up, shut-down troubleshooting, lubrication, maintenance and safety.
   a. Minimum time on-site shall be one 8-hour day.

C. The Contractor alone shall be responsible for requesting these services, and shall coordinate these requests with all other relevant trades, to ensure the effectiveness of the Manufacturers' service. In the event that the lack of coordination by the Contractor results in the need to recall the Manufacturer's factory representative, the lost time shall not be counted against the above days.

1.08 WARRANTY

A. A five (5) year warranty shall be provided for the diesel engine driven pump starting on the date of JEA final acceptance. Running hours shall not be a limiting factor for the system warranty. See Section 01740 for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL

A. This Section is intended to give a general description of what is required, but does not cover all details which will vary in accordance with the requirements of the equipment as offered. It is, however intended to cover all materials, equipment and appurtenances for the complete pumping units as herein specified, whether specifically mentioned in this Section or not.

B. Pumping units shall be provided with a pump, flanged connections, discharge check valve, engine mounted on a skid and inside of a weatherproof enclosure with all other appurtenances specified or otherwise required for proper operation.

1. Parts and components not specifically mentioned in this Section, but which are required to provide a complete pumping unit, shall be included as a part of the equipment to be furnished.

C. Pumps shall be a horizontal, self-priming sewage pumps, specifically designed for pumping raw, unscreened, domestic sanitary sewage. Pumps that require external priming devices that are not a part of the pump-set skid package, such as separate compressors or vacuum pumps, will not be considered.

D. The pump shall be an engine-driven, self-priming centrifugal pump, HL250M Dri-Prime Pump manufactured and assembled by Godwin, or JEA approved equal.

E. Stainless steel nameplates giving the name of manufacturer, the rated capacity, head, speed and all other pertinent data shall be attached to each pump.

F. The pumps and drives shall conform to the noise limitations specified in Section 01170.

2.02 DIESEL ENGINE

A. The diesel engine shall be provided as required in JEA's Water and Wastewater Standards – Section 470, Section II (January 2020 or latest edition).

B. The diesel engine shall be the CAT C9 T3 Flex Engine or approved equal.

C. See Section 15600 for fuel system requirements.

2.03 CENTRIFUGAL PUMP

A. The centrifugal pump shall be provided as required in JEA's Water and Wastewater Standards – Section 470, Section III (January 2020 or latest edition).

B. The pumping unit shall be designed for the following operating conditions and requirements:

1. Primary Capacity
   a. Flow (gpm) 3,000
   b. Total dynamic head, (ft) 127
   c. Maximum NPSHr, (ft) 12

2. Secondary Capacity
   a. Flow (gpm) 2,000
   b. Total dynamic head, (ft) 142
   c. Maximum NPSHr, (ft) 9

3. Run-out Capacity
   a. Flow (gpm) 5,400
   b. Total dynamic head, (ft) 62
   c. Maximum NPSHr, (ft) 23

2.04 ENGINE STARTING AND CONTROL PANEL

A. Engine starting and control panel shall be as required in JEA's Water and Wastewater Standards – Section 470, Section IV (January 2020 or latest edition).

2.05 WEATHERPROOF ENCLOSURE, NON-WALK-IN TYPE

A. Weatherproof enclosure shall be as required in JEA's Water and Wastewater Standards – Section 470, Section IV (January 2020 or latest edition).

2.06 EXHAUST AND MUFFLER

A. Exhaust and muffler shall be as required in JEA's Water and Wastewater Standards – Section 470, Section IV (January 2020 or latest edition).

2.07 SURFACE PREPARATION AND PAINTING

A. Ferrous metal surfaces of castings and welded steel shall be cleaned to remove all casting projections, weld flux, or splatter. Sharp projections of cut or sheared edges shall be ground to a radius to improve paint adherence. The use of chipping tools in a manner that produces cuts,

burrs, or other excessive roughness will not be accepted. Exposed seams shall be filled with a metal filler, finished smooth, and cleaned as required to provide a smooth uniform base for painting.

B. All ferrous metal surfaces, except stainless steel, shall be blast cleaned in the shop in accordance with the paint manufacturer's recommendations. All mill scale, rust, and contaminants shall be completely removed before shop primer is applied.

C. All ferrous metal surfaces and engines shall be shop primed, then given two shop coats of high solids enamel paint. Paint shall have rust inhibitors suitable for outdoor service. The shop coating, including the primer, shall have a minimum dry film thickness of 0.25 mm.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. The pumping unit shall be set up, inspected, and field tested in the presence of the Engineer to demonstrate its compliance with the Contract Documents.

3.02 INSTALLATION

A. Installation shall be in strict accordance with the Manufacturer’s instructions and recommendations in the locations shown on the Drawings. The Contractor shall furnish all required oil and grease for initial operation, if required, in accordance with the Manufacturer's recommendations. Anchor bolts shall be set in accordance with the Manufacturer's recommendations.

B. Upon completion of each pump installation, the Manufacturer shall inspect the unit and submit a certificate stating that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.03 INSPECTION AND TESTING

A. General

1. The Engineer shall be notified in writing prior to initial shipment and/or testing, in ample time so that arrangements can be made for inspection by the Engineer.

2. Field tests shall not be conducted until such time that the pumping system, including controls, is complete and ready for testing.

B. Factory Pump Test

1. All pumps shall receive a non-witness factory test.

2. The Manufacturer shall factory test all pumps prior to shipment in accordance with the Hydraulic Institute standards, latest version. Flow rate, total head and Input KW shall be tested and recorded for at least five points on the pump performance curve. Test shall be performed to demonstrate that the pumps meet ANSI/HI 14.6 acceptance grade 1U for the design condition. The primary and secondary design conditions shall meet acceptance

grade 1E. The five points shall include the points specified in pump performance table in Paragraph 2.03.

3. The Manufacturer shall perform hydrostatic test on the pressure-containing parts in accordance with ANSI/HI 14.6. Test shall be conducted on each pump prior to final coating and shipment.

4. The Manufacturer shall perform the following test on each pump prior to shipment from factory:
   a. Megger motor and pump for insulation breaks or moisture.
   b. The pump shall be run dry and checked for correct rotation.
   c. A written certification test report regarding the above tests shall be submitted for approval prior to shipment.

C. Field Pump Test

1. As specified in Paragraph 1.07, the Manufacturer shall furnish the services of a representative who shall have complete knowledge of proper operation and maintenance to inspect the final installation and supervise the test run of the equipment. The Manufacturer shall include in his price, a minimum of eight hours of a representative's time for the above tests.

2. Written test procedures shall be submitted to the Engineer for approval 30 days prior to testing.

3. The Contractor shall furnish all water, fuel, power, facilities, labor, materials, supplies and test instruments required to conduct the field testing.

4. The Final Acceptance Test shall demonstrate that all items of these Specifications have been met by the equipment as installed and shall include, but not be limited to, the following tests:
   a. That all units have been properly installed and are in correct alignment.
   b. The Contractor shall check for correct lubrication in accordance with manufacturer's instructions. The Contractor shall check direction of rotation of all motors and reverse connections, if necessary.
   c. That the units operate without overheating or overloading any parts and without objectionable vibration.
   d. That there are no mechanical defects in any of the parts.
   e. That the pumps can deliver the specified total head and flow rate to demonstrate that the pumps generally meet the requirements specified (factory performance test is the basis of pump acceptance).
   f. That the pump sensors and controls perform satisfactorily as to sequence control, correct start and stop pressures, and proper alarm functions.

5. If the pump performance does not meet the specifications, corrective measures shall be taken or pumps shall be removed and replaced with pumps which satisfy the conditions specified.

6. A five-day continuous operating period of the pumps will be required before acceptance. If pumping system fails during the test period, the test shall be restarted (including reset of time to zero) after repair (or replacement) has been completed.

D. Field Vibration Testing

1. After installation and as soon as conditions permit full speed operation, and in the presence of the Engineer, have the vibration tests performed in accordance with ANSI/HI 9.6.4 on each unit by a minimum level III qualified vibration technician as defined by Vibration Institute or equivalent to (a) prove compliance with specified limitations, and (b) prove that there are no field installed resonant conditions due to misalignment, the foundation, or the connecting piping and its supports, when operating at any speed within the specified operating range.
   a. At a minimum, if pump system is furnished with vibration and temperature monitoring system, the motor lower vibration sensors may be used for acceptance testing. Alternatively, temporary surface mounted sensors mounted in the vicinity of the installed sensors are preferred to additionally establish the accuracy of the permanently installed system.

2. If required, take corrective action and the units shall be retested to ensure full compliance with this Section. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.

END OF SECTION

SECTION 11306
DRY-PIT SUBMERSIBLE SOLIDS HANDLING PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install, place in operation and field test four (4) dry-pit submersible wastewater pumps as shown on the Drawings and specified herein. The equipment to be furnished and installed shall be as shown on the Drawings and shall include pumps, motors, VFDs, control panels and control systems, and appurtenances, all tested and ready for operation.

B. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment as offered. It is, however, intended to cover the furnishing, factory testing, delivery and complete installation and field testing of all materials, equipment and appurtenances for the complete pumping units as herein specified, whether specifically mentioned in these Specifications or not.

C. Pump motors, cables and appurtenances shall be rated for operation in a Class I Division 2, Group D hazardous environment.

D. The Contractor shall require the pump manufacturer to coordinate pump and motor design with the manufacturer of the variable frequency drives and furnish the drives, as specified in Section 16370.

1.02 RELATED WORK

A. Submittals are included in Section 01300.

B. Operation and maintenance is included in Section 01730.

C. Warranties are included in Section 01740.

D. Concrete work and the installation of anchor bolts are included in Division 3; however, anchor bolts for these units as recommended by the pump manufacturer shall be furnished by the Contractor under this Section.

E. Instrumentation and control description is included in Division 13.

F. Valves, mechanical piping and appurtenances and pipe hangers and supports are included in Division 15.

G. Electrical work is included in Division 16.

1.03 REFERENCE STANDARDS

A. Design, manufacturing and assembly of elements of the equipment herein specified shall be in accordance with, but not limited to, published standards of the following, as applicable:

1. American Gear Manufacturers Association (AGMA)
2. American Institute of Steel Construction (AISC)
3. American Iron and Steel Institute (AISI)
4. American Petroleum Institute (API)
5. American Society of Mechanical Engineers (ASME)
6. American National Standards Institute (ANSI)
7. American Society for Testing Materials (ASTM)
8. American Welding Society (AWS)
9. American Bearing Manufacturers Association (ABMA)
10. Hydraulic Institute Standards (current editions)
11. Institute of Electrical and Electronics Engineers (IEEE)
12. National Electric Code (NEC)
13. National Electrical Manufacturers Association (NEMA)
14. Occupational Safety and Health Administration (OSHA)
15. Steel Structures Painting Council (SSPC)
16. Underwriters Laboratories, Inc. (UL)
17. Factory Mutual (FM)

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 SYSTEM DESCRIPTION

A. The system will pump raw wastewater. The equipment to be furnished under this Section shall include four submersible wastewater pumps in a dry-pit booster configuration, with motors, VFDs and accessories, all as specified herein and as shown on the Drawings. Refer to section 13300 for system description and control narratives. Contractor shall coordinate and be fully responsible for proper operation and compatibility between items in this scope of work and items in Division 13.

1.05 QUALIFICATIONS

A. To assure unity of responsibility, the pumps, motors, VFDs, and other auxiliary equipment, and materials specified in this Section shall be furnished and coordinated by the pump manufacturer (Manufacturer) who shall assume responsibility for the satisfactory operation of the entire pumping system including pumps, motors, VFDs, and accessories.

B. The pumps and other equipment covered by this Specification shall be standard production units of the manufacturers, currently available and listed in the respective manufacturer's catalogs. The pumps furnished shall be in accordance with the Hydraulic Institute Standards and shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

C. The Manufacturer shall have an authorized warranty center within a 300-mile radius of the job site, fully staffed with factory trained mechanics, and equipped with a stock of all necessary spare parts for each model of pump furnished under this Contract. The service facility shall be an established entity prior to delivery of equipment for this project.

D. The VFDs furnished shall have an established record of successful performance with the submersible motors supplied.

E. All equipment furnished under this Specification shall be new and unused, shall be the standard product of manufacturers having a successful record of manufacturing and servicing similar equipment and systems to that specified herein for a minimum of five years.

F. The pumping equipment shall be furnished complete with accessories required and shall meet the detailed requirements of the Specifications.

G. Prior to manufacture, a submittal must be forwarded to the Engineer indicating that the required vibration analyses outlined herein have been performed and that the specified limitations will be met. For the dynamic vibration analysis described, minimum and maximum operating speeds will be in accordance with the operating speeds required to satisfy the conditions of operation specified in Article 2.02. The dynamic vibration analysis required by the following paragraphs shall be performed by Mechanical Solutions Inc. (MSI) of Whippany, NJ, or Engineering Dynamics Inc. (EDI) of San Antonio, TX or alternatively by the Manufacturer if Manufacturer’s demonstrated, successful, vibration analysis experience, in at least twenty projects similar in scope, with proposed personnel involved, may be acceptable to the Engineer with analyses in accordance with the specified requirements.

1. Structural dynamic analysis of the combined pump/motor and the nearby foundation and the piping out to the first pipe restraint or expansion joint. Analysis shall not simply assume the foundation is rigid rather it shall incorporate foundation design shown on the Drawings. The structural dynamic analysis shall predict that no first or second bending mode frequencies will exist within a pump speed and vane pass frequency range from 20 percent below minimum operating speeds shown in Section 2.02 to 20 percent above maximum operating speeds.

2. Lateral rotodynamic analysis - The lateral rotodynamic analysis shall identify and predict that the first lateral critical speed shall be at least 20 percent above the maximum pump speed and vane pass frequency or 20 percent below the minimum pump speed. Any pump component excited resonant frequency shall be no closer than plus or minus 20 percent of the natural frequency of any part of the installed assembled pumping unit. Any lateral rotordynamic frequencies not satisfying the +/- 20% margins shall not result in a forced damped response that will allow contact between the shaft and journal bearings.

3. A torsional rotordynamic analysis of the complete rotating system shall identify and predict that no torsional natural frequencies occur within a separation margin extending

from 20 percent below to 20 percent above the specified pump operating speed range. Additionally, no natural frequencies shall be +/- 10% of 2x times running speed, line frequency, 2x line frequency, vane pass frequency, and VFD control frequencies (if applicable). If a design modification (i.e., such as a shaft diameter change or number of impeller vanes) cannot resolve a separation margin deficiency or is not practical, a forced damped response analysis shall be performed to show that infinite life will be achieved with a safety factor of at least two.

4. Campbell diagrams shall be submitted, documenting the structural lateral, rotating component lateral, and torsional analysis results, graphically demonstrating the separation margins specified above.

5. The pumps shall operate throughout the entire operating range with the maximum vibration velocity in inches per second RMS, measured in the field, conforming to the requirements of ANSI/HI 11.6.

1.06 SUBMITTALS

A. Copies of all materials required to establish compliance with the Specifications shall be submitted in accordance with the provisions of the General Conditions and Section 01300. Submittals shall include at least the following:

1. Shop and erection drawings showing all important details of construction, dimensions and anchor bolt installation requirements.

2. Descriptive literature, bulletins, and/or catalogs of the equipment. Sufficient data shall be submitted to document previous production of each pump model proposed for use on this Contract.

3. Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves to ANSI/HI 11.6 acceptance grade 1U, based on actual factory tests of similar units, which show that they meet the specified requirements for head, flow rate, efficiency, NPSH3, submergence and horsepower. Curves shall be submitted on 8-1/2-inch by 11-inch sheets, at as large a scale as is practical. Curves shall be plotted from zero flow at shut off head to pump flow rate at minimum specified total head (TH). The POR and AOR (refer to ANSI/HI 9.6.3) shall be clearly shown on the curves. Catalog sheets showing a family of curves will not be acceptable.

4. The total weight of the equipment including the weight of the single largest item.

5. Complete wiring diagrams and schematics of all power and control systems showing wiring requirements between all system components, motors, sensors, control panels and related systems.

6. A complete total bill of materials of all equipment.

7. A list of the manufacturer's recommended spare parts to be supplied, with the manufacturer's current price for each item. Include gaskets, seals, etc. on the list. List bearings by the bearing manufacturer's numbers only.

8. All submittal data required by the General Conditions.

9. Complete motor data, including, but not limited to:
   a. Type of enclosure design
   b. Rated horsepower
   c. Rated voltage
   d. FLA
   e. Starting current
   f. LRA
   g. LR KVA
   h. NEMA starting code letter and insulation code letter
   i. RPM
   j. Input power in kW at nameplate rating
   k. Starting calculations
   l. Cable size
   m. Efficiency at 50%, 75% & 100% load, and power factor at 50%, 75% & 100% load
   n. Winding temperature rise
   o. Vibration design limits
   p. Speed torque curves
   q. Recommended trip and alarm settings for temperature and vibration protective devices
   r. Power and control cable size and materials of construction , details of cable sealing method, description and type of motor thermal protection, description of insulation system and service factor.
   s. Submit a certified statement from the motor manufacturer that the motors are capable of a minimum of 12 variable frequency drive starts per hour and continuous operation on the power supply from the variable frequency drives to be furnished without affecting their design life for bearings or windings. This requirement does not replace nor relieve submittal requirements under Division 16.

10. Certified agreement to the conditions of the warranty.

11. Submit description of factory test plan including test procedures and equipment.

12. Submit for approval results of factory testing and field testing.

13. Critical speed analyses report including the specified Campbell diagrams and a statement of guarantee that the critical speed analyses as required in Paragraph 1.05G. of this Section have been completed and that the specified limitations will be met.

B. In the event that the equipment offered does not conform with all of the detailed requirements of the Specifications, describe completely all nonconforming aspects. Failure to describe any and all deviations from the specifications will be cause for rejection.

1.07 MANUFACTURER SERVICES INCLUDING OPERATING INSTRUCTIONS

A. Operating and Maintenance Manual:

1. Operating and maintenance manual shall be furnished by the Manufacturer to the Engineer as provided for in Section 01730. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, description, etc. that are required to instruct operating and maintenance personnel

unfamiliar with such equipment. The maintenance instructions shall include trouble shooting data, full preventative maintenance schedules, and complete spare parts lists with ordering information.

B. Installation Inspection and Startup:

1. The Contractor shall include in his bid price the services of a Manufacturer's factory representative who has complete knowledge of proper operation and maintenance shall be provided to instruct representatives of the Owner and the Engineer on proper operation and maintenance. This work may be conducted in conjunction with the inspection of the installation and start-up. If there are difficulties in operation of the equipment because of the Manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. The listed service requirements are exclusive of travel time, and shall not limit or relieve the Contractor of the obligation to provide sufficient service necessary to place the equipment in satisfactory and functioning condition. Also refer to requirements in PART 3 of this Section.

2. Installation inspection: Complete review of installation in accordance with Section 01465. Provide written certification that the installation is complete and operable in all respects, and that no conditions exist which may affect the warranty. The Manufacturer shall supply the installation inspection services of an experienced Manufacturer's factory representative to verify the proper pump installation. Qualified supervisory services, including Manufacturers' Factory representatives, shall be provided to ensure that the installation is done in a manner fully approved by the Manufacturer. The Manufacturer's factory representative shall specifically approve the installation and alignment of the pump with the motor, the grouting, and the alignment of the connecting piping and the installation of the field installed packing or mechanical seal. If there are difficulties in the start-up or operation of the equipment due to the Manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. Services of the Manufacturer's factory representative and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.
   a. Minimum time on-site shall be one 8-hour day per station.

3. Start-Up: Provide written report, summarizing test procedures, tested and measured variables (flow rates, total heads, shaft-speed, vibration measurements, etc.):
   a. Minimum time on-site shall be one 8-hour day per station.

C. Training:

1. Field and classroom instruction on operation and maintenance of the equipment, including start-up, shut-down troubleshooting, lubrication, maintenance and safety.

2. The Manufacturer shall provide detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.

3. The Manufacturer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to Owner.
   a. Minimum time on-site shall be one 8-hour day.

D. The Contractor alone shall be responsible for requesting these services, and shall coordinate these requests with all other relevant trades, to ensure the effectiveness of the Manufacturers' service. In the event that the lack of coordination by the Contractor results in the need to recall the Manufacturer’s factory representative, the lost time shall not be counted against the above days.

1.08 TOOLS AND SPARE PARTS

A. The Manufacturer shall furnish a complete list of recommended spare parts, gaskets, lubricants, sealants and heat transfer medium necessary for the first five years operation of each pumping system.

1.09 PRODUCT HANDLING

A. All equipment and parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of fabrication, including storage in accordance with Manufacturer’s requirements until final delivery to the job site.

B. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

C. Finished surfaces of all exposed pump openings shall be protected by wooden blanks, strongly built and securely bolted thereto or by other approved means.

D. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

E. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

F. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.10 WARRANTY

A. All equipment supplied under this section shall be warranted for a period of two years by the Contractor and the Manufacturer. Warranty period shall commence on the date of Owner acceptance, as outlined in Division 1 and in Division 0.

B. In addition, Manufacturer shall warrant the pump/motor for a period of five years, prorated after the initial 1.5 years. This Manufacturer warranty duration includes the warranty period identified above and as outlined in Divisions 1 and 0.

C. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the Owner.

D. The Manufacturer 's warranty period shall run concurrently with the Contractor 's warranty period. No exception to this provision shall be allowed.

E. Refer to Section 01740 for additional warranty requirements.

1.11 PROJECT/SITE REQUIREMENTS

A. Environmental Requirements: for dry pit application suitable for continuous duty operation under the following service conditions:

1. Environment: Outdoor raw wastewater pumping application involving occasional severe duty conditions.

2. Area classification: Non-hazardous.

3. Maximum ambient temperature: 40 degrees C.

4. Altitude: up to 45 feet above MSL.

PART 2 PRODUCTS

2.01 GENERAL

A. The pumping units required under this Section shall be complete including pumps and motors with proper alignment and balancing of the individual units. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the work to be done. Ample room shall be provided for inspection, repairs, and adjustments.

B. Each pump shall be provided with a solid steel baseplate or cast iron stand. Baseplates shall be designed to be rigidly support the pumping units and shall be accurately anchored into position. All necessary anchor bolts, plates, nuts, and washers shall be furnished and installed by the Contractor in strict accordance with the Manufacturer's recommendations.

C. Stainless steel nameplates giving the name of the manufacturer, the rated flow rate, head, speed, and all other pertinent data shall be permanently attached to each pump and/or motor. Additional stainless steel nameplates shall be provided to be installed by the Contractor on the VFD enclosures or other above grade location as instructed by the Engineer such that the pumps do not need to be removed to gather the information.

D. The pumps shall be totally submersible, solids handling, rotodynamic pumps with submersible close coupled motors designed to pump raw, unscreened wastewater.

2.02 CONDITIONS OF OPERATION

A. The pumps shall be as manufactured by Flygt (Xylem). The primary pumps shall be NP3231/706 3~680 and the jockey pump shall be NP3202/MT3~641.

B. Each pump shall be designed for the conditions of service tabulated as follows and shall operate within the system head curve envelope as appended. All pumps with specific speed less than 4,500 (US units) shall have a continuously rising head performance curve for stable pump operation from the minimum head operating point to the shut-off head. For pumps where specific speed is greater than or equal to 4,500, the intersection of the pump head and system head curves shall be used to demonstrate stable operation.

C. The pumps shall operate throughout the entire operating range with the maximum vibration velocity in inches per second RMS unfiltered, measured in the field less than the requirements of ANSI/HI 11.6-latest edition.

D. Each Primary pump shall be designed for the conditions of operation tabulated as follows:

Item Description	Pump Design Conditions
Application	Primary Pumps
Number of Pumps	2 (1 duty/1 standby)
Maximum Motor Full Load Speed (FLS) (rpm)	1185
Maximum Allowable Motor (HP)	150
Motor Design Voltage/Phase/Frequency	460/3/60
Maximum Anticipated Pumped Fluid Temperature (deg F)	90
Minimum Pump Discharge Size (inches)	8
Minimum Pump Suction Size (inches)	10
Minimum Pump Shut-Off Head at Motor FLS (feet)	185
Secondary TH (feet)	169
Minimum Flow Rate at Secondary TH (gpm)	1,000
Minimum Overall Efficiency at Secondary TH (%)*	50
Intermediate (Design) Flow Rate (gpm)	3,000
Minimum TH at Intermediate (Design) Flow Rate (feet)	127
Minimum Overall Efficiency at Intermediate (Design) Flow Rate (%)*	79
Minimum Overall Efficiency at Best Efficiency Point (%)*	82
Minimum Best Efficiency Point Flow Rate (gpm)	2,900
Minimum Best Efficiency Point TH (feet)	130
Primary TH (feet)	96
Minimum Flow Rate at Primary TH (gpm)	4,300
Minimum Overall Efficiency at Primary TH Flow Rate (%)*	65
Minimum Size Solids Passing (inches)	3
Maximum NPSH3 at Primary TH (feet)	36
Required Pump Speed Range (% FLS)	65-100

* Note that minimum overall efficiencies listed are “wire-to-water” in accordance with ANSI/HI 11.6 – latest edition.

E. Each jockey pump shall be designed for the conditions of operation tabulated as follows:

Item Description	Pump Design Conditions
Application	Jockey Pumps
Number of Pumps	2 (1 duty/1 standby)
Maximum Motor Full Load Speed (FLS) (rpm)	1170
Maximum Allowable Motor (HP)	45
Motor Design Voltage/Phase/Frequency	460/3/60
Maximum Anticipated Pumped Fluid Temperature (deg F)	90
Minimum Pump Discharge Size (inches)	7
Minimum Pump Suction Size (inches)	9
Minimum Pump Shut-Off Head at Motor FLS (feet)	90

Item Description	Pump Design Conditions
Secondary TH (feet)	70
Minimum Flow Rate at Secondary TH (gpm)	1,000
Minimum Overall Efficiency at Secondary TH (%)*	50
Intermediate (Design) Flow Rate (gpm)	1525
Minimum TH at Intermediate (Design) Flow Rate (feet)	63
Minimum Overall Efficiency at Intermediate (Design) Flow Rate (%)*	72
Minimum Overall Efficiency at Best Efficiency Point (%)*	79
Minimum Best Efficiency Point Flow Rate (gpm)	2,200
Minimum Best Efficiency Point TH (feet)	54
Primary TH (feet)	20
Minimum Flow Rate at Primary TH (gpm)	3800
Minimum Overall Efficiency at Primary TH Flow Rate (%)*	45
Minimum Size Solids Passing (inches)	3
Maximum NPSH3 at Primary TH (feet)	36
Required Pump Speed Range (% FLS)	40-100

* Note that minimum overall efficiencies listed are “wire-to-water” in accordance with ANSI/HI 11.6 – latest edition.

F. Each pumping unit and its driving equipment shall be designed and constructed to withstand the maximum turbine run-away speed of the unit due to back flow through the pump.

G. Each jockey pump shall be configured to allow for constant torque variable frequency drives.

H. All pumps, motors, and VFDs shall be designed to allow pumps to run in reverse.

2.03 PUMP CONSTRUCTION

A. The overall pump design shall combine high efficiency, low required NPSH3, the ability to handle high solids concentrations effectively. The impeller/casing design shall result in a passage free of surfaces to which solid or fibrous materials can adhere and shall be capable of passing fibrous and nonwoven materials as found in domestic wastewater. The design shall permit low liquid velocities and gradual acceleration and change of flow direction of the pumped media.

B. All external pump and motor parts shall be of close grained cast iron, ASTM A48 Class 35B construction, with all parts in contact with wastewater protected by corrosion resistant coatings. All external bolts and nuts shall be type 316 stainless steel.

C. Impellers shall be constructed of ASTM A532 IIC hardened cast iron. Impellers shall be dynamically balanced.

D. The impeller shall be a rotodynamic, a semi-open, solids handling type capable of passing solids either due to internal clearances or other features to facilitate solids processing including a wear plate with groove. The wear plate to impeller clearance shall be easily adjustable without the need for disassembly of the pump or the need to add or remove shims. The impeller may include pump out vanes on the upper shroud to reduce axial thrust and

minimize clogging due to debris accumulation around the mechanical seal. The impeller shall be dynamically balanced to the ISO 1940 G6.3 standard to provide smooth, vibration free operation.

E. A casing wear plate shall be installed to provide efficient sealing between the casing and the impeller. The wear plate shall consist of a stationary stainless steel plate installed in the lower half of the casing. Alternative materials and design approaches shall be as approved by the Engineer.

F. Each pump shall be provided with a balanced tandem mechanical shaft seal system. The upper (inner) of the tandem set of seals shall operate in an seal lubricant chamber located just below the stator housing. At a minimum, this set shall contain one stationary silicon carbide or tungsten carbide and one positively driven rotating carbon ring and shall function as an independent secondary barrier between the pumped liquid and the stator housing. The lower (outer) of the tandem set of seals shall function as the primary barrier between the pumped liquid and the stator housing. This set shall consist of a stationary ring and a positively driven rotating ring, both of which shall be either tungsten carbide or silicon carbide. Each interface shall be held in contact by its own 316SS spring system isolated from the pumped media. The o-rings shall be FKM (Viton)® The seals shall require neither maintenance or adjustment, but shall be easily inspected and replaceable. Seal design shall provide pressure applied to the outside diameter of the face. Shaft seals with conventional double mechanical seals containing either a common single or double spring acting between the upper and lower units are not acceptable nor equal to the dual independent seal specified.

G. The minimum pump discharge size, shall be the minimum allowable nominal diameter of the discharge connection provided for attachment to the discharge piping, as shown on the Drawings, except as allowed otherwise by this specification. Unless otherwise noted, the diameter of the opening at the connection between the pump and the discharge should normally be the same as the minimum specified discharge size.

H. The pump casing shall have a machined ASTM B16.1 125 lb flange connection to attach to the discharge piping. The pump baseplate and sole plates shall be bolted to the concrete support base piers of the dry pit arrangement with Type 316 stainless steel J-type cast-in anchor bolts, monel nuts and accessories. The baseplate and associated accessories shall conform to the following:

1. The baseplate or stand shall be proportioned to support each entire pump/motor assembly and the loads (including the results of the dynamic analysis) to which it may be subjected during operation. It shall be properly supported on split sole plates and anchored and located as shown on the Drawings. Lifting lugs or eye bolts, special slings, strongbacks, or other devices necessary to handle the pump during loading, unloading, erection, installation, and subsequent disassembly and assembly shall be furnished.

2. Sole plates shall be provided under each pump baseplate. The sole plates shall be installed, leveled and grouted in accordance with API RP 686, Chapter 5 – Mounting Plate Grouting. Jacking bolts and Five Star non-shrink epoxy grout as specified below shall be provided for leveling the baseplate assembly.

3. An anchor bolt layout shall be provided to aid in placement of anchor bolts. All leveling jacking bolts shall be backed off after grouting so that they do not support any of the load.

4. The grout for use in grouting under the sole plates supported by jack bolts (no shim stacks) shall be Five Star HP Epoxy Grout per specification 03600, Paragraph 2.02.B.1. or approved equal, mixed and applied according to the manufacturer's directions.

5. The presence of a Manufacturer' representative during the pouring of the epoxy grout as well as the use of rigid non-absorbing formwork and a head box are mandatory. The surface of the formwork in contact with the epoxy grout shall be covered with a layer of paste wax to facilitate removal. Clearance between the concrete surface and the bottom surfaces of the sole plates shall be per manufacturer's recommendation.

6. The concrete surface to be in contact with the epoxy grout shall be chipped to present a slightly rough surface and remove the laitance. The surface shall then be cleaned of all dust, moisture and oil. A thin layer of leveling grout shall be placed under metal discs that the jack bolts shall bear on. A one-inch minimum diameter by 1/4 inch thick stainless steel disk, with full radiused edges shall be placed under each jack bolt. All metal edges in contact with the epoxy grout shall be radiused to a minimum 1/2 inch radius in order to prevent stress risers in the epoxy grout. Plastic vent tubes, sized and spaced per manufacturer's recommendation, shall be placed under the sole plates to vent air during grouting and prevent voids in the epoxy grout.

7. The annular space between the anchor bolts and the anchor bolt sleeve shall be filled with expanding urethane foam. The threads of both the anchor bolts and jack bolts in contact with the grout shall be covered with paste wax and a layer of duct tape. After all alignment tolerances are met, the anchor bolts shall be tightened snug to prevent movement during the pour. The epoxy grout shall not be allowed to extend above the top edge of the sole plates. After the epoxy grout has fully cured, within 24 to 48 hours after pouring, the jack bolts shall be removed and the anchor bolts tightened to the torque levels as recommended by the Manufacturer.

8. The threaded jack bolt holes shall be coated with grease and the jack bolts cleaned of the paste wax and duct tape then reinserted and secured in position with a lock nut to within 1/4 inch of the bottom of the hole. After grouting, edges shall be chipped and patched lo present a smooth finish.

2.04 SUBMERSIBLE MOTORS

A. Pump motors shall be inverter duty rated, housed in an air filled, water-tight casing, and shall have Class F or better non-hygroscopic insulated windings which shall be moisture resistant. Oil filled motor housing are not acceptable. The motors shall be suitable for use with the VFDs. The motor stator shall be dipped and baked three times in a VPI process and heat shrunk fitted into the stator housing. As an alternative, trickle impregnation method may be used for motor stator windings. All motors using variable frequency drives shall be rated for inverter duty and shall be in accordance with the latest NEMA MG1, Part 31. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. Motors shall be NEMA Design B, equipped with a 1.15 service factor, as defined in the NEMA MG1 standard, based upon the nameplate horsepower rating for utility power service. A service factor of 1.0 will be acceptable when driven by a VFD (non-sinusoidal power supply). The motor insulation system shall be rated at 155^{o}C or better. Motor shall be capable to operate in an ambient temperature of 40^{o}C continuously with Class B temperature rise. The motor shall be NEMA Starting Code G or H, or better. Motors shall be non-overloading and capable of sustaining a minimum of ten starts per hour. Upper motor bearing

shall be insulated. Motors shall be provided with a minimum power factor of 0.78 at full load. The motor efficiency shall comply with the minimum required at full load to meet the wire-to-water efficiency specified in paragraph 2.02.

B. Pump motors shall have cooling characteristics suitable to permit continuous operation in a non-submerged condition. Each motor shall incorporate three overheat sensing devices, one in each motor winding. These devices shall trip at 140ºC. The sensing device shall be wired into the pump controls in a manner such that if the device operates, the pump will shut down. The temperature device shall be self-resetting.

C. The pump motor shall incorporate a closed-loop cooling circuit with an integrated cooling pump rated for continuous duty in a completely dry mode; as well as; in a fully submerged condition without damage. The cooling jacket shall be cast iron ASTM A48 class 30 or steel. The coolant pump impeller shall be mounted directly on the motor shaft between the tandem mechanical seals to circulate coolant fluid into the top inter-space between the cooling jacket and motor housing, over the surface of the motor, through ducts in the bearing housing and into a casing heat exchanger. Heat losses from the motor shall be transferred to the fluid pumped in the casing heat exchanger, which forms a structural unit together with the discharge cover of the pump. After passing through the volute-casing heat exchanger, the coolant shall return to the suction side of the internal coolant pump (impeller). Coolant shall be an environmentally safe glycol based antifreeze or an environmentally safe food grade oil rated for use down to temperatures of minus 20ºC (minus four degrees Farinheight).

D. The pump/motor shaft shall be constructed of type 420 or type 431 stainless steel. When operating at the pump design point, the shaft shall have a maximum deflection of 0.2 mm at the lower seal face and a maximum deflection of 0.45 mm at the wear ring area. The shaft shall rotate on permanently lubricated ball bearings properly sized to withstand the axial and radial forces. The ABMA Minimum L-10 bearing life shall be at least 30,000 hours rated at the pump BEP.

E. The pump motor with its appurtenances and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet. All mated surfaces shall be machined, fitted with O-rings for watertight sealing.

F. The pumps shall be provided with a cable entry design that shall preclude specific torque requirements to insure a water tight and submersible seal. The cable entry shall be certified by UL or FM to have passed pull-testing requirements. The cable entry junction chamber and motor shall be separated by a stator lead, sealing gland or terminal board, which shall isolate the motor interior from foreign material gaining access to the pump motor top. The cable entry system shall be field serviceable. The power and control cable entry into the lead connection chamber may also be epoxy encapsulated for positive moisture sealing. A BUNA-N cable grommet shall be provided in addition to the epoxy sealed leads.

G. Cables, Conduits and Accessories

1. The pumps shall be supplied with power and sensor conductors. Pump motor cables shall be sized to meet applicable NEC requirements. The cable shall consist of a type SOWinsulated cable with a double jacketed protection system. The cable shall have a neoprene or chlorinated polyethylene outside and synthetic rubber inside, and shall exceed industry standards for oil, gas and sewage resistance. Pump cables shall be

provided of sufficient length so that the cables will be continuous between the pump and the disconnect with no splices being allowed.

2. If more than one cable is being provided per pump, the Contractor shall furnish and provide for the installation of the additional conduits, etc. as required for each additional cable. Only one cable per conduit will be allowed at the pump station. Conduit sized per manufacturers recommendations but not smaller than 3/4-inch.

3. Contractor shall furnish all required stainless steel conduit hardware and fittings.

4. Water tight connectors shall be equal to Crouse-Hinds Type "CGB", with neoprene lands shall be furnished with and installed in the control panel enclosure or disconnect to terminate each conduit and seal each cable entry.

5. Conduit seals shall be equal to Crouse-Hinds Type "EYS".

6. Coordinate the installation of the above materials with the Manufacturer.

2.05 VARIABLE FREQUENCY DRIVES

A. The speed control for variable speed pumps shall be Variable Frequency Drives, as specified in Section 16370, suitable for installation as shown on the Drawings.

B. The Variable Frequency Drives shall be supplied by the Manufacturer and shall be completely coordinated with the pumps and pump driving motors and shall include all internal auxiliaries required to meet the functional specifications.

C. The Variable Frequency Drives shall conform to all requirements stipulated in this Section and Division 16, Electrical, and shall be designed for a speed range of 30% to 100% of full load motor speed.

D. The Variable Frequency Drives shall be compatible with the motors provided by the Manufacturer.

2.06 PUMP/MOTOR PROTECTION SYSTEM/PANEL

A. A pump/motor protection system shall be provided to monitor machine vibration, temperature, and moisture. The system shall provide warning and shutdown protection and shall be UL listed. All of the pump/motor unit protective and monitoring sensors shall be connected to an electronic module which will provide a signal from the pump/motor sensors to the devices located in the pump/motor protection panel. Modules shall be as manufactured by Benshaw, (pump) Manufacturer or equal.

B. Detailed operational data shall be accessible using a standard web browser on a computer with no special software required. Alternatively, data shall be capable of easily being transferred to a higher level distributed control system such as a Supervisory Control and Data Acquisition (SCADA) system.

C. The pump/motor protection system shall monitor each pump/motor 's temperature, vibration and moisture (leakage). The system shall be provided with Ethernet, Modbus and modem

communications ports, and shall be capable of communicating with the SCADA system. Provide relay outputs for remote monitoring of warning and alarm.

D. The pump/motor protection panel shall be mounted on the dead-front panel. The pump/motor protection panel shall include soft-touch type navigation keypad, alarm acknowledgement keypad, amber warning lamp, red alarm lamp and a LCD digital display. The digital display shall provide the local readout of pump/motor sensor and alarm status and aid in navigation through the system during set-up.

E. Each pump/motor unit(s) shall be equipped with the following protection and monitoring sensors:

1. Three motor winding bi-metalic thermal switches or thermistors, one installed in each motor stator phase winding, and connected in series to monitor and protect the winding from over temperature operation. The thermal switches shall open, activating an alarm and stopping the motor should a high temperature event occur.

2. One PT-100 (Platinum, 100 ohm, 2 or 3-wire) temperature probe shall be installed in the bearing housing holding the outer race of the thrust bearing and lower support bearing to provide for accurate temperature monitoring of the bearings.

3. Three PT-100 (Platinum, 100 ohm, 2 or 3-wire) temperature probes, one installed in each motor stator phase winding, to provide direct stator temperature read-out of each phase winding.

4. One PT-100 (Platinum, 100 ohm, 2 or 3-wire) temperature probe shall be installed in the bearing housing holding the outer race of the upper support bearing to provide for accurate temperature monitoring of the bearing.

5. One Float-type Moisture (Leakage) Sensor (Stator FLS) shall be provided to detect water intrusion into the motor stator chamber. If activated, the FLS will activate an alarm.

6. One Float-type Moisture (Leakage) Sensor (Electrical Connection FLS) shall be provided to detect water intrusion into the motor electrical connection (cable junction) chamber. If activated, the FLS will activate an alarm.

7. One vibration sensor shall be installed in the power cable junction chamber of the pump/motor unit. The vibration sensor shall be capable of monitoring vibration velocity in in/sec RMS unfiltered. Alternatively, one vibration sensor shall be installed to the outside of the pump casing near the upper bearing housing in accordance with manufacturer’s recommendations. A separate sensor mounting base equipped with mounting stud shall be connected to the pump with epoxy-based adhesive, to which the sensor shall be mounted. If utilized, external sensor (accelerometer) shall be model SA6200UW as manufactured by Metrix or equal. Provide associated model 5535 signal conditioner/transmitter as manufactured by Metrix or equal to be mounted in the pump/motor protection panel.

8. All relays associated with the monitoring and protective devices furnished.

2.07 PRESSURE GAUGES

A. Each pump suction and discharge piping shall be equipped with a pressure gauge. See Instrumentation specifications for pressure gauge requirements.

2.08 SHOP PAINTING

A. Each pump and associated equipment shall be shop-primed and finished-coated in accordance with the Manufacturer's standard practice prior to shipment. Color shall be per the Manufacturer’s standard and an adequate supply of touch-up paint shall be supplied by the Manufacturer.

B. All interior and exterior wetted surfaces of pumps, exterior and interior of cooling jacket and exterior of motor enclosure shall be thoroughly cleaned, dry and free of all rust, mill scale, grease, dirt, other foreign matter and supplied with Manufacturer’s standard coatings meeting the requirements in Sections 09901 and 09902.

C. All nameplates shall be properly protected during painting.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the Manufacturer’s instructions and recommendations in the locations shown on the Drawings. The Contractor shall furnish all required oil and grease for initial operation, if required, in accordance with the Manufacturer's recommendations. Anchor bolts shall be set in accordance with the Manufacturer's recommendations.

B. Upon completion of each pump installation, the Manufacturer shall inspect the unit and submit a certificate stating that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.02 INSPECTION AND TESTING

A. General

1. The Engineer shall be notified in writing prior to initial shipment and/or testing, in ample time so that arrangements can be made for inspection by the Engineer.

2. Field tests shall not be conducted until such time that the pumping system, including controls, is complete and ready for testing.

B. Factory Pump Test

1. All pumps shall receive a non-witness factory test.

2. The Manufacturer shall factory test all pumps prior to shipment in accordance with the Hydraulic Institute standards, latest version. Flow rate, total head and Input KW shall be

tested and recorded for at least five points on the pump performance curve. Test shall be performed to demonstrate that the pumps meet ANSI/HI 11.6 acceptance grade 1U for the design condition. The primary and secondary design conditions shall meet acceptance grade 1E. The five points shall include the points specified in pump performance table in Paragraph 2.02.

3. The Manufacturer shall perform hydrostatic test on the pressure-containing parts in accordance with ANSI/HI 11.6. Test shall be conducted on each pump prior to final coating and shipment.

4. The Manufacturer shall perform the following test on each pump prior to shipment from factory:
   a. Megger motor and pump for insulation breaks or moisture.
   b. Prior to submergence, the pump shall be run dry and checked for correct rotation.
   c. Pump shall be run for a minimum of 30 minutes in a submerged condition.
   d. The pump shall be removed from test tank, meggered immediately for moisture and upper and lower seal unit shall be checked for water intrusion.
   e. A written certification test report regarding the above tests shall be submitted for approval prior to shipment.

C. Field Pump Test

1. As specified in Paragraph 1.07 B., the Manufacturer shall furnish the services of a representative who shall have complete knowledge of proper operation and maintenance to inspect the final installation and supervise the test run of the equipment. The Manufacturer shall include in his price, a minimum of eight hours of a representative's time for the above tests.

2. Written test procedures shall be submitted to the Engineer for approval 30 days prior to testing.

3. The Contractor shall furnish all water, power, facilities, labor, materials, supplies and test instruments required to conduct the field testing.

4. The Final Acceptance Test shall demonstrate that all items of these Specifications have been met by the equipment as installed and shall include, but not be limited to, the following tests:
   a. That all units have been properly installed and are in correct alignment.
   b. The Contractor shall check for correct lubrication in accordance with manufacturer's instructions. The Contractor shall check direction of rotation of all motors and reverse connections, if necessary.
   c. That the units operate without overheating or overloading any parts and without objectionable vibration.
   d. That there are no mechanical defects in any of the parts.
   e. That the pumps can deliver the specified total head and flow rate to demonstrate that the pumps generally meet the requirements specified (factory performance test is the basis of pump acceptance).
   f. That the pump sensors and controls perform satisfactorily as to sequence control, correct start and stop elevations, and proper level alarm functions.

5. If the pump performance does not meet the specifications, corrective measures shall be taken or pumps shall be removed and replaced with pumps which satisfy the conditions specified.

6. A five-day continuous operating period of the pumps will be required before acceptance. If pumping system fails during the test period, the test shall be restarted (including reset of time to zero) after repair (or replacement) has been completed.

D. Field Vibration Testing

1. After installation and as soon as conditions permit full speed operation, and in the presence of the Engineer, have the vibration tests performed in accordance with ANSI/HI 11.6 on each unit by a minimum level III qualified vibration technician as defined by Vibration Institute or equivalent to (a) prove compliance with specified limitations, and (b) prove that there are no field installed resonant conditions due to misalignment, the foundation, or the connecting piping and its supports, when operating at any speed within the specified operating range.
   a. At a minimum, if pump system is furnished with vibration and temperature monitoring system, the motor lower vibration sensors may be used for acceptance testing. Alternatively, temporary surface mounted sensors mounted in the vicinity of the installed sensors are preferred to additionally establish the accuracy of the permanently installed system.

2. If required, take corrective action and the units shall be retested to ensure full compliance with this Section. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.

END OF SECTION

SECTION 12484
FLOOR MATS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish all labor, materials, equipment and incidentals required and install floor mats as shown on the Drawings and as specified herein.

B. Related Requirements:

1. Concrete work is included in Division 3.

1.3 ACTION SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings showing materials and construction with substrate surface preparation installation procedures. Submittals shall include the following:

1. Two samples of each type of mat proposed and proposed adhesive. Sample size shall be approximately 6-in by 6-in.

PART 2 - PRODUCTS

2.1 FLOOR MATS

A. Electrically Energized Equipment Mats: Rubber or vinyl electric insulating type mats conforming to ASTM D178, Type I, Class 2; branded continuously on back. Bevel edges of mats or attach electric insulating rubber reducing strips as approved to provide a non-trip perimeter.

1. Locations: Provide in front of all electrical equipment.
2. Size: 1/4-in thick, 3-ft wide, in lengths equal to bench length or equipment piece length.
3. Materials and Construction: Construct electrically energized equipment mats of prime quality rubber compound, free of calendaring and curing defects, with narrow continuous longitudinal corrugations.
4. Color: Black.

5. Product: Provide one of the following:
   a. "ASTM Switchboard" by American Floor Products Company, Inc.
   b. "Switchboard Runner Matting," by Musson, R. C. Rubber Co.
   c. "Corrugated Switchboard," by Tennessee Mat Co.
   d. Or equal.

2.2 ACCESSORIES

A. Provide waterproof adhesive, approved by the manufacturer, for securing floor mat to substrate.

2.3 FABRICATION

A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare substrate and install entrance mats according to approved procedures and when directed by the Engineer. Set length of units perpendicular to traffic direction through vestibule. Set units tightly together.

B. Lay floor mats in place when and where directed.

END OF SECTION

SECTION 13300
INSTRUMENTATION AND CONTROLS – GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall procure the services of a single Process Control System Supplier (PCSS) to furnish and install all materials, equipment, labor and services, except for those services and materials specifically noted, required to achieve a fully integrated and operational system as specified herein and in other Specification Sections listed below.

B. The work shall include furnishing, installing and testing the equipment and materials detailed in the following Sections:

Section No.	Title
13300	Instrumentation and Controls (I&C) - General Provisions
13302	I&C - Testing
13311	I&C - Digital Hardware and Software
13320	I&C – Networking and Telemetry
13321	I&C – Fiber Optic Cabling and Equipment
13330	I&C – Control Panels and Panel Mounted Equipment
13340	I&C – Field Instruments

Requirements specified in this Section apply to all equipment specified in the above sections, unless otherwise specified.

C. The responsibilities of the PCSS shall be generally as follows:

1. Furnish and install all field instrumentation as shown in the Drawings and listed in Section 13340.

2. Provide the Pump Station Control Panel as shown in the Drawings and listed in Section 13330. Panel-mounted components are detailed in Sections 13300, 13311, and 13320. Fiber optic cable and related components are detailed in Section 13321.

3. Provide and install radio telemetry equipment for communication of data between the Robena Road Pump Station and the OWNER's SCADA network, as shown in the Drawings and described in Section 13320. Coordinate with the Electrical subcontractor regarding the provision, installation, and termination of cables. Coordinate with the OWNER for radio survey information.

D. The following activities are excluded from the PCSS scope of supply:

1. Coordinate with the Electrical subcontractor regarding the provision, installation, and termination of cables.

2. The OWNER will provide a radio survey that will indicate the expected required height and orientation of the radio antenna.

3. The OWNER will provide all programming for the PLC to be furnished under this Section, the operator interface terminal (OIT), and the human-machine interface (HMI). The PCSS shall provide only temporary programming where required to facilitate testing. Refer to Section 13302.

E. 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, shall be included whether they are shown on the Drawings or not.

F. Substitutions on functions or type of equipment specified shall not be acceptable unless specifically noted. In order to confirm compatibility between all equipment, coordinate all interface requirements with mechanical and electrical systems and furnish any signal isolation devices that might be required.

G. Equipment shall be fabricated, assembled, installed and placed in operating condition in full conformity with the project Specifications, Drawings, Engineering data, instructions, and recommendations of the equipment manufacturer as approved by the ENGINEER.

H. To facilitate the OWNER'S future operation and maintenance, similar products shall be supplied from the same manufacturer.

I. All equipment and installations shall satisfy applicable Federal, State and local codes.

J. Use the equipment, instrument, and loop numbering scheme that has been developed and shown on the Drawings and specifications in the development of the submittals. Do not deviate from or modify said numbering scheme without the ENGINEER'S approval.

1.02 RELATED WORK

A. Process & Instrumentation Diagrams (P&ID) are included in the Drawings.

B. Control System Architecture Block Diagram is included in the Drawings.

C. General conditions are specified in Divisions 0 and 1.

D. Process and mechanical equipment is specified in Divisions 11, 13 and 15.

E. Electrical is specified in Division 16.

1.03 SUBMITTALS

A. General submittal requirements include:

1. Refer to Section 01300 for general submittal requirements.

2. Additional submittal requirements are contained in related Instrumentation Sections in Division 13.

3. Shop drawings shall demonstrate that the equipment and services to be furnished comply with the provisions of these specifications and shall provide a complete record of the

equipment as manufactured and delivered. Submittals shall be complete; giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature shall not be acceptable.

4. Hard copies of submittals shall be bound in separate three-ring binders, with an index and sectional dividers, with all drawings reduced to a maximum size of 11-inch by 17-inch, then folded to 8.5-inch by 11-inch for inclusion within the binder. Maximum binder size shall be 3 inches.

5. The submittal drawings' title block shall include, as a minimum, the PCSS's registered business name and address, OWNER and project name, drawing name, revision level, and personnel responsible for the content of the drawing.

6. Incomplete or partial submittals not complying with the submittal arrangements outlined in this Section may be returned without review.

B. Input/Output (I/O) Address List Submittal

1. Submit a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.

2. I/O list shall be based on the P&ID's, the Drawings, the design I/O list (if included within these specifications), and requirements outlined in the Specifications.

3. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format, and an 8-1/2 inch by 11-inch hard copy.

4. The I/O list shall reflect all active and spare I/O points. Add points to accommodate spare I/O.

5. The I/O list shall be arranged such that each control panel has a dedicated worksheet. At a minimum, I/O worksheet tables shall include the following information:
   a. TAG NUMBER(S): The identifier assigned to a device that performs a function in the control system. As part of this information, the loop number of the tag shall be broken out 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: The 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. LOGICAL POINT ADDRESS: I/O address of each point.
   f. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, Virtual points (VDI, VDO, VAI, VAO) connected via network.
   g. 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 are "1."
   h. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
   i. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.

j. P&ID – the 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.

6. The I/O list shall be sorted in order by:
   a. Physical location
   b. I/O Type
   c. Loop Number
   d. Device Tag

7. After the I/O list is approved, do not modify the PLC I/O addresses without approval by the ENGINEER.

8. Where multiple mechanical components are provided for process redundancy, their field connections to I/O modules shall be arranged such that the failure of a single I/O module will not disable all mechanical components of the redundant system. This applies to all I/O types.

C. Field Instruments Submittal

1. Submit complete documentation of all field instruments using ISA-TR20.00.01-2001 (updated in 2004-2006) data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment. The list shall be sorted by Loop Number.

2. Submit separate data sheets for each instrument including:
   a. ISA tag number.
   b. Product (item) name used herein and on the Drawings.
   c. Manufacturer's complete model and/or part number(s).
   d. Location of the device.
   e. Input - output characteristics.
   f. Range, size, and graduations in engineering units.
   g. Physical size with dimensions, enclosure NEMA classification and mounting details in sufficient detail to determine compliance with requirements.
   h. Materials of construction for enclosure and wetted parts.
   i. Instrument or control device sizing calculations where applicable.
   j. Certified calibration data for all flow metering devices.
   k. Two-wire or four-wire device type as applicable.

3. Submit descriptive manufacturer literature for each instrument that fully describes that instrument and demonstrates its conformance to the Specifications. In literature that describes multiple items, circle or otherwise highlight the particular instrument or configuration that is to be furnished. Any deviation from the Specifications shall be explained in detail.

4. Submit proposed mounting details of all instruments.

D. Hardware Submittal

1. Submit a bill of materials that lists, at a minimum, product name, manufacturer, model number, and location, for each hardware component furnished under Section 13300 or Related Sections.

2. Submit descriptive manufacturer literature for each hardware component that fully describes that component and demonstrates its conformance to the Specifications. In literature that describes multiple items, circle or otherwise highlight the particular instrument or configuration that is to be furnished. Any deviation from the Specifications shall be explained in detail.

3. Submit a complete system architecture diagram showing in schematic form the interconnections between major hardware components including control centers, panels, power supplies, consoles, computer and peripheral devices, networking equipment, processors, I/O modules, local operator interfaces, and like equipment. The system architecture shall depict all required cables, media type between components, network protocol used at each network level, details on connection requirements such as cable pin-outs, port numbers, and rack slot numbers.

E. Panel Layout Drawings and Wiring Diagrams Submittal

1. Panel Layout Drawings: Submit layout drawings shall be furnished for all panels, consoles, and equipment enclosures specified. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. The panel drawings shall include the following:
   a. Interior and exterior panel elevation drawings to scale.
   b. Nameplate schedule.
   c. Conduit access locations.
   d. Panel construction details.
   e. Cabinet assembly and layout drawings to scale. The assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. The bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify any component of the assembly by manufacturer and model number.
   f. Panel, subpanel and nameplate colors.
   g. 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.
   h. Heating and cooling calculations for each panel located in a non-conditioned area. Calculations shall include the recommended type of equipment required for both heating and cooling.
   i. Calculation of UPS load and battery life for all connected equipment, as applicable.
   j. Submit evidence that all control panels shall be constructed in conformance with UL 508A and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. All costs associated with obtaining the UL seal and any inspections are the responsibility of the PCSS.

2. Panel Wiring Diagrams: Submit panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. Diagrams shall be 11"x17" in size. Panel wiring diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring shall include the device ISA-tag and a unique numeric identifier. The diagrams shall identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the PCSS and approved by the ENGINEER. I/O wiring shall be numbered with rack number, slot number, and point number. Two-wire and four-wire equipment shall be clearly identified and power sources noted. Submit final wire numbering scheme.

3. Where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions, coordinate with the General Contractor to obtain the approved shop drawings and submittals that include complete wiring diagrams showing all wiring connections in the I/O system. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. These drawings will be included in the Final Documentation submittal. Leaving this information blank on the Final Documentation drawings is not acceptable.

F. Fiber Optic Cable-related Submittals: Refer to Section 13321.

G. Testing Submittals

1. Test Form Submittals: Submit the procedures proposed to be followed for each test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests. Include sign-off forms for each testing phase or loop with sign-off areas for the PCSS, ENGINEER, and OWNER. Refer to Section 13302 for specific testing requirements, and submit separate procedures for each specified test phase.

2. Test Documentation: Upon completion of each required test, document the test by submitting a copy of the signed off test procedures. A test shall not be considered complete until the signed-off test procedures have been submitted and approved. Submittal of other test documentation is not an acceptable substitute for the formal test documentation.

3. Each loop shall have a Loop Status signoff form to organize and track its inspection, adjustment and calibration. These forms shall include the following information and checkoff items:
   a. Project Name.
   b. Loop Number.
   c. Detailed test procedure indicating exactly how the loop will be tested including all required test equipment, necessary terminal block numbers, and simulation techniques required.
   d. Tag Number for each component.
   e. Checkoffs/signoffs for each component.
      i. Tag/identification
      ii. Installation
      iii. Termination - wiring
      iv. Termination - tubing
      v. Calibration/adjustment

f. Checkoffs/signoffs for the loop.
   i. Panel interface terminations
   ii. I/O interface terminations
   iii. I/O signal operation
   iv. Inputs/outputs operational: received/sent, processed, adjusted
   v. Total loop operation
   vi. Space for comments.
   vii. Sign off and date fields for the CONTRACTOR, the ENGINEER, and the PCSS.

4. Each active analog subsystem element shall have a Component Calibration form. These forms shall have the following information including space for data entry:
   a. Project Name.
   b. Loop Number.
   c. ISA Tag Number and I/O Module Address.
   d. Manufacturer.
   e. Model Number/Serial Number.
   f. Summary of Functional Requirements. For example:
      i. For Indicators: Scale ranges
      ii. For Transmitters/Converters: Scale and chart ranges
      iii. For Computing Elements: Function
      iv. For Controllers: Action (direct/reverse) control modes (PID)
      v. For Switching Elements: Unit range, differential (FIXED/ADJUSTABLE), reset (AUTO/MANUAL)
      vi. For I/O Modules: Input or output
   g. Calibrations; for example:
      i. For Analog Devices: Required and actual inputs and outputs at 0, 50 and 100 percent of span.
      ii. For Discrete Devices: Required and actual trip points and reset points.
      iii. For Controllers: Mode settings (PID).
      iv. For I/O Modules: Required and actual inputs or outputs for 0, 50 and 100 percent of span.
   h. Space for comments.
   i. Sign off and date fields for the CONTRACTOR, the ENGINEER, and the PCSS.

H. Spares, Expendables, and Test Equipment Lists Submittal

1. This submittal shall include for each Subsystem:
   a. A list of, and descriptive literature for, spares, expendables, and test equipment as specified in Division 13.
   b. A list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the manufacturer.
   c. Unit and total costs for the additional spare items specified or recommended for each subsystem.

I. Final System Documentation (O&M)

1. Submit in accordance with Section 01730.

2. The Final System Documentation shall consist of operations and maintenance manuals as specified herein. The manuals shall be bound in three-ring binders, maximum size of three inches, with Drawings reduced to 11-inch by 17-inch, then folded to 8.5-inch by 11-inch

for inclusion. Each section shall have a uniquely numbered tab divider, and each component within each section shall have a separate binder tab divider.

3. The operations and maintenance manuals shall, at a minimum, contain the following information:

    a. Table of Contents
        i. A Table of Contents shall be provided for the entire manual with the specific contents of each volume clearly listed. The complete Table of Contents shall appear in each volume.
    b. Instrument and Equipment Lists
        i. The following lists shall be developed in Excel and provided as hardcopy and electronically.
        ii. An instrument list for all devices supplied including tag number, description, specification section and paragraph number, manufacturer, model number, serial number, range, span, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
        iii. An equipment list for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, serial number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
    c. Data Sheets with Vendor Operations and Maintenance Information
        i. ISA S20 data sheets shall be provided for all field instruments.
        ii. Cover page for each device, piece of equipment, and OEM software that lists, at a minimum, date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA S20, general data sheet; however, other formats will be acceptable provided they contain all required information.
        iii. Final vendor O&M documentation for each device, piece of equipment, or OEM software shall be either new documentation written specifically for this project, or modified standard vendor documentation. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or crossed out. Groups of pages that do not apply at all to the specific model supplied shall be removed.
        iv. For any component requiring dip switch settings or custom software configuration, that information shall be included along with the corresponding data sheets and O&M information.
    d. As-Built Drawings
        i. Complete as-built drawings, including all drawings and diagram specified in this section under the "Submittals" section. These drawings shall include all termination points on all equipment the system in connected to, including terminal points of equipment not supplied by the PCSS.
        ii. As-built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Any errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.
    e. Electronic O&M Information
        i. In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals on CD-R or DVD-R. Electronic documents shall be supplied in PDF format.

ii. Provide electronic files for all custom-developed manuals. Text shall be supplied in both Microsoft Office format and PDF format.
iii. Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, and fonts into individual zip files along with the drawing file.

4. The cover and edge of each volume shall contain the following information:

   Project Name (refer to Contract Documents)
   Contract Number (refer to Contract Documents)

   Instrumentation and Control System
   Hardware [or Applications Engineering] Operations and Maintenance Manual
   Specification Sections _____, _____, _____

   Subcontractor Name
   Date
   Volume X of Y
   (Where X is the volume number and Y is the number of volumes)

5. Provide as-built panel drawings, for both new and modified control panels, to be stored within that panel.

   a. Provide one complete set of drawings that shall be stored in the print pocket: 11x17 inch size; laser printed, not inkjet; in full color where appropriate.

   b. An additional copy of all key electrical drawings, such as power distribution, networking and I/O, shall be laminated and affixed to the inside of the door. 8.5x11 inch size may be used if there is not enough room for 11x17 inch size.

1.04 REFERENCE STANDARDS

A. Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.

B. International Society of Automation (ISA)

1. ISA S5.2, Binary Logic Diagrams for Process Operations

2. ISA S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.

3. ISA S5.4, Instrument Loop Diagrams.

4. ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

5. ISA RP60.3, Human Engineering for Control Centers

6. ISA RP60.6, Nameplates, Labels, and Tags for Control Centers

C. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 1016-1998, Recommended Practice for Software Design Descriptions

D. National Electrical Manufacturers Association (NEMA)

E. National Fire Protection Agency (NFPA)

1. NFPA 70, National Electrical Code (NEC).

F. PROFIBUS & PROFINET International

1. PROFIBUS Design Guideline (8.012), version 1.13, May 2015

2. PROFIBUS Assembling Guideline (8.022), version 1.14, May 2015

3. PROFINET Installation Guideline for Cabling and Assembly (8.072), version 1.0, January 2009

G. Underwriters Laboratories, Inc. (UL)

1. UL 508 - Industrial Control Equipment - for custom fabricated equipment

2. A nationally recognized testing laboratory, as approved by the Authority having jurisdiction, may substitute for UL listing on commercial off the shelf products.

1.05 QUALITY ASSURANCE

A. The Instrumentation 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" shall be interpreted to mean an organization that complies with all of the following criteria:

1. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel shall hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel shall include, as a minimum, the lead field technician.

2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be for projects where the contract was of similar size to this project.

3. Has been actively engaged in the type of work specified in this Specification Section for a minimum of five years.

B. The PCSS shall 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. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 8 hours of notification starting at two months before scheduled startup to two months after startup completion.

C. Actual installation of the instrumentation system need not be performed by the PCSS's employees; however, the PCSS as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.

1.06 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling shall be in accordance with Section 01600.

B. Shipping Precautions

1. After completion of shop assembly, factory test and approval of all equipment, cabinets, panels and consoles shall be packed in protective crates and enclosed in heavy duty (5 mil) polyethylene envelopes or secured sheeting to provide protection from damage, dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at the job site.

2. Manufacturer’s special instructions for field handling, storage and installation required for protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other means of protection.

3. If any apparatus has been damaged, such damage shall be repaired at no additional cost to the OWNER.

1.07 NOMENCLATURE AND IDENTIFICATION

A. Field Instrument Tags

1. A stainless steel or other non-corrosive metal tag firmly attached and permanently and indelibly inscribed with the instrument tag number, as indicated in the Drawings, shall be provided on each piece of equipment supplied under this Section. Equipment shall be tagged before shipping to the site.

2. Provide 1/8-in by 3/8-in, Type 316 stainless steel button head machine screws.

3. All supplied field instrument transmitters and field instrument transmitter elements shall have a stainless-steel identification tag attached to each transmitter and element prior to shipment. Tag shall be attached via stainless steel chain or stainless steel wire (24-gauge minimum) to a non-removable part of the device. The tag size shall be a minimum of 1.5 square inches. Tag shall include the ISA alphanumeric instrument number as indicated in the P&ID, loop, and detail drawings. The alphanumeric instrument number shall be stamped into the tag and shall have a minimum of 3/16-in high alphanumeric characters.

B. Panel Nameplates

1. See Section 13330.

1.08 WARRANTY

A. Provide warranty per Section 01740, Warranties and Bonds, and as specified herein.

B. The PCSS shall provide a two (2) year unconditional warranty beginning at Final Completion of all work furnished by them under this Contract. The warranty shall include materials, installation, and applications; and shall constitute complete replacement and delivery to the site of materials, installation and applications to replace defective material or defective workmanship with new materials/workmanship conforming to the Contract Drawings and Specifications. The PCSS shall also ensure that the warranties of supplied components are honored by their respective manufacturers.

C. The PCSS shall provide telephone technical support within 4 hours of warranty claim. If failure cannot be resolved by telephone, PCSS shall provide onsite technical support within 24 hours of warranty claim.

1.09 PROJECT/SITE REQUIREMENTS

A. Environmental Requirements. Refer to Section 16000 for specific environmental and hazardous area classifications.

B. Elevation: Equipment shall be designed to operate at the project ground elevation.

C. Temperature:

1. Outdoor areas' equipment shall operate between -10 and 50 degrees C ambient.

2. Equipment located in indoor locations shall operate between 0 and 40 degrees C ambient.

3. Storage temperatures shall range from 0 to 50 degrees C ambient.

4. Additional cooling or heating shall be furnished if required by the equipment as specified herein.

D. Relative Humidity. Air-conditioned area equipment shall operate between 20 to 95 percent relative, non-condensing humidity. All other equipment shall operate between 0 to 100 percent relative, condensing humidity.

PART 2 PRODUCTS

2.01 GENERAL

A. All instrumentation and electronic equipment shall be of the manufacturer’s latest design, utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture and fungus. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.

B. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks unless otherwise noted. Fasteners for securing control panels and enclosures to walls and floors shall be either hot-dipped steel galvanized after fabrication, or stainless steel. Only stainless steel fasteners will be acceptable in corrosive areas rated NEMA 4X on the Drawings or as defined under Section 16000. Provide and size anchors in accordance with Division 1 and 5 as required per the seismic calculations. Provide minimum size anchor of 3/8-inch.

C. All indicators shall be linear in process units, unless otherwise noted. All transmitters shall be provided with indicators in process units, accurate to two percent or better.

D. All equipment, cabinets and devices furnished shall be heavy-duty type, designed for continuous industrial service. The system shall contain similar products of a single manufacturer, and shall consist of equipment models, which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

E. All electronic/digital equipment shall be provided with radio frequency interference protection.

F. Electrical

1. Equipment shall operate 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 shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

2. With the exception for field device network connected devices, all electronic instrumentation shall 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, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.

4. Discrete signals shall be nominal 120VAC, 60Hz.

5. All switches shall have double-pole double-throw contacts rated at a minimum of 600 VA, unless noted otherwise.

6. Switches and/or signals indicating an alarm, failure or upset condition shall be wired fail-safe to the SCADA system. A fail-safe condition is an open circuit when in an alarm state.

7. Materials and equipment shall be UL approved. Where components are not available with UL approval, integrate the device with ground fault protective devices, isolation transformers, fuses, or other protective equipment necessary to achieve compliance with UL 508 requirements.

8. All equipment furnished shall be designed and constructed so that in the event of power interruption, the systems specified herein shall go through an orderly shutdown with no

loss of memory, and shall resume normal operation without manual resetting when power is restored, unless otherwise noted.

9. All transmitter output signals shall include signal and power source isolation.

2.02 ELECTRICAL SURGE PROTECTION

A. General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an 8x20µs impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground in accordance with Section 16660.

B. Provide protection of all analog and serial signal circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit.

C. Provide the following surge protection devices:

1. 230VAC power feeds (single phase): Citel DS42S-230

2. 120VAC power feeds: Citel DS41S-120

3. 24VDC power feeds: Citel DS220S-24DC

4. 24VDC/4-20mA analog signals (within panel): Citel DLAW-24D3

5. Profibus DP signals (within panel): Citel DLAW-06D3

6. Profibus DP and 120VAC power (at field instrument): Citel CAD2-120S-112-A

D. Refer to Section 13320 for coaxial cable surge protection requirements.

2.03 SPARE PARTS

A. All spare parts shall be wrapped in bubble wrap, sealed in a polyethylene bag complete with dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's contact information (address and phone number), part name, part number, part ordering information, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the OWNER or ENGINEER.

B. Furnish one of each type of surge protection devices used (see paragraph 2.02.C).

C. Other spare parts are specified in each Instrumentation Specification Section (see paragraph 1.01.B).

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

A. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices indicated are approximate only. Exact locations of all devices shall be as approved by the ENGINEER during construction. Obtain in the field, all information relevant to the placing of process control equipment and in case of any interference with other work, proceed as directed by the CONTRACTOR and furnish all labor and materials necessary to complete the work in an approved manner at no additional cost to the OWNER.

B. The P&IDs and Drawings indicate the intent and not the precise nature of the interconnection between the individual instruments. Where indicated on the P&IDs or Drawings as not requiring installation, provide the instruments suitably packaged for storage.

C. All equipment used in areas designated as hazardous shall be designed for the Class, Group and Division as required for the locations as shown on the Drawings and specified in Division 16. All work shall be in strict accordance with codes and local rulings.

D. Unless specifically indicated, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, 5-valve manifolds for calibration, testing and blow down service shall also be provided. For chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

E. All piping and tubing to and from field instrumentation shall be provided with necessary unions, calibrations and test tees, couplings, adaptors, and shut-off valves. Process tubing shall be installed to slope from the instrument toward process for gas measurement service and from the process toward the instrument for liquid measurement service. Provide drain/vent valves or fittings at any process tubing points where the required slopes cannot be maintained.

F. Brackets and hangers required for mounting of equipment shall be provided. They shall be installed as shown and not interfere with any other equipment.

G. The shield on each process instrumentation cable shall be continuous from source (PLC) to destination and be grounded at only one point for each shield on the PLC side.

H. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, ship material in sections sized to permit passing through restricted areas in the building. Provide on-site service to oversee the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the ENGINEER'S approval. Certify that field wiring associated with his/her equipment is installed in accordance with best industry practice. Schedule and coordinate work under this section with that of the electrical work specified under applicable Sections of Division 16.

I. Installation of fiber optic cable within control panel and console assemblies. Refer to cable manufacturer's specifications for bend radius. Use cable breakout assembly as recommended by the cable manufacturer. Provide wire basket, strain relief as required to meet manufacturer's strain requirements.

J. Provide sunshades for equipment mounted outdoors in direct sunlight. Sunshades shall include standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North or as required to minimize the impact of glare on LED, LCD, or other digital readouts.

3.02 TESTING

A. Refer to Section 13302.

END OF SECTION

SECTION 13302
I&C – TESTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor and materials required and installed. Complete as shown on the Drawings and as specified herein.

B. This section covers the testing requirements for all devices and systems furnished and installed detailed on the Drawings and in the Loop Diagrams, and as described in the related Sections of Division 13.

C. Refer to Section 13300.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TESTING - GENERAL

A. See execution requirements in Section 13300.

B. As part of the requirement of this Section, it is the responsibility of the PCSS to provide a complete operational control system. Confirmation of an operational control system is dependent upon results derived from test procedures as specified in this Section.

C. The following tests shall be conducted:

1. Unwitnessed Factory Test (UFT).

2. Operational Readiness Test (ORT).

3. Site Acceptance Test (SAT).

D. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.

E. All tests shall be conducted in accordance with prior ENGINEER and/or OWNER-approved procedures, forms, and checklists as submitted by the PCSS under Section 13300. Each test to be performed shall be described and a space provided after it for sign-off by the appropriate parties after its satisfactory completion. The PCSS shall include “punchlist” forms with the test procedures to document issues that arise during the testing. Punchlist forms, at a minimum, shall include a specification cross reference; an issues description field; a resolution description field; and a sign-off area for the PCSS, OWNER, and ENGINEER. No test listed herein may proceed until the test documentation for that test has been submitted and approved by the ENGINEER.

F. Copies of the signed-off test procedures, forms, and checklists will constitute the required testing documentation. The test result forms shall be submitted to the ENGINEER for approval

within 10 days of completion of each test. Each test listed herein must be successfully completed, and its required documentation approved by the ENGINEER, before the next test may be scheduled.

G. The PCSS shall provide all facilities, materials and equipment required to conduct the test, at no additional cost to the OWNER. 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 suitable means of simulation. The PCSS shall describe planned simulation techniques in the test submittal(s).

1. For PLC I/O testing, the PCSS shall use SIMATIC STEP 7 version 5.5 software.

2. The PCSS shall furnish temporary PLC programming for I/O checkout if necessary to facilitate the testing procedures required herein.

H. The PCSS shall furnish the services of field service engineers, all special calibration and test equipment, and labor to perform the field tests. The PCSS shall be responsible to enlist the services of the Control Panel Builder as required during all applicable testing.

I. The PCSS shall coordinate all required testing with the CONTRACTOR, the Control Panel Builder, all other affected Subcontractors, the ENGINEER, and the OWNER. Witnessed tests must be witnessed by at least one representative of the ENGINEER and/or the OWNER.

J. The ENGINEER reserves the right to test or retest all specified functions, whether or not explicitly stated on the Test Procedures, as required to determine compliance with the functional requirements of the overall system. Such testing required to determine compliance with the specified requirements shall be performed at no additional cost to the OWNER. The ENGINEER'S decision shall be final regarding the acceptability and completeness of all testing.

K. No equipment shall be shipped until the ENGINEER and/or OWNER has received all test results and approved the system is ready for shipment.

L. Correction of Deficiencies

1. All deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet specification requirements at no additional cost to the OWNER.

2. Testing, as specified herein, shall be repeated after correction of deficiencies is made until the specified requirements are met. This work shall be performed at no additional cost to the OWNER.

3.02 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)

A. Prior to shipment of the equipment, all available elements of the system shall be interconnected and tested to ensure the system will operate as specified. All analog and discrete input/output points, controllers, and other equipment not connected at this time shall be simulated to ensure proper operation of all alarms, monitoring devices/functions, and control devices/functions.

B. Tests to be performed shall include, but not be limited to, the following. Each of these tests shall be specifically addressed in the Test Procedure submittal.

1. All panels and enclosures being provided shall undergo a thorough inspection to verify the integrity of the cabinet enclosures, frame structures, paint work and finish, etc.

2. Panel wire pull tests shall be performed on all wiring to ensure all wiring has been connected to the appropriate torque to prevent wires from coming loose.

3. Panel heat loading tests shall be performed to ensure proper cooling/ventilation is being provided.

4. For each subpanel, inspection shall include, 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.

5. An I/O point checkout shall be performed to verify proper operation of the input/output points. The verification of the signals will be accomplished via the use of the PLC configuration files and the PLC programming software. At a minimum, the I/O checkout shall consist of four steps.
   a. Digital input signals shall be jumpered within the termination connections of the PLC panels and verification of proper alarming, statuses, etc., shall be performed utilizing the tools available in the PLC programming software.
   b. Analog input signals shall be connected to a signal generator at the termination connections and signals shall be verified at 0, 25, 50, 75, and 100 percent of full scale. The appropriate scaled value shall be verified utilizing the tools available in the PLC programming software.
   c. Digital output signals shall be initiated by the user by writing to the signals utilizing the PLC programming software. Verification shall occur in the PLC panel by connecting a digital multimeter to measure the continuity at the terminations, thus verifying the command from the PLC has properly executed the contact closure.
   d. Analog output signals shall be initiated by the user by writing to the signals utilizing the PLC programming software. Verification shall occur in the PLC panel by utilizing a digital multimeter to measure the current/voltage generated at the termination points.

6. UPSs shall be tested with all equipment connected to verify the UPSs have been sized correctly to maintain the specified run time.

7. 100 percent wiring and database address verification of panel components and process controller I/O as applicable.

8. Demonstrate basic functionality of the operator interface terminal (OIT).

9. Demonstrate network communication among the PLC, all Remote I/O racks, and other devices being furnished.

10. Demonstrate all system software functions specified, including clock synchronization.

11. Test system recovery from failure scenarios including cold boot, warm boot, communication loss, power failure, etc.

C. Provide, in addition to the documentation described in the Test Documentation Submittal paragraphs in Section 13300, digital photos and/or videos that clearly show that the panel size, finish, layout, components, construction, etc., are correct and in conformance with Drawings, Specifications, and approved shop drawings.

3.03 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

A. Following installation of the process control system components and prior to startup and functional testing, the entire system shall be certified (inspected, wired, calibrated, tested, etc., and documented) that it is installed and ready for the ORT as defined below.

B. Loop/Component Inspections and Tests: The entire system shall be checked for proper installation, calibrated, and adjusted on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and these Specifications.

C. The Loop/Component Inspections and Tests shall be implemented using ENGINEER-approved forms and checklists. Each loop shall have a Loop Status Report to organize and track its inspection, adjustment, and calibration. These reports shall include the following information and check-off items with spaces for sign-off by the system supplier:

1. Project Name, Test Date, PCSS Name, and Lead PCSS Technician Name.

2. Loop Number.

3. Tag Number for each component.

4. Check-offs/sign-offs for each component: Tag/identification; installation; termination (wiring and tubing); scale, range, and setpoint as applicable; and calibration/adjustment (four-point for analog, set point for switches) rising and falling.

5. Check-offs/sign-offs for the loop: Panel interface terminations; I/O interface terminations; I/O signal operation; inputs/outputs operational (received/sent, processed, adjusted); total loop operation; process controller scaling and adjustment; and space for comments.

6. Each active Analog Subsystem element and each I/O module shall have a Component Calibration Sheet. These sheets shall have the following information, spaces for data entry, and a space for sign-off by the PCSS.
   a. Project Name.
   b. Loop Number.
   c. Component Tag Number of I/O Module Number.
   d. Component Code Number Analog System.
   e. Manufacturer (for Analog system element).
   f. Model Number/Serial Number (for Analog system).
   g. Summary of functional requirements shall include, but not be limited to, scale and chart ranges of indicators, recorders, and transmitters/converters; functions of computing elements; and parameters of controllers (i.e., proportional, integral, derivative, reverse/forward acting, etc.).
   h. Calibrations shall include testing of analog input and output signals at 0, 25, 50, 75, and 100 percent of span. Where appropriate, discrete input signals shall include details regarding actual trip points and reset points.
   i. Space for comments.

j. Space for sign-off by the PCSS.

D. The PCSS shall maintain the Loop Status Reports sheets at the job site and make them available to the ENGINEER/OWNER at any time.

E. These inspections, calibrations, and tests do not require witnessing. However, the ENGINEER will review Loop Status Sheets and spot-check the PCSS test process periodically. Any deficiencies found shall be corrected by the PCSS prior to commencement of the Functional Demonstration Test.

F. For all new and modified panels, heat load tests shall be performed to ensure proper cooling/ventilation is being provided.

G. Upon successful completion of the ORT, the PCSS shall submit a record copy of the test results to the OWNER and ENGINEER.

3.04 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

A. After completion of the Operational Readiness Test, the OWNER will install self-developed PLC, OIT and HMI programming. The OWNER will notify the PCSS in writing of the start and end dates of their installation activities, not to exceed 30 calendar days. This period constitutes the Site Acceptance Test.

B. During this time, PCSS personnel shall be present as required to address any potential issues with equipment furnished under the PCSS's scope of supply. The PCSS shall provide contact information for OWNER personnel to use to ensure that support staff are available by phone and/or on-site within four hours of a request by operations staff.

C. While this test is proceeding, the OWNER shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. Plant operations shall remain the responsibility of OWNER and the decision of plant operators regarding plant operations shall be final.

D. Any malfunction during the tests shall be analyzed, and corrections made by the PCSS where applicable. The ENGINEER and/or OWNER will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.

E. Any malfunction within the PCSS scope of supply that occurs during this 30 consecutive day test period, which cannot be corrected by the PCSS's personnel within 24 hours of occurrence, or more than two similar failures of any duration, will be considered as a non-field-repairable malfunction. Upon completion of repairs by the PCSS, the SAT will be re-started from the date which the PCSS successfully corrected the malfunction(s) and the OWNER and ENGINEER have accepted and signed off on the repairs.

F. In the event of rejection of any part or function, the PCSS shall perform repairs or replacement within 10 days.

G. All data base, process controller logic, and graphical interface system errors must be functioning as required per the specifications prior to the start of each test period. The 30-day test will not be considered successful until all data base points and logic functions are tested and verified to be correct.

H. The total availability of the system shall be greater than 99.5 percent during this test period. Availability shall be defined as:

Availability in percent = 100 * (Total Testing Time – Down Time) / Total Testing Time

I. Down times due to power outages or other factors outside the normal protection devices or backup power supplies provided shall not contribute to the availability test times above.

J. Upon successful completion of the 30-day operation test and subsequent review and approval of complete system final documentation, the system shall be considered substantially complete and the warranty period shall commence.

3.05 CERTIFICATE OF INSTALLATION

A. Following successful completion of the 30-day test, the PCSS shall issue a Certification of Installation. Certification shall be on PCSS corporate letterhead and signed by an officer of the firm. Certification shall state that the process control system has been completed in conformance with plans and specifications. Certification shall be submitted to the ENGINEER as specified herein.

END OF SECTION

SECTION 13311
INSTRUMENTATION AND CONTROLS – DIGITAL HARDWARE AND SOFTWARE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Refer to Section 13300.

1.02 RELATED WORK

A. Refer to Section 13300.

1.03 REFERENCE STANDARDS

A. ASTM D999-91: Vibration

B. (CFR) Title 47, Part 18 (European EN 55011 (formerly CISPR 11))

C. CSA Certification Class I, Division 2, Group A, B, C, D Hazardous or non-hazardous locations

D. IEC 60068-2.1 Environmental testing – Part 2-1: Tests - Test A: Cold, 2.2 Environmental testing - Part 2: Tests. Tests B: Dry heat, 2.3, 2.6 Environmental testing - Part 2: Tests - Test Fc: Vibration (sinusoidal) and 2.27 Environmental testing. Part 2: Tests. Test Ea and guidance: Shock

E. IEC 61000 Electromagnetic compatibility (EMC) - Testing and measurement techniques

1. Part 4-2: Electrostatic discharge immunity test

2. Part 4-3: Radiated, radio-frequency, electromagnetic field immunity test

3. Part 4-4: Electrical fast transient/burst immunity test

4. Part 4-5: Surge immunity test

5. Part 4-6: Immunity to conducted disturbances, induced by radio-frequency fields

F. IEC 61131-3: Programmable controllers - Part 3: Programming languages

G. IEC 801-3: RFI Immunity

H. IEC 801-5: Ground Continuity

I. IEC 801-2: Electrostatic Discharge

J. IEEE 472-1974/ANSI C37.90/90A-1974 (Surge Withstand) IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus

K. MIL STD 461B CS02: RFI/EMI Susceptibility

L. NEMA Pub No ICS2-230.42: Showering Arc Test

M. NSTA Project 1A

N. UL 508 and CSA Standard C22.2 No. 142 (Isolation Voltages)

1.04 NOMENCLATURE AND IDENTIFICATION DEFINITIONS

A. AI: Analog Input

B. AO: Analog Output

C. Fixed I/O: A PLC style consisting of a fixed number of I/O, a processor, and a power supply all in one enclosure. Some fixed PLCs have limited expansion ability.

D. CPU: Central Processing Unit

E. DI: Discrete Input

F. Distributed I/O: Hardware specially designed to function as Remote I/O.

G. DO: Discrete Output

H. HMI: Human-Machine Interface

I. I/O Input and/or Output

J. Modular: A PLC style consisting of modules assembled to comprise a complete unit. All I/O, CPU, and Power Supply are dedicated cards. Typically, modules are inserted into a chassis.

K. Master/Slave: Communication between devices in which one device, the master, controls all communications. The other devices, the slaves, respond only when queried by the master. Typically used in a Remote I/O application.

L. Peer to Peer: Communication between two or more devices, typically PLC's, in which each device can control the communication exchange.

M. PID: Control action, proportional plus integral plus derivative.

N. PLC: Programmable Logic Controller

O. Remote I/O: I/O that is located remotely from the processor. Remote I/O can communicate over a variety of communication protocols and can use standard rack based I/O, or special Remote I/O hardware referred to as Distributed I/O.

P. SCADA: Supervisory Control and Data Acquisition

1.05 SPARE I/O

A. Each new I/O location shall include at least 25 percent (minimum of four) points of each type (AI, AO, DI, and DO) for future use, regardless of whether any of those point types are used in that location or not. The spares shall be the same type of I/O modules supplied.

B. Spare output points that require the use of an external relay shall be supplied with the external relay. Analog input and output points require surge suppressors.

C. Regardless of the spare requirement, all installed unused points on all I/O modules shall be wired to terminal blocks in the order that they occur on the I/O modules. Unwired spares shall not be acceptable.

PART 2 PRODUCTS

2.01 GENERAL

A. All required accessories, including but not limited to racks, chassis, cables, connectors, terminating resistors, unused slot fillers, faceplates, covers, rails, endcaps, mounting hardware, onboard batteries and memory modules, shall be furnished whether listed herein or not, as needed to compose a complete system.

B. Furnish products designed for continuous industrial service, listed and classified by Underwriters Laboratories (UL), CSA, or FM approval as suitable for purpose specified and indicated.

2.02 PLC EQUIPMENT LIST

A. All PLC components shall be manufactured by Siemens, or shall be specifically authorized and designed for use in conjunction with Siemens equipment, and shall consist of models or parts that are currently in production. Substitutions of the model and part numbers specifically listed herein must be approved by the Engineer. Note that not all parts required to assemble a complete system are listed.

B. Pump Station Control Panel

1. Central Processing Unit: CPU315-2 PN/DP (6ES7 315-2EH14-0AB0)

2. Power Supply, Rack Mounted: PS307, 2 Amp (6ES7 307-1BA01-0A00) or 5 Amp (6ES7 307-1EA01-0A00)

3. Profibus Communication module: CP341 RS422/485 (6ES7 341-1CH02-0AE0)

4. Serial Communication module: CP340 RS232 (6ES7 340-1AH02-0AE0)

5. Digital Input module, 16x120VAC (6ES7 321-7BH01-0AB0)

6. Digital Output module, 16x120VAC (6ES7 322-1BH00-0AA0)

7. Relay Output module, 16 x relay 120VAC (6ES7 322-1HH00-0AA0)

8. Analog Input module, 4-20mA plus HART, 8x16bit, optically isolated (6ES7 331-7NF10-0AB0)

9. Analog Output module, 4x16bit (6ES7 332-7ND02-0AB0)

2.03 NETWORKING EQUIPMENT LIST

A. Ethernet (PROFINET) Switch: Furnish Siemens SCALANCE X212-2, or approved alternate model/part number by the same manufacturer.

B. Ethernet (PROFINET) Fiber Optic Media Converter: Furnish Siemens SCALANCE X101-1, or approved alternate model/part number by the same manufacturer.

C. PROFIBUS DP Diagnostic Repeater: Furnish Siemens 6ES7 972-0AB01-0XA0, or approved alternate model/part number by the same manufacturer.

D. PROFIBUS Fiber Optic Media Converter: Furnish Siemens OLM/G11, p/n 6GK1503-2CB00, or approved alternate model/part number by the same manufacturer.

2.04 OPERATOR INTERFACE TERMINAL (OIT)

A. Manufacturers

1. Siemens TP1500 Comfort (6AV2 124-0QC02-0AX1), or approved equal part number by same manufacturer.

B. Software

1. The Operator Interface Terminal shall be packaged with configuration and programming software; this software includes one of the following:
   a. SIMATIC WinCC Comfort (TIA Portal)

2. The integrated OIT software shall have the following features
   a. Trending
   b. Data Logging
   c. Alarms
   d. Graphic Symbols

C. Interfaces: (2) RJ-45 Ethernet for PROFINET; (1) RS485/422 for PROFIBUS/MPI; (2) USB-host; (1) USB-device; (2) SD card slot.

D. Display: 12.1 inch TFT, 1280x800, 16 Mio colors.

E. Environmental: NEMA 4X/IP 65 exterior when panel mounted.

2.05 WIRES AND CONNECTORS

A. Ethernet 10/100/1000 BASE-T/TX Cable

1. The unshielded twisted pair cable shall be designed for use with a high speed (10/100/1000 Mbps) Ethernet 10/100/1000 BASE-T/TX communications network. The twisted pair cable shall have a nominal impedance 100 ohms at one MHz, a maximum attenuation of 8 dB per 1000 feet at one MHz. The twisted pair cable must have frequency tested up to 250 MHz or more. The twisted pair cable shall be plenum rated and shall have a minimum of four 23 AWG solid copper conductor pairs. All 10/100/1000 BASE-T/TX (RJ-45) terminations on the twisted pair cable shall be done in a professional and workman like manner.

Terminations shall provide for proper strain relief on the cable jacket. Strain relief on the wire and/or wire insulation shall not be acceptable.

2. Cable shall be Siemens 6XV1840-2AH10 or approved equal. Connectors shall be industrial type, Siemens 6GK1901-1BB10-2AA0 or approved equal.

B. PROFIBUS DP Cable

1. Where required, provide shielded twisted pair cable designed for use with a PROFIBUS DP network. The twisted pair cable shall be non-plenum, with one 22AWG solid copper conductor pair, a tinned copper braid shield, and sunlight resistant PVC jacket. The cable shall have nominal impedance of 150±15 ohms at 3-20MHz, and maximum attenuation of 5.4dB per 100m at 16MHz. All RS485 bus connector terminations shall be done in a professional and workmanlike manner and shall provide for proper shield grounding and strain relief.

2. Cable shall be Siemens Fast Connect type 6XV1830-0EH10 or approved equal. Connectors shall be Brad Harrison MA9D00-42 and MA9D01-42 type or approved equal.

C. Serial Cable

1. Where required, provide DB9 serial RS232 patch cables, with connectors suitable for industrial environments.

D. Fiber Optic Cable. Refer to Section 13321.

2.06 PLC SOFTWARE AND PROGRAMMING EQUIPMENT

A. Refer to Section 13302.

2.07 SPARE PARTS

A. Refer to Section 13300.

B. The following spare parts shall be furnished under this Section:

1. CPU: Provide one (1) spare processor unit of each type installed.

2. PLC Power supplies: Provide one (1) spare power supply for each unique power supply installed.

3. I/O: Provide 10%, minimum one (1), spare for each unique I/O module type installed.

4. Communication modules: Provide one (1) spare module for each type installed.

5. Provide one (1) spare Diagnostic Repeater.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

A. Maintain area free of dirt and dust during and after installation of programmable controller products.

B. Anchor PLC and Remote I/O racks within enclosures as recommended by the PLC manufacturer.

C. Ventilation slots shall not be blocked, or obstructed by any means.

D. Examine areas, surfaces, and substrates to receive PLCs for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Install in accordance with manufacturer's instructions.

3.02 PANEL LAYOUT

A. Coordinate size and configuration of enclosure to meet project requirements.

B. Comply with clearance dimensions and wire sizes recommended by PLC manufacturer. Doors on all components shall be able to be fully closed when all the wires are installed. No wiring, wire ducts, or other devices shall obstruct the removal of cards from the rack. PLC status lights, keyholes, communication ports, and memory card slots shall not be blocked at any time.

C. Control panel designer shall provide independent line fuses or circuit breakers, per the PLC manufacturer recommendation, for each power supply, input module, output module, and other modules with separately derived power requirements.

D. All analog, discrete, and communication signals shall be protected from surge and interference as prescribed in Section 13300.

E. All PLC equipment shall be powered from the UPS power conditioning system in Section 13330.

F. Where multiple mechanical components are provided for process redundancy, their field connections to I/O modules shall be arranged such that the failure of a single module will not disable all mechanical components associated with the process redundancy (e.g., inputs and outputs for redundancy device 1 shall reside on different modules than the inputs and outputs for redundancy device 2, etc.), irrespective of the number of used points resulting from this configuration.

G. Provide all required cables, cords, and connective devices for interface with other control system components.

END OF SECTION

SECTION 13320
INSTRUMENTATION AND CONTROLS – RADIO TELEMETRY

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish the labor and materials required to install and bring into operation the control and data network as shown on the Drawings and specified herein.

B. Refer to Section 13300.

1.02 RELATED WORK

A. Division 16 Specifications - Electrical

B. Drawings – Electrical (E) and Instrumentation (I)

C. Refer to Section 13300.

1.03 SUBMITTALS

A. Refer to Section 13300.

B. The submittal requirements for this Section include:

1. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment specified herein.

2. Complete bill of materials for the equipment.

3. Spare parts list.

4. Complete system architecture diagram showing in schematic form, the interconnections between major hardware components including control centers, panels, power supplies, consoles, computer and peripheral devices, networking equipment, processors, I/O modules, local operator interfaces, process equipment vendor controllers, and like equipment. The system architecture shall be complete and shall depict all required cables, media type between components, network protocol used at each network level, details on connection requirements such as cable pin-outs, port numbers, and rack slot numbers. The intent of this specification requirement is to develop a diagram that is complete in every aspect to allow purchase of all required equipment by part number, and to allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature. Sheet size shall be 11"x17" and using more than one sheet is acceptable.

5. Submit signed and sealed designed calculations and drawings for radio towers and poles in conformance with the requirements of this Section.

PART 2 PRODUCTS

2.01 SPREAD SPECTRUM RADIO - 900MHZ

A. Functional:

1. Band: 902-928 MHz unlicensed ISM band.

2. Agency Approvals: FCC Part 15, UL 508, UL 1604, IC Approved

3. Transmitter: 1 Watt, user selectable down to 100mW; CPFSK modulation.

4. Receiver: Sensitivity, -105 dBM typical; CRC error detection.

5. Power Requirements: 6-30VDC, average current drain not to exceed 1.3A @ 6VDC (1.18A when transmitting, 0.155A when receiving).

6. Signal Connections:
   a. One (1) RJ45 Ethernet TCP/IP connection.
   b. One (1) TNC antenna connection.

7. Physical
   a. Environmental: Class 1 Div.2 hazardous area approved.
   b. Operating Temperature: -40 to 70°C, 0 to 95% RH non-condensing.

B. Manufacturer:

1. GE MDS SD9, no exceptions.

2.02 TRANSMISSION CABLE AND ACCESSORIES

A. Furnish and install a single continuous piece of transmission cable between the radio and antenna, complete with connectors, support hangers, weatherproofing, and grounding. Refer to the Instrumentation Drawings for a detail listing the equipment required.

B. Surge Protection. Provide surge protection on all coaxial cable runs in accordance with Section 13300. Provide protection between radio and antenna, mounted either outside or in the wall of the enclosure, in accordance with NEMA and UL standards. Surge protection devices shall be Citel P8AX series, Polyphaser, or equal.

2.03 ANTENNA

A. An antenna shall be provided and installed. Refer to the Instrumentation Drawings for a detail listing the equipment required.

2.04 TOWER

A. A new tower shall be erected and all appurtenances for antenna mounting provided. Refer to the Instrumentation Drawings for more details of the equipment required.

B. Each completed tower installation shall be designed in accordance to TIA-222 Rev G. Submit structural calculations for the antenna foundation signed and sealed by a Registered Professional

Engineer in the State of Florida. See Divisions 2, 3, and 5 of the Specifications for requirements for concrete foundation, anchor bolts, and excavation.

2.05 SPARE PARTS

A. General requirements for spare parts are specified in Section 13300.

B. The following Network and Communications System spare parts shall be furnished at the Collection/Distribution System:

1. One (1) coaxial cable surge protector.

2. Four (4) coaxial cable connectors.

3. One (1) serial patch cable.

4. One (1) local management patch cable.

PART 3 EXECUTION

3.01 RADIO TELEMETRY INSTALLATION

A. Install the radio telemetry system as shown on the Drawings and in accordance with manufacturer's instructions and approved shop drawings.

B. Exact equipment locations shall be as approved by the Engineer/Owner during construction. Obtain in the field all information relevant to the placing of work and in case of any interference with other work, proceed as directed by the Engineer/Owner and furnish all labor and materials necessary to complete the work in an approved manner.

C. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the system supplier shall bear full responsibility for such violations and assume all costs arising there from.

D. Brackets, hangers, etc., required for mounting of equipment shall be provided. They shall be installed in a workmanlike manner and not interfere with any other equipment.

E. Radio Tower Erection

1. Steel tower structures shall be erected in accordance with AISC, the drawings and specifications and the fabrication and erection drawings prepared by the tower fabricator. Erection equipment and procedures shall be suitable for a safe, efficient tower erection without overstressing structural components and without damaging or endangering existing facilities or personnel.

2. Bent, twisted or otherwise deformed members shall be straightened or replaced as directed by the Engineer. Members that are, in the opinion of the Engineer, damaged in a manner causing a reduction in their strength shall be replaced. Special care shall be taken to prevent injury to the galvanized surfaces.

3. Each tower shall be erected plumb with a tolerance of one unit in 500 units of height as measured with a transit.

4. Contact surfaces of joints shall be cleaned of dirt and other foreign materials before assembly. Reaming of mismatched holes will not be permitted. Any error in shop work which prevents the proper assembly and fitting of parts by the moderate use of drift pins shall be immediately reported to the Engineer and shall then be corrected as directed by the Engineer.

5. Connection holes shall be accurately aligned to prevent damage to the threads and galvanized finish of the bolts inserted therein. Bolts shall be inserted from the outside of the tower members so that only the head of the bolts will be exposed on the exterior surfaces of the completed tower. Bolts shall be selected to minimize projection beyond the nut when the connection is tight.

6. Nuts shall be handled and installed in a manner that will not damage or impair the effectiveness of the galvanized finish. Wrenches which deform the nut or bolt head or which mar the galvanized finish shall be repaired or removed from construction operations and replaced in a manner acceptable to the Engineer. Damaged bolts and nuts shall be replaced with new, undamaged bolts and nuts of the same type, size, quality and manufacturer as the original bolts.

7. Towers shall be clean of dirt or other foreign material when erected. In muddy or marshy areas the towers shall be kept clear of the ground during assembly and erection.

8. The PCSS shall protect all existing buildings, structures, vehicles and equipment during the fabrication and erection of the towers. The PCSS shall be liable for any damage caused to such buildings, structures, vehicles and equipment.

F. Grounding

1. Install all grounding connections from the towers to the ground grids. Grounding shall be in accordance with the requirements of the electrical specifications and drawings.

G. Field Painting

1. Galvanized surfaces scratched or otherwise damaged during delivery, unloading or erection shall be thoroughly cleaned by wire brushing the damaged area to remove all loose, cracked or bruised galvanizing. Cleaned areas shall then be painted with galvanizing repair paint. Galvanizing repair paint shall be Carboline Carbon Zinc 11"; Valspar Mobilzinc 7"; or Sealube ZRC.

2. The PCSS shall prepare the surface to be painted so that it is clean and free of all dust, dirt, oil, grease, earth, moisture, loose rust, loose scale and other undesirable residue immediately before the application of paint. Mechanical cleaning shall be used to remove solid residue such as rust and earth by scraping, wire brushing or sanding until a sound metal or painted surface remains. All paint shall be thoroughly mixed immediately prior to and during the application of paint. Paint shall be not be applied to surfaces which are more than 5 degrees F below the air temperature. Paint shall not be applied in rain, fog, mist, snow or when relative humidity exceeds 85 percent.

3.02 FIELD TESTS AND ACCEPTANCE

A. Prior to start-up, radio equipment shall be inspected for proper alignment, proper connection and satisfactory performance.

B. The grounding of all antennas assemblies shall be checked for the antenna, mast, supports, and where applicable, towers. Grounding shall be per manufacturer recommendations, and shall conform to the requirements of Section 16660.

C. The installed RF feedlines and antennas shall be tested for VSWR and other losses using a time domain reflectometer (TDR). Submit test results for approval.

D. The received signal at all locations shall not be less than 20 dB fade margin based on radio manufacturer's published receiver sensitivity of 10^{-6} bit error rate.

E. Submit a final field radio survey report including received signal levels and fade margins of all communications paths at both ends, as described in paragraph 1.06.D.4, for inclusion in the O&M Manual for the project.

F. Refer to Section 13300.

3.03 ADJUSTMENTS

A. Directional antennas shall be adjusted for maximum received signal strength.

B. Transmitter power shall be adjusted if needed to comply with FCC rules and regulations before acceptance testing.

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SECTION 13321
INSTRUMENTATION AND CONTROLS – FIBER OPTIC CABLING AND EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Work of this Section includes providing a fiber optic communications infrastructure including, but not limited to, fiber optic cable (FOC), patch panels, terminations, testing, and implementation.

B. The Work includes testing individual fiber cables installed under this Contract, and testing a completed fiber optic communications network.

1.02 RELATED WORK

A. Delivery, Storage and Handling in Section 01600.

B. Process Instrumentation and Control System in Section 13300.

1.03 SUBMITTALS

A. Submit to the ENGINEER, in accordance with Sections 01300 and 01730, the following:

1. Bill of materials and catalog data for cables, termination devices, patch panels, breakout enclosures, splice kits, pigtails, and fan-outs where applicable. Product data sheets shall include the manufacturer's name and catalog number for each item, the manufacturer's descriptive literature, catalog cuts, and any power supply requirements.

2. Provide a fiber optic power budget for each cable run in excess of 1000 feet. The budget shall include transmitter power, receiver sensitivity, connector losses, cable losses, and a 3db-aging margin. Fiber optic transmission line shall maintain a minimum of 10db safety margin.

3. Catalog data on all testing devices proposed for use plus certifications of accuracy, calibration, and traceability to standards of the National Institute for Standards and Testing.

B. Test reports, for the tests required in Part 3 herein.

1.04 REFERENCE STANDARDS

A. The optical fiber cable shall conform to the latest issue of the following standards documents, which are incorporated by reference into this specification:

1. EIA-455: Standard Fiber Optic Test Procedures (FOTPs) Devices.

2. EIA-598-A: Standard Colors for Color Identification and Coding.

3. MIL-202: Test Methods for Electronic and Electrical Component Parts.

4. MIL-454: Standard General Requirements for Electronic Equipment.

5. MIL-810: Environmental Test Methods and Engineering Guidelines.

6. EIA-568-B.3: Commercial Building Telecommunications Cabling Standard: Optical Fiber Cabling Components.

7. ICEA 5-83-696: Fiber Optic Premises Distribution Cable (Indoor/Outdoor).

8. National Electrical Code (NEC) Article 770.

9. UL 1581 VW-1 - Vertical Tray Cable Flame Test.

10. UL 1666 - UL Standard for Safety Test for Flame-Propagation Height of Electrical and Optical-Fiber Cables Installed in Vertical Shafts.

11. NFPA 262 – Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use IN Air-Handling Spaces.

12. IEEE Standard 383 - Flame Retardancy.

13. DOD-STD-1678.

14. National Electrical Manufacturers Association (NEMA).

15. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

B. All fiber optical cables shall be constructed in accordance with EIA-455, and 100 percent of all optical fibers and jacketing shall meet or exceed the requirements contained in this specification.

1.05 QUALITY ASSURANCE

A. The cable manufacturer shall be ISO9001 certified and registered.

B. The fiber optic cabling system materials furnished under this Section shall be provided by Fiber Optic Suppliers who have been providing these types of materials for the past three years. The Fiber Optic Suppliers shall provide personnel capable of providing technical assistance during installation.

C. The installation of fiber optic cabling system materials furnished under this Section shall be performed by an installation contractor who has been installing these types of materials and systems for the past three years.

D. Supplier must furnish five working installation references.

E. The ENGINEER shall determine whether a product is an Equal based upon the information listed herein and the manufacturer’s data sheets regarding the models specified. Alternate equipment must meet the criteria listed herein and any additional information in the manufacturer’s data sheets in order to be accepted as an Equal.

1.06 SYSTEM DESCRIPTION (NOT USED)

1.07 DELIVERY, STORAGE AND HANDLING

A. The cable shall be packaged in cartons and/or wound on spools or reels. Each package shall contain only one continuous length of cable. The packaging shall be constructed so as to prevent damage to the cable during shipping and handling.

B. When the length of an order requires a large wooden reel, the cable will be covered with a three-layer laminated protective material. The outer end of the cable shall be securely fastened to the reel head so as to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slot in the side of the reel or into housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing.

C. Test tails shall be at least two meters long. The inner end shall be fastened so as to prevent the cable from becoming loose during shipping and installation. Reels shall be permanently marked with an identification number that can be used by the manufacturer to trace the manufacturing history of the cable and fiber.

D. Wooden reels shall be plainly marked to indicate the direction in which it should be rolled to prevent loosening of the cable on the reel.

E. All fiber optic cables shall be attenuated tested. The attenuation of each fiber shall be provided with each cable reel by the manufacturer.

F. The attenuation shall be measured at 1310 nm and 1550 nm for single-mode fibers and 850nm and 1300nm for multimode fiber cables after received on site. The manufacturer shall submit the test results prior to installation of the cable.

G. Packaging

1. The completed cable shall be packaged for shipment on non-returnable wooden reels. It is the responsibility of the CONTRACTOR to determine all required cable lengths.

2. Top and bottom ends of the cable shall be available for testing.

3. Both ends of the cable shall be sealed to prevent the ingress of moisture.

4. Each reel shall have a weatherproof reel tag attached identifying the reel and cable. The reel tag shall include the following information:
   a. Cable Number Gross Weight.
   b. Shipped Cable Length in Meters.
   c. Product Number.
   d. Date Cable was Tested.
   e. Cable Length Markings Item Number.

H. Each cable shall be accompanied by a cable data sheet.

1.08 SPARE PARTS AND TEST EQUIPMENT

A. Spare Parts

1. Provide a minimum five percent spares of ST connectors and dust covers, but not less than 20 spare ST style connectors and 40 dust covers.

2. Provide a minimum five percent spare 36” spare multimode patch cables with connectors (both ends) terminated, but not less than ten 36” spare multimode patch cables with connectors (both ends) terminated.

B. Test Equipment and Tools

1. One complete fiber optic connector termination tool kit. The kit shall be the CTS version with VFL, Model TKT-UNICAM-CTS by Corning Cable Systems, or equal.

PART 2 PRODUCTS

2.01 GENERAL MATERIALS

A. Cabinets: cabinets shall be provided as indicated on the contract Drawings.

B. Provide tight buffered cables that are not gel filled and are suitable for indoor/outdoor applications. These cables shall be flame retardant for indoor applications and water and fungus resistant for outdoor applications.

C. Optical Fiber Characteristics

1. All fibers in the cable must be usable fibers and meet required specifications.

2. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be matched clad design.

3. Multi-mode: Provide multimode, optical glass fiber compatible with LED or laser based transmission systems.

D. Cable Size/Capacity. Fiber optic cables shall be a minimum of 24 fibers except where otherwise indicated on the Drawings.

E. Manufacturers

1. Corning Cable Systems Corp.

2. CommScope.

3. Belden Cable.

4. Or equal.

2.02 STANDARD 62.5/125 µM FIBER

A. The multimode fiber shall meet EIA/TIA-492AAAA-A-1997, "Detail Specification for

62.5-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers".

1. Geometry

Core Diameter (µm)	62.5 ± 3.0
Core Non-Circularity	≤ 5 %
Cladding Diameter (µm)	125.0 ± 2.0
Cladding Non-Circularity	≤ 1.0 %
Core-to-Cladding Concentricity (µm)	≤ 1.5
Coating Diameter (µm)	245 ± 5
Colored Fiber Nominal Diameter (µm)	253 - 259

2. Optical

Cabled Fiber Attenuation (dB/km) 850 nm 1300 nm	 ≤ 3.5 ≤ 1.0
Point Discontinuity (dB) 850 nm 1300 nm	 ≤ 0.2 ≤ 0.2
Cabled Effective Modal Bandwidth[1)] (MHz•km) 850 nm	 ≥ 220
IEEE 802.3 GbE Distance (m) 1000BASE-SX Window (850 nm) 1000BASE-LX Window (1300 nm)	 up to 300 up to 550
OFL Bandwidth (MHz•km) 850 nm 1300 nm	 ≥ 200 ≥ 500
Numerical Aperture	0.275 ± 0.015

[1)]As predicted by RML BW, per TIA/EIA 455-204 and IEC 60793-1-41, for intermediate performance laser based systems (up to 1 Gb/s).

2.03 LOOSE TUBE FIBER OPTIC CABLE (INDOOR/OUTDOOR)

A. Cable shall be flame-retardant, UV stabilized, fully water blocked with dielectric central member for use in indoor/outdoor applications. The buffer tubes shall be gel-free. Each buffer tube shall contain a water-swellable yarn for water-blocking protection. Cable manufacturer shall have a minimum of 20 years in manufacturing optical fiber cable in order to demonstrate reliable field performance. Cable and fiber manufacturer shall be the same company to ensure long-term reliability of the cabled fiber and to ensure the availability of fully integrated technical support. Cable shall be suitable for installation in duct, aerial, and riser environments. Cable shall meet UL OFNR specifications and not require transition splicing upon building entry in order to meet fire codes.

B. Optical fibers shall be placed inside a buffer tube.

C. Each buffer tube shall contain up to 12 fibers.

D. In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together.

E. Buffer tubes shall be kink-resistant within the specified minimum bend radius.

F. Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed.

G. The central anti-buckling member shall consist of a glass-reinforced plastic rod. The purpose of the central member is to prevent buckling of the cable.

H. The cable core shall contain a water-blocking material. The water-blocking material shall be non-nutritive to fungus, electrically non-conductive, and homogenous. It shall also be free from dirt and foreign matter and shall be readily removable with conventional non-toxic solvents. Cable shall contain water-blocking threads between tubes.

I. The cable shall contain at least one ripcord under the sheath for easy sheath removal.

J. Tensile strength shall be provided by a combination of high tensile strength dielectric yarns.

K. The high tensile strength dielectric yarns shall be helically stranded evenly around the cable core.

L. All dielectric cables (with no armoring) shall be sheathed with medium density polyethylene (MDPE). The minimum normal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and water-blocking material. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

2.04 CABLE CONSTRUCTION

A. Riser Cables

1. Riser cables up to 24 fibers: In cables with more than one fiber, the fibers shall be stranded around a dielectric member and surrounded by layered aramid yarns. The aramid yarns shall serve as the tensile strength member of the cable. A ripcord may be applied between the aramid yarns and the outer jacket to facilitate jacket removal. The outer jacket shall be extruded over the aramid yarns for physical and environmental protection.

2. Riser cables with more than 24 fibers: The buffered fibers shall be grouped into six fiber subunits. In each subunit, the individual fibers shall be stranded around a dielectric central member and surrounded by layered aramid yarns. A ripcord shall be incorporated in the subunit design to facilitate access to the individual fibers. The subunit jacket shall be extruded over the aramid yarns for additional physical and environmental protection. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the units for physical and environmental protection.

B. Plenum Cables

1. Plenum cables up to 24 fibers: The fibers shall be stranded around a dielectric member and surrounded by layered aramid yarns. The aramid yarns shall serve as the tensile strength member of the cable. A ripcord may be applied between the aramid yarns and the outer jacket to facilitate jacket removal. The outer jacket shall be extruded over the aramid yarns for physical and environmental protection.

2. Plenum cables with 24 to 72 fibers: The buffered fibers shall be grouped into six fiber subunits. In each subunit, the individual fibers shall be stranded around a dielectric central member and surrounded by layered aramid yarns. A ripcord shall be incorporated in the subunit design to facilitate access to the individual fibers. The subunit jacket shall be extruded over the aramid yarns for additional physical and environmental protection. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the units for physical and environmental protection.

3. Plenum cables with more than 72 fibers: The buffered fibers shall be grouped into twelve fiber subunits. In each subunit, the individual fibers shall be stranded around a dielectric central member and surrounded by layered aramid yarns. A ripcord shall be incorporated in the subunit design to facilitate access to the individual fibers. The subunit jacket shall be extruded over the aramid yarns for additional physical and environmental protection. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the units for physical and environmental protection.

C. The strength member shall be a high modulus aramid yarn. The aramid yarns shall be helically stranded around the buffered fibers. Non-toxic, non-irritant talc shall be applied to the yarn to allow the yarns to be easily separated from the fibers and the jacket.

D. Cable Jacket

1. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness; jackets extruded under high pressure are not acceptable. The jacket shall be smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand the stresses expected in normal installation and service.

2. The cable and subunit jacket color shall be orange for cables containing multimode fibers.

3. The cable and subunit jacket color shall be yellow for cables containing single-mode fibers.

4. For cables with more than two fibers, the cable jacket shall be designed for easy removal without damage to the optical fibers by incorporating a ripcord under each cable jacket. Non-toxic, non-irritant talc shall be applied to the aramid yarns to allow the yarns to be easily separated from the fibers and the jacket.

5. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, low smoke, and environmental test requirements of this document over the life of the cable.

E. The cable shall be all-dielectric.

2.05 CABLE IDENTIFICATION

A. The individual fibers shall be color coded for identification. The optical fiber color coding shall be in accordance with EIA/TIA-598, "Color Coding of Fiber Optic Cables." The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color coded buffered fibers shall not adhere to one another. When fibers are grouped into individual units, each unit shall be numbered in the unit jacket for identification. The number shall be repeated at regular intervals.

B. The outer cable jacket shall be marked with the manufacturer's name or UL file number, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet. The markings shall be in contrasting color to the cable jacket.

2.06 CABLE TESTING REQUIREMENTS

A. Fiber cables shall be tested by the manufacturer in accordance with the following industry standard (EIA-455) tests:

1. FOTP-41, Compressive Loading Resistance Test.

2. FOTP-104, Fiber Optic Cable Cyclic Flexing Test.

3. FOTP-25, Repeated Impact Testing.

4. FOTP-33, Fiber Optic Cable Tensile Loading and Bending Test.

5. FOTP-85, Fiber Optic Cable Twist Test.

6. FOTP-181, Lightning Damage Susceptibility Test.

7. FOTP-3, Procedure to Measure Temperature Cycling Effects on Optical Fibers, Cables, and other Passive Fiber Optic Components.

8. FOTP-82, Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable.

9. FOTP-37, Low or High Temperature Bend Test for Fiber Optic Cable.

10. FOTP-98, External Freezing Test.

11. FOTP-27, Fiber Diameter Measurements.

12. FOTP-28, Measurement of Dynamic Tensile Strength.

13. FOTP-34, Interconnection Device Insertion Loss Test.

14. FOTP-89, Cable Jacket Elongation and Tensile Strength Test.

B. The CONTRACTOR shall submit laboratory test reports on representative samples of similar cable design to demonstrate compliance prior to cable installation.

2.07 FIBER CABLE TERMINATIONS, CONNECTORS, AND CABLE ASSEMBLIES

A. Pigtail Splicing

1. For termination of fiber cables at a termination or connector panel (patch panel), with one end of a piece of cable preconnectorized and the other end unterminated for splicing to the cable that needs to be terminated. Splicing and connectors shall meet the requirements listed in this Section.

2. A splice/termination tray shall house the splices and serve to fully protect excess lengths of loose tube fibers from exposure. Splice tray shall be compatible with the selected patch panel and installed for easy access to the spliced cable sections.

3. Pigtail assemblies shall match fiber cable type and model and shall be as manufactured by Corning Cable Systems or equal.

B. Buffer Tube Fan-Out Kits

1. Individual fibers within a loose tube cable with 250 µm coated fibers shall use a fan-out kit to maintain flexibility and ease of handling fibers within a termination cabinet. Fan-out kits shall be installed in the patch panel enclosures to transition the loose tube fibers to ruggedized tight-buffered fiber pigtail cables. Optical fusion splices shall connect the loose tube fibers to the tight-buffered pigtail cables. The optical splice loss shall comply with the specifications for optical splices. Splice protection sleeves shall be employed on all splices to protect the splices.

2. The tight-buffered pigtails shall be factory-preconnectorized with STTM connectors as specified.

C. Connectors (Cable Assemblies)

1. The fiber optic communications system shall utilize stainless steel ST style connectors for all fiber optic connections. SC style connectors will be acceptable only if ST style connectors are not compatible with the equipment being provided. The connectors shall be designed for use with 50/62.5/125/250 micron cable. Each connector shall cause a maximum signal attenuation of 1.6 dB.

2. Field-Installed Connectors: Type ST compatible, SC or LC design with ceramic or polymer ferrule and strain relief boot. The connector installation shall not require the use of epoxies, adhesives or ovens. The connector shall be installable upon 900 µm buffered fiber in one minute or less and upon 2.9 mm jacketed cable in three minutes or less total time. The connector shall contain a mechanical splice and have a tool kit available to aid in assembly. The installation tools used to terminate the connector shall be able to terminate other small-form-factor and single-fiber UniCam connector designs. The connector shall not require end-face polishing in the field. The connector shall have a factory polished optical fiber stub in the connector ferrule that

is bonded in the ferrule micro hole. Ferrule material shall be available in ceramic or polymer. Connector specifications shall be as follows:
a. Insertion loss (typical): 0.3 dB
b. Durability (mating cycles): 500 (minimum)
c. Repeatability: Less than 0.2 dB
d. Operating Temperature: 0 to plus 60 degrees C

3. After termination with connectors, the fiber ends must be visually inspected at a magnification of not less than 100 power for multimode and 200x for single mode to check for cracks or pits in the endface of the fiber.

4. Connectors shall have a maximum allowable connection loss of 0.3 dB per mated pair, as measured per EIA-455-34. No index-matching gel is to be used; dry interfaces only.

5. Each connector shall be of the industry standard ST type compatible; designed for single-mode and multimode tolerances; shall meet or exceed the applicable provisions of EIA-455-5, 455-2A, and 455-34; and shall be capable of 100 repeated ratings with a maximum loss increase of 0.1 dB. Connectors shall incorporate a key-way design and shall have a Zirconia ceramic ferrule. Connector bodies and couplings shall be made of corrosion-resistant and oxidation-resistant materials such as nickel-plated zinc, designed to operate in humid environments without degradation of surface finishes. Connectors shall be capable of operating in a range of -40 to 80 degrees C.

6. Manufacturers
a. Corning Cable Systems, Hickory, NC
b. AMP, Inc., Harrisburg, PA
c. 3M Telecom Systems Group, Austin, TX or equal.

D. Fiber Optic Patch Cables

1. Fiber optic patch cable shall be two-fiber zipcord 50/62.5/125 core/clad micron multimode riser rated cable.

2. Installation of patch cables shall include all spares and observe the minimum fiber bend radius and strain relief.

2.08 FIBER OPTIC TERMINATION PATCH PANELS

A. General

1. Patch panels shall be suitable for wall mounting, comprised of internal mounting plate, cable holders, slack cable take up/organizer blocks, patch block with connectors, and ground lugs as indicated. Panels shall be NEMA 4X, 316 stainless steel construction for outdoors; and NEMA 12, 316 stainless steel or fiberglass for indoor use. Patch panels shall be suitable for multimode system operation at 800 and 1300 nanometers. Patch panels shall be suitable for ST or LC connectors. The patch panels shall be sized to handle the number of fibers as required. All fibers shall be terminated in the patch panel.

2. Where shown on the plans or in the related specification Sections, the fiber optic cable shall terminate inside a communications cabinet on a termination patch panel. All fiber sub-cables within the exposed buffer tube shall be terminated with fan-out kits with preconnectorized pigtails. The patch panel shall have a fiber capacity equal to the total number of fibers (connected and spare) for all cables to be connected.

3. Unused buffer tubes shall be uncut and looped within the patch panel for continuous routing of the fiber buffer tube within the cable assembly.

4. Patch panels shall be designed for either rack mounting on a standard equipment rack or housed in an enclosure for direct wall mounting. The patch panel shall contain "ST" type bayonet or LC couplings. All unused couplings shall have protective dust covers. All panels shall be furnished with locking doors.

5. Factory-terminated, tight-buffered, aramid-reinforced fiber optic jumper assemblies or interconnect cables, standard 3.0-mm O.D., shall connect the optical cable terminations to the patch panel couplings.

6. The termination patch panel shall be equipped with a suitable means for routing and securing of cables, and shall provide a suitable means of protection for the mounted fiber connectors to prevent damage to fibers and connectors during all regular operation and maintenance functions. All cables shall be provided with strain relief. Bend diameters on cable fibers and jumpers must be greater than four inches at all times to ensure optical and mechanical integrity of the optical fibers.

7. Termination panels shall be equipped with splice trays (where applicable) and holders for pigtail and through fiber splicing.

8. Termination panels shall be provided with all hardware, options, and accessories to provide for a complete installation of the fiber optic system.

9. Panels shall be as manufactured by Corning Cable Systems LANscape or equal.

B. Rack Mount Fiber Distribution Center (FDC) Splice Housing

1. A rack-mountable Fiber Distribution Center splice housing shall be provided for pigtail splicing and through fiber splicing equipment.

2. The splice housing shall be compatible with the FDC for interconnection of the splicing equipment with the fiber cable management, termination, and distribution rack equipment.

3. Splice trays shall be provided for pigtail splicing.

4. The splice housing shall be sized and equipped with sufficient capacity to terminate and feed through all required fiber cable, plus an additional 20 percent.

5. Provide one spare splice tray.

6. Splice housing shall be Corning Cable Systems LANscape CSH series.

C. Rack Mount Fiber Distribution Center (FDC)

1. The Fiber/Network equipment rack shall be supplied with two rack-mountable Fiber Distribution Centers (FDCs) capable of 48 ST fiber termination points each. The connector center shall be 19" rack-mountable and provide for internal fan-out, splicing, and connection of the fiber optic cable to front panel ST connection patch panel.

2. The FDC shall provide backbone and intermediate connects and cable strain relief for a maximum of five fiber cable systems. The front shall be swing open construction with keyed latch mechanism.

3. The FDC shall be compatible for interconnection with the FDC Splice Housing and provide space and support the addition of fiber cable splice trays for future cable connection and termination.

4. The Fiber Connection Center shall be Corning Cable Systems LANscape CCH series.

D. Wall/Panel Mount Fiber Distribution Center (WDC)

1. The field-mounted fiber termination enclosures shall be supplied with a Wall Mount Fiber Distribution Center (WDC) capable of 48 ST fiber termination points. The distribution center shall be panel-mounted and provide for internal fan-out, splicing, and connection of the fiber optic cable to the patch panel assemblies.

2. Splice trays shall be provided for pigtail splicing. The WDC shall be provided with pass-thru splice trays for continuation of the fiber cable system to additional sites.

3. Provide one spare splice tray.

4. The WDC shall provide space and support the addition of future fiber cable splice trays.

5. The Wall Mount Fiber Distribution Center shall be Corning Cable Systems LANscape (WCH) series.

PART 3 EXECUTION

3.01 GENERAL

A. Provide all material, equipment, and labor to test and integrate the fiber optic system as indicated and as specified.

B. Installation shall comply with EIA/TIA Standards 568 and 569.

C. Fiber optic cables shall be continuous from component to component. Intermediate fiber splices shall not be allowed.

D. Provide delivery, storage, and handling of materials and equipment in accordance with Section 01600.

3.02 IDENTIFICATION

A. Label each termination point.

B. Label each cable, buffer tube, and fiber with permanent waterproof typewritten tags.

3.03 PHYSICAL CHECKOUT

A. General Procedures

1. Conduct physical checkout of the fiber optic data highway network.

2. Physical checkout shall be performed prior to functional testing.

B. Check Procedures

1. Verify that fiber optic cable reels have been off-loaded from truck carefully and not damaged.

2. Submit to the ENGINEER all test data provided by the fiber manufacturer.

3. Verify that the optical fibers of the cable assembly are the type and quantity as specified and as recommended by the Instrumentation System Supplier.

4. Verify that cable construction is the type specified.

5. Verify that fiber optic patch panels have been installed plumb and level at locations indicated.

6. Verify that optical fiber connections or terminations within patch panels and splice closures are in accordance with cable manufacturer's recommendations.

3.04 FIBER OPTIC CABLE TESTING

A. General: The CONTRACTOR shall perform pre-installation and post-installation FOC tests. The Construction Manager shall be notified a minimum of 10 days in advance so that these tests are witnessed. All test equipment shall be traceable to NIST standards.

B. Test equipment: The CONTRACTOR shall use the following to perform pre-installation and post-installation FOC tests:

1. Optical time domain reflectometer (OTDR). The OTDR shall be laser precision, and be able to test single mode or multimode systems with a visual fault locator. The OTDR shall be as manufactured by Corning, Agilent Technologies, Fluke Networks, or equal.

C. Pre-installation Tests

1. The purpose of these tests is to perform acceptance tests on the cable prior to installation to verify that the cable conforms to the manufacturer's specifications; is free of defects, breaks, and damages by transportation and manufacturing processes; and to provide baseline readings in dB.

2. Prior to removal of each cable from the delivery reel, all optical fibers within the cables shall be tested by the CONTRACTOR using an OTDR. The OTDR tests shall consist of end-to-end length and fiber attenuation (dB/km) measurements to ensure proper performance of the fiber optic cable. The tests shall be performed from both ends of each fiber to ensure complete fiber continuity within the cable structure.

3. Pre-installation, "on-reel" test results shall be compared with the manufacturer's test report delivered with the cable. Gross dissimilarities shall be noted and remedied between the CONTRACTOR and manufacturer. In all cases, all fibers must meet the optical attenuation specifications prior to cable installation.

4. The CONTRACTOR shall perform tests on all reels of cable. The Construction Manager shall be notified a minimum of 15 days prior to any test.

5. The CONTRACTOR shall document each test and submit the report to the Construction Manager for review. Documentation shall consist of both hard copy and 3.5-inch electronic disk complete with all application software.

6. Cable shall not be installed until the Construction Manager has reviewed the test report.

7. Maximum allowable attenuation is 0.5 dB/km at 1310 and 1550 nm. The CONTRACTOR shall replace any cable in which any fiber does not meet this requirement.

D. Post-installation tests: After FOC has been installed and connectorized, the following tests shall be performed:

1. Visually inspect terminal connectors for out-of-round condition and surface defects such as micro-chips and cracks using a 200X (minimum) inspection microscope.

2. A recording OTDR shall be used to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall have an X-Y plotter to provide a hard copy record of each trace of each fiber. The OTDR shall be equipped with sufficient internal masking to allow the entire cable section to be tested. This may be achieved by using an optical fiber pigtail of 30 feet or more to display the required cable section.

3. The maximum permissible end-to-end loss shall be 0.5 dB/km. The CONTRACTOR shall replace any cable in which any fiber does not meet this requirement.

4. The OTDR shall be calibrated for the correct index of refraction to provide proper length measurement for the known length of reference fiber.

5. A transmission test shall be performed with the use of a 1310 and 1550 nm stabilized light sources and 1310 nm/1550 nm power meters for SMF. This test shall be conducted in both directions on each fiber of each cable.

6. Hard and electronic copies of test documentation shall be submitted to the Construction Manager. The documentation shall include:
   a. The trace plot.
   b. Index.
   c. dB/km loss.
   d. Cable length.
   e. Date and time of test.
   f. Wavelength.
   g. Pulse width.
   h. The test site.
   i. Cable ID.
   j. Fiber number and type.
   k. Operator's initials.

   The CONTRACTOR shall compare the pre-installation test results to the post-installation results. If a deviation of greater than one dB occurs, the Construction Manager shall be notified in writing by the CONTRACTOR, and the cable shall be removed and replaced at no additional cost to the OWNER.

7. Upon completion of the previous tests, all FOC coils shall be secured with ends capped to prevent intrusion of dirt and water.

E. Certification of completion of pre- and post-fiber installation testing including test results shall be provided to the ENGINEER, CONTRACTOR, and Ozone Control System Supplier. Test results shall be submitted on paper in a binder, including results indicated in tables or a spreadsheet. Test results that exceed specification limits shall be noted. The electronic copy shall be included in the binder.

F. Required OTDR Trace Information

1. All traces shall display the entire length of cable under test, highlighting any localized loss discontinuities (installation-induced losses and/or connector losses). The trace shall display fiber length (in kilofeet), fiber loss (dB), and average fiber attenuation (in dB/km), as measured between two markers placed as near to the opposite ends of the fiber under test as is possible while still allowing an accurate reading. Care shall be taken to ensure that the markers are placed in the linear region of the trace, away from the front-end response and far-end Fresnel reflection spike. Time averaging shall be used to improve the display signal to noise ratio. The pulse width of the OTDR shall be set to a sufficient width to provide adequate injected power to measure the entire length the fiber under test.

2. If connectors exist in the cable under test, then two traces shall be recorded. One trace shall record the fiber loss (dB) and average attenuation (dB/km) of the entire cable segment under test, including connectors. The second trace shall display a magnified view of the connector regions, revealing the connector losses (dB). All connector losses shall be measured using the five-point splice loss measurement technique.

3. The OTDR trace shall also include the following information:
   a. The date and time of the test.
   b. The cable ID number.
   c. The cable segment ID number.
   d. The fiber color or sub-cable number.
   e. Launch point connector number.
   f. The optical wavelength used for the test.
   g. The refractive index setting of the OTDR.
   h. The pulse width setting of the OTDR.
   i. The averaging interval of the test.

3.05 WARRANTY

A. Refer to Section 13300.

B. The CONTRACTOR shall provide an unconditional warranty on all installed cable for a minimum period of 20 years, commencing at the time of final acceptance by the OWNER.

C. This Section describes the material and installation requirement for the fiber optic cabling system and associated equipment.

END OF SECTION

SECTION 13330
INSTRUMENTATION AND CONTROLS – CONTROL PANELS AND PANEL MOUNTED EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Refer to Section 13300.

B. Furnish and install new control panels and panel mounted equipment as specified herein and shown on the Drawings.

C. Additions and modifications to existing panels shall conform to the standards and requirements of this Section wherever applicable.

D. All new panels and panel components shall match existing equipment makes and models wherever possible, so that system additions can be most easily integrated with respect to operation and maintenance training, spare parts inventory, and service contracts. Even when exact matches are not possible, equipment furnished must be fully compatible with the existing system. Color, size, and material of new panels should conform to that of existing panels.

E. The following new control panels shall be provided under this Section:

1. Pump Station Control Panel. Located in the Electrical Room. NEMA 12 steel construction, free-standing. Maximum size: 90”H x 48”W x 20”D.

PART 2 PRODUCTS

2.01 LIGHTNING/SURGE PROTECTION

A. Refer to Section 13300.

2.02 CONTROL PANEL GENERAL REQUIREMENTS

A. The dimensions within this Section and on the Contract Drawings are for general reference only. Ensure that final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified herein and in the Contract Documents.

B. Each control panel and terminal cabinet shall bear the UL label. The UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and any other equipment necessary to achieve compliance with UL 508A requirement. The Drawings do not detail all UL 508A requirements.

C. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.

D. The devices designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment. Heat generating devices such as power supplies shall be located at or near the top of the panel.

E. All components shall be mounted in a manner that shall permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component mounting shall be oriented in accordance with manufacturer's recommendations. The internal components shall be identified with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawing, specifications, and PCSS's data.

F. All hardware and fasteners shall be 316 stainless steel. All mounting screws shall be drilled and tapped; self-tapping screws are not permitted.

G. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.

H. Nameplates

1. All panels and panel devices shall be supplied with suitable nameplates, which identify the panel and individual devices as required. Unless otherwise indicated, each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).

2. Nameplates shall be 3/32-inch thick, plastic laminate with engraved inscriptions. The letters shall be White against a Black background unless otherwise noted. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.

3. Nameplate fasteners and mounting shall be epoxy adhesive or stainless steel screws.

4. For every panel, provide a main panel nameplate with a minimum of 1" high letters. Provide legend plates or 1-in by 3-in engraved nameplates with 1/4-in lettering for identification of door mounted control devices, pilot lights, and meters.

5. Single lamicoid nameplates with multiple legends shall be used for grouping of devices such as selector switches and pilot lights that relate to one function.

I. Mounting Elevations

1. ISA Recommended Practice RP60.3 shall be used as a guide in layout and arrangement of panels and panel mounted components. Dimensions shall account for all housekeeping pads that panels will sit on once they are installed.

2. Centerline of indicators and controllers shall be located no lower than 48-inches or higher than 66-inches above the floor on a panel face.

3. Centerline of lights, selector switches, and pushbuttons shall be located no lower than 32-inches or higher than 70-inches above the floor on a panel face.

4. Tops of annunciators shall be located no higher than 86-inches above the floor on a panel face.

5. Installation of panel components shall conform to component manufacturers' guidelines.

2.03 PANEL MATERIALS AND CONSTRUCTION

A. Structure and Enclosure

1. All panels in indoor, dry, non-corrosive environments shall be NEMA 12 unless otherwise noted, and shall be of steel construction. All panels in outdoor, wet, or chemically corrosive environments shall be NEMA 4X and of 316 stainless steel construction. All panels located in a hazardous location shall be rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).

2. Provide angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally the panels shall be supplied with a structural framework for instrument support purposes and panel bracing. The internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.

3. Each panel shall be provided with full height, fully gasketed access doors. Doors shall be provided with a three-point stainless steel latch and heavy duty stainless steel locking handle. Panel access doors shall be provided with full length, continuous, piano type stainless steel hinges with stainless steel pins. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments. Clamp-type door latches are not permitted.

4. The panels, including component parts, shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.

5. The panel shall be suitable for top and bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry, the panel top shall be provided with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided 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.

B. Freestanding and Floor-Mounted Vertical Panels. Freestanding and floor-mounted vertical panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of 12-gauge sheet steel, suitably braced internally for structural rigidity and strength. All panels shall be constructed of 316 stainless steel. Front panels or panels containing instruments shall be not less than 10-gauge stretcher leveled sheet steel, reinforced to prevent warping or distortion.

C. Wall and Unistrut Mounted Panels. All wall and Unistrut mounted panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of not less than USS 14-gauge steel, suitably braced internally for structural rigidity and strength. All wall mounted panels shall be constructed of 316 stainless steel.

D. Instrument Racks

1. Instrument racks shall be sized and configured to support all indicated instruments and accessories, such that they are easily accessible to operators. Mounting elevation requirements provided herein shall apply. Elements to be mounted on an instrument rack may include transmitters and controllers; sensor assemblies; sample and drain pipes, tubes, valves and manifolds; sample pumps or compressors; power supplies, surge suppressors and disconnects.

2. Instrument rack plates shall be fabricated from .125 Marine Grade Aluminum, powder-coated white on all surfaces. Depending on overall size, racks may be fabricated in single or multiple segments for attachment to the support framing, to preserve rigidity. All exposed corners, edges, and other projections shall be smooth rounded or chamfered to prevent injury.

3. Each instrument rack shall be securely attached by stainless steel hardware to two or more steel support struts. Struts shall be steel, no less than 1 inch square, permanently installed in concrete, coated in bitumastic paint up to 18 inches above the concrete for protection against moisture. All exposed corners, edges and protruding bolts shall be smooth rounded or capped to prevent injury.

4. Instrument racks located outdoors shall be fully covered by sun shields as described herein.

E. Finish Requirements (except for NEMA 7 rated enclosures)

1. All sections shall be descaled, degreased, filled and ground, phosphate cleaned, and finished.

2. Enclosure finish shall be polyester powder-coated. NEMA 12 indoor enclosure exterior shall be ANSI 61 gray. The exterior of outdoor panels and NEMA 4X panels shall be white. All instrument rack panels and sun shield panels shall be white. All enclosure interiors shall be white.

F. Print storage pockets shall be provided on the inside of each panel. The storage pockets shall be constructed of compatible material with the panel door, welded onto the door, and finished to match the interior panel color. The storage pocket shall be sufficient to hold all of the prints required to service the equipment, and to accommodate 8.5 inch by 11 inch documents without folding.

2.04 ENVIRONMENTAL CONTROL

A. Heat load calculations shall be submitted for all unvented control panels that are not located in air-conditioned areas. The internal temperature of all panels shall be regulated to minimum 5°C; maximum 40°C, or 5°C below the lowest rated component, whichever is greater; under all conditions. Heat calculations shall account for:

1. Loading and dissipation effects on all surfaces of the enclosure. Any surface not available for heat transfer, e.g. against a wall, shall be accounted for. The effects of sun shields shall be accounted for.

2. Internal heat load of components (load and duty cycle).

3. Outside temperature: assume 95°F.

B. Provide custom fabricated sun shields for all outdoor panels and instrument racks in accordance with the following requirements:

1. Sun shields shall be fabricated from .125 Marine Grade Aluminum, powder-coated white on all surfaces. Units shall be designed, fabricated, installed, and supported 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.

2. 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.

3. Sun shields shall not be attached directly to the enclosure by drilling holes through, or welding studs to, the enclosure surfaces, and shall be designed and mounted to provide a minimum 3-inch air gap all around the enclosure for air circulation and heat dissipation.

4. The top section of all sun shields shall be sloped at a minimum angle of 5 degrees from horizontal. For wall mounted enclosures, the top section shall slope downward away from the wall and towards the front of the enclosure. For free standing, floor mounted and frame mounted enclosures the top section shall slope downward towards the back side of the enclosure.

5. The front edge of the top section of all sun shields shall incorporate a narrow and more steeply sloped drip shield segment which sheds water away from the front of the enclosure and prevents it from dripping or running directly onto the front panel of the enclosure.

6. All seam welds used in sun shield fabrication shall be continuous and shall be ground smooth.

7. All exposed corners, edges and projections shall be smooth rounded or chamfered to prevent injury.

C. Under no circumstances shall temperature control methods compromise the NEMA rating of the panel. Air conditioners are not allowed.

D. All control panels that are located outdoors or in unconditioned indoor process areas shall be provided with an integral heater, fan, and adjustable thermostat to reduce condensation and maintain the minimum internal panel temperature. Mount the unit near the bottom of the enclosure with discharge away from heat-sensitive equipment. Heater shall be Hoffman DAH or equal.

2.05 CORROSION CONTROL

A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Technologies International Corporation, Model Zerust VC; Hoffman Model AHCI; or equal.

2.06 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring

1. Wire type 12 AWG and smaller shall be Hook-Up/Lead tinned copper, minimum 18 AWG stranded, Belden 35612 Hook-Up Lead-UL AWM Style 3173-XL-DUR or equal.

2. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.

3. Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6 inches. Different wiring systems shall terminate on separate terminal blocks.

4. Wiring troughs shall be wide slot, hinged cover type. Trough edges may be located no less than 1.5 inches from the nearest terminal block or component or subpanel edge. Troughs shall not be filled to more than 40 percent visible fill.

5. Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 18 AWG minimum. Electronic analog circuits shall utilize 20 AWG minimum, foil and braided shielded twisted pair, cable insulated for not less than 600 volts. Insulation is to be stripped back 6” from the terminal connection to allow clamp on measurement of a 4-20ma loop.

6. All control wires are to have Insulated Ferrules mounted on all the ends. This includes the ends of all field wires. Proper manufacturer recommendations are to be followed when installing each ferrule.

7. Terminations
   a. All wiring shall terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable.
   b. Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Each group of terminal blocks shall have a minimum of 25 percent spares. Terminal blocks shall be by WAGO.
   c. Discrete terminal blocks shall be double deck. Analog terminal blocks are to be triple deck. Terminal block colors shall match UL508A voltage code.
   d. Terminal blocks shall be the compression type, fused, unfused, or switched as shown on the Contract Drawings or specified elsewhere in Division 13.
   e. Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments. All active and spare PLC and controller points shall be

wired to terminal blocks. All active and spare PLC DO points shall be wired to interposing relays as described herein.

f. Analog inputs and outputs (AI and AO) shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Ground the shielded signal cable at the PLC cabinet. All analog inputs and outputs shall also be wired to 24V surge suppressors, as specified in Section 13300. All active and spare PLC and controller points shall be wired to terminal blocks and surge suppressors.
g. Wire and tube markers shall be the tube type with heat impressed letters and numbers.
h. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not 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.
i. Circuit power from the SCADA cabinet out to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards shall be isolated with an isolating switch terminal block with flip cover that is supplied with a dummy fuse. One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.
j. All PLC discrete outputs to the field shall be isolated with an interposing relay, as specified in paragraph 2.12 of this Section.

8. All wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection, shall be clearly identified as such.

9. All wiring shall be clearly tagged and color coded. All tag numbers and color coding shall correspond to the panel wiring diagrams and loop drawings. All power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. The color coding scheme shall be in accordance with UL 508a.

10. Provide surge protectors on all incoming power supply lines at each panel per the requirements of Section 13300.

11. Mount all terminal blocks, fuse blocks, and other devices wherever feasible, on extended DIN rail, attached to the subpanel by stainless steel screws.

12. Wiring trough for supporting internal wiring shall be wide width, plastic type, with snap-on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.

13. Each panel shall have a work light fixture, LED type, mounted internally to the ceiling of the panel, with manual switch.

14. Each panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally. The convenience receptacle shall be protected by a dedicated fuse or circuit breaker, and shall be clearly labeled "Computer Use Only – 3 Amp Maximum".

15. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.

16. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.

17. Each panel shall have control, signal, and communication line surge suppression in accordance with Section 13300.

18. All microprocessor-based electronic devices in the panel shall be powered by the UPS, as specified herein.

19. Each panel shall be provided with a circuit breaker to interrupt incoming power.

20. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. shall be in compliance with the requirements of Division 16.

B. Relays not provided under Division 16 and required for properly completing the control function specified in Division 13, Division 16, or shown on the Drawings shall be provided under this Section.

C. The orientation of all devices including PLC and I/O when installed shall be per the manufacturer's recommendations. No vertical orientation of PLC racks shall be allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and also approved by the Engineer.

2.07 GENERAL PURPOSE RELAYS AND TIME DELAYS

A. Type:

1. General purpose plug-in type.

B. Functional:

1. Contact arrangement/function shall be as required to meet the specified control function; Mechanical life expectancy shall be in excess of 10 million.

2. Duty cycle shall be rated for continuous operation; Units shall be provided with integral indicating light to indicate if relay is energized.

3. Solid state time delays shall be provided with polarity protection (DC units) and transient protection.

4. Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.

C. Physical:

1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide contacts rated 5 amps at 28 VDC, for electronic (milliamp/millivolt) switching applicator provide gold plated contacts rated for electronic service; relays shall be provided with dust and moisture resistant covers.

D. Options/Accessories Required:

1. Provide mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps.

2. Provide mounting rails/holders as required.

E. Manufacturer(s):

1. Finder.

2. IDEC.

3. WAGO.

2.08 EMERGENCY ALARM BEACON AND AUDIBLE HORN

A. Beacon alarm light:

1. Type:
   a. Beacon alarm light.

2. Physical:
   a. Beacon alarm light for building exterior mounting shall be 120 VAC, flush mounted, weatherproof construction.
   b. A 750,000-candle power xenon strobe tube and red polycarbonate lens.

3. Manufacturer(s):
   a. Federal Signal.
   b. Edwards.
   c. Wheelock.
   d. Equal.

B. Alarm Horn:

1. Type:
   a. Alarm horn shall be vibrating type for 120 Volts, 60 Hz.

2. Manufacturer(s):
   a. Federal Signal Corp.
   b. Edwards Co.
   c. Benjamin.
   d. Equal.

2.09 INTRINSIC SAFETY BARRIERS (FOR 2-WIRE TRANSMITTER SYSTEMS)

A. Intrinsic safety barriers shall be passive devices requiring no external voltage supply and supplied with series resistors, series fuse and shunt zener diodes to limit the transfer of energy to levels required by intrinsically safe protection between safe and hazardous locations.

B. Unit shall be Factory Mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493).

C. Manufacturer(s):

1. P&F.

2. Gems.

3. Unitech.

4. Equal.

2.10 24 VDC POWER SUPPLY

A. Provide one or more 24VDC power supplies as required. Each 24 VDC power supply shall meet the following requirements:

1. Input power: 115 VAC, plus or minus 10 percent, 60 Hz.

2. Output voltage: 24 VDC.

3. Output voltage adjustment: 5 percent.

4. Line regulation: 0.05 percent for 10-volt line change.

5. Load regulation: 0.15 percent no load to full load.

6. Ripple: 3 mV RMS.

7. Operating temperature: 32 to 140 degrees Fahrenheit.

B. Equip each power supply with a power on/off circuit breaker. Furnish separate power supplies for internal panel devices and for loop-powered instruments outside the panel. For the internal panel devices, furnish a redundant pair of power supplies with automatic failover unit.

C. Size each 24 VDC power supply to accommodate its design load plus a minimum 25 percent spare capacity.

D. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.

E. Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.

F. Manufacturer: PULS.

2.11 24 VDC UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Type: 24 VDC uninterruptible primary switched mode power supply unit. The power supplied to all microprocessor-based equipment, principally PLCs, Remote I/O, and networking equipment, shall be protected by UPS.

B. Operation:

1. Provide uninterrupted 24 VDC power to output upon loss of input power.

2. When 24 V supply voltage is applied, connected battery module is charged.

3. In event of a supply voltage failure, battery module is connected to the output, and stored power ensures that all connected devices continue to operate without interruption. UPS supplies a 24 VDC voltage with a load current up to 10 A.

C. Functional:

1. Input voltage range: 22.5 - 30 VDC.

2. Nominal Output Voltage: 24 VDC.

3. Output Current: 10 A or as required.

D. Controls:

1. Dry contacts shall be provided for remote monitoring of UPS conditions:
   a. UPS on battery.
   b. Fault.

E. Physical:

1. Mounting: horizontal DIN rail mounting.

2. Operating temperature range: 0 - 50 degrees C.

3. UL508A/1778 rated, capable of being installed in industrial control enclosures and preserving NEMA 4X or 12 rating.

4. Batteries shall be fully sealed, high-temperature type (50ºC).

F. Performance: UPS shall provide a minimum of 5 minutes of run time for calculated full load. Unit may have either internal or external batteries as necessary to support runtime requirements.

G. Manufacturer:

1. Siemens SITOP Series with signaling contact module.

2.12 SPARE PARTS

A. General requirements for spare parts are specified in Section 13300 and related sections.

B. The following control panel spare parts shall be furnished:

1. Relays and sockets - Two of each type installed.

2. Fuses and circuit breakers - 10% (minimum of 10 fuses and 2 circuit breakers) of each type and size installed.

3. Power supplies - one of each type installed.

4. Surge protectors – refer to Section 13300.

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to Section 13300.

3.02 TESTING

A. Refer to Section 13302.

END OF SECTION

SECTION 13340
INSTRUMENTATION AND CONTROLS – FIELD INSTRUMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section covers the furnishing, installation, and services for instruments.

B. Refer to Section 13300.

1.02 SUBMITTALS

A. Refer to Section 13300.

1.03 MAINTENANCE

A. Refer to Section 13300.

PART 2 PRODUCTS

2.01 ULTRASONIC TRANSIT TIME FLOWMETER

A. Flow Element:

1. Type:
   a. Externally mounted non-intrusive transit time type.
   b. Strap on sensor design.

2. Function/Performance:
   a. Measuring Range: As required by range indicated in the Instrument Device Schedule up to 50 ft/s (15 m/s).
   b. Operating Temperature: -29 to 149 degrees F.

3. Physical:
   a. Encapsulated submersible transducer.

4. Power Requirements:
   a. Transducer shall receive its power from the remote transmitter.

5. Accessories/Documentation Required:
   a. Provide a certificate of conformance/calibration subsequent to installation for each flowmeter.
   b. Manufacturer's cable for connection of transducer to transmitter. Length as required by installation indicated on Drawings.
   c. Stainless steel mounting hardware for installation on piping.

B. Transmitter:

1. Type:
   a. Microprocessor based, compatible with transducers provided.

2. Function/Performance:
   a. Accuracy (including flow element): ± 1.0%.
   b. Sensitivity (including flow element): 0.005 ft/s (0.0015 m/s).
   c. Operating Temperature: 32 to 140 degrees F.
   d. Output: One isolated 4-20 mA output adjustable and scaled in engineering units.
   e. Diagnostics: On screen display of self-diagnostics and calibrated parameters.
   f. Display: Digital indicator displaying flow in engineering units indicated on the Drawings or in the Instrument Device Schedule.
   g. Totalizer: A fully configurable totalizer integral to the transmitter. Totalized flow shall be displayed.

3. Physical:
   a. Transmitter shall be suitable for surface mounting.
   b. Enclosure shall be NEMA 4X (IP65).

4. Power Requirements:
   a. Transmitter shall be 120 VAC powered instrument.

C. Manufacturer:

1. Flexim FLUXUS F721 transmitter with FSK-NNNTS-000/LC sensors, no exceptions.

D. Units to be Furnished by PCSS:

1. FIT-106: Robena Road PS Flow
   a. Range: 0-3,000 gpm
   b. Pipe Size: 20 inches

2.02 PRESSURE TRANSMITTER

A. Type:

1. Microprocessor based, intelligent type.

2. For flow metering applications, the output shall be proportional to the square root of the input differential pressure.

B. Function/Performance:

1. Range: Range of the transmitter shall be the standard range of the manufacturer closest to the pressure range to be metered.

2. Accuracy: ±0.5% of full range span at room temperature, with 0.03% of full scale per deg. C temperature effect.

3. Repeatability: ±0.1% of full range span.

4. Long-term stability: ±0.25% of range/year maximum.

5. Operating Temperature: -40 to 85 degrees C.

6. Output: 4-20 mA DC linear with pressure, level, or flow; with HART protocol. Zero adjustable over the range of the instrument provided calibrated span is greater than the minimum calibrated span.

7. Display: Digital indicator displaying pressure, level or flow, in the engineering units indicated herein.

8. Diagnostics: Self-diagnostics with transmitter failure driving output to below out of range limits.

9. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored by the instrument.

C. Physical:

1. Enclosure: NEMA 4X (IP66). Furnish explosion proof, approved for Class I, Division 1, Groups C and D (EEx d IIC T5) where required.

2. Process Wetted Parts: Isolating diaphragm and other wetted metal parts shall be Type 316L stainless steel, unless otherwise indicated in the device schedule.

3. Power Supply: 24 VDC loop power.

4. Sensor Fill Fluid: Silicone.

D. Accessories Required:

1. Provide span and zero adjustment using the local display and pushbuttons without the use of an external programming device.

E. Manufacturer(s):

1. United Electric Controls, 1XTXSW series

2. Or Approved Equal.

F. Units to be Furnished by PCSS:

1. PIT-100A & B: Robena Road PS Inlet Pressure (Primary/Secondary Device)
   a. Range: -14.7 to 30 psig

2. PIT-110A: Emergency Diesel Pump Suction Pressure
   a. Range: 0-10 psig

3. PIT-105: Robena Road PS Discharge Pressure
   a. Range: 0-100 psig

2.03 PRESSURE GAUGE

A. Type:

1. Bourdon tube actuated dial face pressure gauge.

B. Function/Performance:

1. Accuracy: ±1.0% of span.

C. Physical:

1. Case: Phenolic shock resistant or type 316 stainless steel for surface/stem mounting with a pressure relieving back. The case shall be vented for temperature/atmospheric compensation. Gauge shall be callable of being liquid filled in the field or at the factory.

2. Window: Clear acrylic or shatter proof glass.

3. Bourdon tube: Stainless steel.

4. Connection: ½ in. NPT.

5. Gauge size: Minimum 4-in. viewable.

6. Pointer travel: Not less than 200 degrees not more than 270-degree arc.

D. Accessories/Options Required:

1. Shutoff valve: Each gauge shall have a process shutoff valve that can also be used as an adjustable pressure snubber.

2. Gauges shall be liquid filled from the factory for the purpose of reducing needle vibration. Liquid shall be glycerin or other clear, inert fluid, appropriate for the temperature conditions where installed.

E. Manufacturer(s):

1. Ashcroft.

2. Ametek/US Gauge.

3. Or Approved Equal.

F. Units to be Furnished by PCSS:

1. PG-100A & B: Robena Road PS Inlet Pressure (Primary/Secondary Device)
   a. Range: 0-10 psig

2. PG-101A, 102A, 103A, 104A: Booster Pump No.1,2,3,4 Suction Pressure
   a. Range: 0-10 psig

3. PG-101B, 102B, 103B, 104B: Booster Pump No.1,2,3,4 Discharge Pressure
   a. Range: 0-100 psig

4. PG-110A: Emergency Diesel Pump Suction Pressure
   a. Range: 0-100 psig

5. PG-110B: Emergency Diesel Pump Discharge Pressure

a. Range: 0-100 psig

6. PG-105: Robena Road PS Discharge Pressure
   a. Range: 0-100 psig

2.04 ANNULAR SEAL FOR PRESSURE INSTRUMENTS

A. Function/Performance:

1. Size: 2 inches, as shown on the Instrumentation Detail.

B. Physical:

1. Body material: Carbon steel.

2. Instrument connection: 1/4-inch NPT.

3. Sensing Sleeve: Buna-N.

4. Sensing Liquid: Silicone Oil.

C. Manufacturer(s):

1. Red Valve Series 742.

2. Or approved equal.

D. Units to be Furnished by PCSS:
1. PE-100-A & B: Robena Road PS Inlet Pressure (Primary/Secondary Device)
2. PE-101A, 102A, 103A, 104A: Booster Pump No.1,2,3,4 Suction Pressure
3. PE-101B, 102B, 103B, 104B: Booster Pump No.1,2,3,4 Discharge Pressure
4. PE-110A: Emergency Diesel Pump Suction Pressure
5. PE-110B: Emergency Diesel Pump Discharge Pressure
6. PE-105: Robena Road PS Discharge Pressure

2.05 SPARE PARTS

A. Miscellaneous: One year’s supply of items recommended by the manufacturer of the equipment, including all reagents, batteries, chart paper, calibration standards as needed to operate and maintain the furnished equipment.

B. Additional specific spares as follows:

1. One pressure gauge of each type and range furnished.

PART 3 EXECUTION

Refer to Section 13300.

END OF SECTION

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SECTION 15050
PIPING – GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies the basic administrative and testing requirements for piping. Specific piping materials, systems and related installation and testing requirements are specified in other Sections of Division 15.

1.02 RELATED WORK

A. Piping materials and systems are included in other Sections of Division 15.

B. Yard piping is included in Division 2.

C. Valves are included in Section 351 JEA Water and Wastewater Standards (January 2020 or latest), and Section 15100.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, general submittals for piping and piping systems are listed below. It is not intended that all submittals listed below be provided for all piping materials and systems. The Contractor shall refer to individual System or Piping Sections for specific submittals.

B. Shop Drawings and Product Data

1. Piping layouts in full detail.

2. Location of pipe hangers and supports.

3. Location and type of backup block or device to prevent joint separation.

4. Large scale details of wall penetrations and fabricated fittings.

5. Schedules of all pipe, fittings, special castings, couplings, expansion joints and other appurtenances.

6. Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners and other accessories.

7. Brochures and technical data on coatings and linings and proposed method for application and repair.

C. Samples

D. Design Data

E. Test Reports

1. Copies of certified shop tests showing compliance with appropriate standard.

2. Copies of all field test reports, signed by Contractor.

F. Certificates

1. Copies of certification for all welders performing work in accordance with ANSI B31.1.

G. Manufacturer's Installation (or application) instructions.

H. Statement of Qualifications

I. Manufacturers Field Report

J. Project Record Document

K. Operation and Maintenance Data in accordance with Section 01730.

L. Warranties

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

B. American National Standards Institute (ANSI)

1. ANSI B16.5 - Pipe Flanges and Flanged Fittings

2. ANSI B31.1 - Power Piping

C. American Welding Society (AWS)

1. AWS B2.1 - Specification for Welding Procedure and Performance Qualifications

D. American Water Works Association (AWWA)

1. AWWA Manual M11 - Steel Pipe - A Guide for Design and Installation

E. American Society of Mechanical Engineers (ASME)

F. Underwriters Laboratories (UL)

G. Factory Mutual (FM)

H. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. All materials shall be new and unused.

B. Install piping to meet requirements of local codes.

C. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified. Reference to standards such as ASTM and ANSI shall apply to those versions in effect at the time of bid opening.

D. Coordinate dimensions and drilling of flanges with flanges for valves, pumps and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.

E. Reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner and acid solder.

F. Pipe-joint compound, for pipe carrying flammable or toxic gas, must bear approval of UL or FM.

G. Unless otherwise specified, pressures referred to in all Piping Sections are expressed in pounds per square in gauge above atmospheric pressure, psig and all temperature are expressed in degrees Fahrenheit (F).

1.06 DELIVERY, STORAGE AND HANDLING

A. During loading, transportation and unloading, the Contractor shall take care to prevent damage to pipes and coating. The Contractor shall carefully load and unload each pipe under control at all times. The Contractor shall place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to ensure no injury to pipe, coating and lining.

PART 2 PRODUCTS

2.01 MATERIALS

A. Specific piping materials and appurtenances are specified in the respective Piping or System Sections.

B. Piping materials shall be as specified in Section 350, 351, 429, and 430 JEA Water and Wastewater Standards (January 2019 or latest).

PART 3 EXECUTION

3.01 GENERAL

A. All dirt, scale, weld splatter, water and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.

B. All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint.

C. The Contractor shall install piping in a neat manner with lines straight and parallel or at right angles to walls or column lines and with risers plumb. The Contractor shall run piping so as to avoid passing through ductwork or directly under electric light outlets and/or interference with other lines. All work shall be accomplished using recognized methods and procedures of pipe fabrication and in accordance with the latest revision of applicable ANSI Standards, ASME Codes and Pipe Fabrication Institute Standards.

1. The Contractor shall use full length of pipe except where cut lengths are necessary. Do not spring or deform piping to make up joints.

2. Pipe shall be cut square, not upset, undersize or out of round. Ends shall be carefully reamed and cleaned before being installed.
   a. Bending of pipe is not permitted. Use fittings for all changes in direction.

3. The Contractor shall not use bushings except where specifically approved by the Engineer. Reducers shall be eccentric to provide for drainage from all liquid-bearing lines and facilitate air removal from water lines.

4. The Contractor shall verify the locations and elevations of any existing piping and manholes before proceeding with work on any system. Any discrepancies between the information shown on the Drawings and the actual conditions found in the field shall be reported at once to the Engineer. No claim for extra payment will be considered if the above provision has not been complied with.

5. Where lines of lower service rating tie into services or equipment of higher service rating the isolation valve between the two shall conform to the higher rating.

6. Mitering of pipe to form elbow is not permitted.

7. All piping interiors shall be thoroughly cleaned after installation and kept clean by approved temporary closures on all openings until the system is put in service. Closures should be suitable to withstand the hydrostatic test.

8. End caps on pre-cleaned pipe shall not be removed until immediately before assembly. All open ends shall be capped immediately after completion of installation.

D. Test Connections

1. Provide 1/2-in female NPT test connection equipped with 1/2-in brass plug on all pump suction and discharge lines. Where indicated on the Drawings, test connections should be equipped with bar stock valve and gauge. Provide test connections at all steam traps. The connection shall be located on the discharge side of the trap between the trap and the first valve. It shall consist of a 1/2-in branch connection terminated with a gate valve.

E. Unions

1. Unions screwed or flanged shall be provided where indicated and in the following locations even if not indicated.
   a. In long runs of piping to permit convenient disassembly for alterations or repairs.
   b. In by-passes around equipment.

c. In connections to tanks, pumps and other equipment between the shut-off valve and the equipment.
d. In connections on both sides of traps, controls and automatic control valves.

3.02 UNIONS

A. Use unions to allow dismantling of pipe, valves and equipment.

3.03 WELDING

A. Welding in accordance with ANSI B31 and AWS B3.0.

B. The Contractor shall install welding fittings on all welded lines. The Contractor shall make changes in direction and intersection of lines with welding fittings. The Contractor shall not miter pipes to form elbows or notching of straight runs to form tees, or any similar construction. The Contractor shall not employ welder who has not been fully qualified in above specified procedure and so certified by approved welding bureau or similar locally recognized testing authority.

3.04 FLANGED JOINTS

A. The Contractor shall make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped. The Contractor shall use number and size of bolts conforming to same ANSI Standard as flanges. Before flanges pieces are assembled, remove rust resistant coating from machined surfaces, clean gaskets and smooth all burrs and other defects. The Contractor shall make up flanged joints tight, care being taken to prevent undue strain upon valves or other pieces of equipment.

3.05 SLEEVE COUPLINGS

A. The Contractor shall install tierods, pipe clamps or bridles when sleeve type couplings or fittings are used in piping system where indicated, and at changes in direction or other places as necessary, to prevent joints from pulling apart under pressure. The Contractor shall use bridles and tierods at least 3/4-in in diameter, except where tierods replace flange bolts of smaller size, in which case fit with nut on each side of pair of flanges. Joint harnessing shall conform, as a minimum, to the requirements for the bolts and tie bolt lugs as set forth in AWWA Manual M11.

3.06 WALL SLEEVE SEALS

A. The Contractor shall use expandable rubber segmented sealing device with corrosion-resistant fasteners to make watertight the annular space between pipe and sleeve. Determined the required inside diameter of each individual wall opening or sleeve to fit the pipe and seal it to assure a watertight joint as recommended by the Manufacturer, before ordering, fabricating or installing. Install pipe concentrically through wall sleeve. Install and tighten seal per manufacturer's instructions.

3.07 TESTING

A. The Contractor shall test all pipelines for water/gas tightness as specified in the Piping or System sections. The Contractor shall furnish all labor, testing plugs or caps, pressure pumps,

pipe connections, gauges and all other equipment required. Testing shall be performed in accordance with one or more of the testing procedures appended to this Section as specified in each Piping or System Section. All testing shall be performed in the presence of the Owner's Representative.

B. The Contractor shall repair faulty joints or remove defective pipe and fittings and replace as approved by the Engineer. Retest.

3.08 HYDROSTATIC TEST

A. Scope: This test shall be used to hydrostatically test piping systems for structural integrity and leaks. The test shall be performed at ambient temperature unless otherwise specified.

B. Test Fluid

1. Water should be used as the test fluid whenever possible. In those systems where water cannot be used the test fluid may be either the one to be used in the system or the one agreed upon by the Engineer and the Contractor.

C. Test Equipment

1. Water - Of sufficient capacity to deliver the required test pressure.

2. Strainer - On inlet side of the pump to prevent foreign matter from entering the system.

3. Valves - Shall be provided on the suction and discharge side of the pump.

4. Heater - To allow heating of the test fluid when elevated temperatures are required for test.

5. Relief Valve - Set at a pressure to relieve at 20 to 25 percent above the required test pressure.

6. Pressure Gauge(s) - Capable of reaching 50 percent over the test pressure. These should be located at the pump discharge and any other place deemed convenient by the Contractor.

7. Pressure gauges and relief valves shall be checked for accuracy before use in test procedures.

D. Preparation for Test

1. Determine the fluid to be used for the test, and, if other than ambient temperature is required, what the test temperature will be.

2. When a fluid other than water is used for a test, the equipment used for the test shall be of a material compatible with the test fluid. Normally this would be equal to the piping material.

3. Remove or block off, all relief valves, rupture discs, alarms, control instruments, etc, that shall not be subjected to the test pressure.

4. All discs, balls, or pistons from check valves shall be removed if they interfere with filling of the system. Open all valves between inlet and outlet of the section to be tested.

5. Connect pump and provide temporary closures for all of the external openings in the system. Use caution to ensure that the closures are properly designed and strong enough to withstand the test pressure.

6. All joints, including welds, are to be left uninsulated and exposed for examination during test.

7. A joint previously tested in accordance with this Section may be covered or insulated.

8. Expansion joints shall be provided with temporary restraint for additional pressure under test or shall be isolated from the test.

9. Flanged joints, where blanks are inserted to isolate equipment during the test, need not be tested.

E. Test Pressure

1. The hydrostatic test pressure shall be 1-1/2 times the design pressure unless otherwise specified in the System Section.

F. Test Procedure

1. Allow the test fluid to enter the system. Open vents to allow displacement of all entrapped air. For all pipelines exceeding 500-ft in length, the maximum rate of filling shall be limited to that which produces a maximum nominal flow velocity of one foot per second in the pipe to be tested.

2. Close vents and restrict personnel in the test area to those involved in the test.

3. Raise the pressure slowly with the pump until the predetermined test pressure is reached. Maintain pressure for duration of time specified in System Section, keeping personnel at a safe distance.

4. Reduce the pressure about 20 percent and hold it at that point while the entire system is carefully inspected for leaks, cracks, or other signs of defects.

5. If defects are found, the pressure shall be released, the system drained, the defects corrected and the test repeated.

6. After a satisfactory test has been completed, the line shall be drained.

G. Flushing

1. Lines tested with water shall be completely drained.

2. Lines shall be flushed, after test.

H. Test Records

1. Records shall be maintained of all tests performed.

2. Test records shall include:
   a. Date of Testing
   b. Identification of Piping Tested
   c. Test Fluid
   d. Test Pressure
   e. Signature of Contractor and Owner's Representative

3. If leaks are found, they shall be noted, on the record. After correction, retesting as specified for original test.

4. Records of test shall be maintained by the Contractor and copies furnished to the Engineer.

END OF SECTION

SECTION 15064
PLASTIC PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install 1/8-in to 6-in non-buried plastic piping and appurtenances for water services (hose bibbs) and ARV vent drains as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Valves and appurtenances are included in Section 15100.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data required to establish compliance with this Section. Submittals shall include the following:

1. Shop drawings including piping layouts and schedules shall be submitted to the Engineer and shall include dimensioning, fittings, locations of valves and appurtenances, joint details, methods and locations of supports and all other pertinent technical specifications for all piping to be furnished.

2. Shop drawing submittals for piping under this Section shall include all data and information required for the complete piping systems. All dimensions shall be based on the actual equipment to be furnished. Types and locations of pipe hangers and/or supports shall be shown on the piping layout for each piping submittal.

1.04 REFERENCE STANDARDS

A. ASTM International.

1. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

2. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.

3. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

4. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

5. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

6. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

7. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.

8. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

9. ASTM D3311 - Standard Specification for Drain, Waste and Vent (DWV) Plastic Fittings Patterns.

10. ASTM D5260 - Standard Classification for Chemical Resistance of Poly(Vinyl Chloride) (PVC) Homopolymer and Copolymer Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

11. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.

12. ASTM F594 - Standard Specification for Stainless Steel Nuts.

B. Plastic Pipe Institute (PPI)

1. PPI Handbook of Polyethylene Pipe

C. Handbook of PVC Pipe Design and Construction, Uni-Bell PVC Pipe Association

D. American National Standard Institute (ANSI)

1. ANSI B16.5 Pipe Flanges and Flanged Fittings.

E. National Sanitation Foundation (NSF)

F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. All plastic pipe and fittings of each type shall be furnished by a single manufacturer who is experienced in the manufacture of the items to be furnished; however, it shall not be a requirement that the pipe and fittings be manufactured by the same manufacturer, provided that the pipe and fittings are compatible in both compounding and size. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall be suitable for the intended service.

1.06 SYSTEM DESCRIPTION

A. Piping shall be installed in those locations as shown on the Drawings.

B. The equipment and materials specified herein are intended to be standard types of plastic pipe and fittings for use in transporting wastewater.

C. Plastic piping systems shall be designed for the following conditions:

1. System: Water, ARV drain

2. Material: Schedule 80 PVC

3. Flow Velocity: Up to 10 fps

4. Temperature: 35 to 100 degrees F

5. Fluid: Water

6. Pressure: Atmosphere to 65 psig

7. Temperature: Ambient

PART 2 PRODUCTS

2.01 MATERIALS

A. Poly (Vinyl Chloride) Pipe and Fittings - PVC

1. Pipe shall be manufactured from PVC compounds meeting ASTM D1784, Class 12454 in accordance with ASTM D1785, PVC 1120. The pipe shall have a minimum hydrostatic design stress of 2,000 psi at 73 degrees F and shall be suitable for field cutting and solvent welding. Pipe shall be of the sizes as shown on the Drawings and shall be Schedule 80 unless otherwise shown.

2. Fittings shall be the socket type for solvent welded joints conforming to ASTM D2467 or ASTM D2466 where Schedule 80 pipe is shown on the Drawings. Fittings shall be manufactured from PVC compound meeting ASTM D1784, Class 12454. Solvent cement shall be as specified in ASTM D2564.

3. Flange bolt spacing, number and dimensions shall conform to the requirements of ANSI B16.5. CPVC and PVC flanges shall be suitable for solvent cementing to the pipe and shall be suitable for a minimum pressure of 150 psi.

4. Bolts, nuts and washers for flanged joints shall be for corrosive service conditions and shall be Type 316 stainless steel. Anti-seize compound for stainless steel bolts and nuts shall be of a molybdenum disulfide base such as Molycoat-G or equal.

B. Fittings, specials, unions and flanges shall be of the same schedule number and manufactured of the same materials as the pipe. Whenever unions are called out on the Drawings, flanged connections may be substituted, provided that dimensional controls do not preclude use of flanges.

C. Expansion joints for PVC sizes 1/2-in to 6-in shall be telescoping type as manufactured by Plastinetics, Inc.; ASAHI/America or equal. Expansion in pipes smaller than 1/2-in shall be accommodated with expansion loops.

PART 3 EXECUTION

3.01 INSTALLATION

A. The installation of plastic pipe shall be strictly in accordance with the manufacturer's technical data and printed instructions.

B. Joints for PVC pipe shall be solvent cemented unless flanged or threaded are otherwise shown on the Drawings or are specified as other types herein. In making solvent cemented connections, clean dirt and moisture from pipe and fittings, bevel pipe ends slightly with emery cloth to remove any shoulder or burrs created by cutting of the pipe. Solvent cement joints shall be made in accordance with ASTM D2855. Primer shall be used whenever recommended by the pipe, fitting, or cement manufacturer and in all cases for joints on pipe systems 4-in in diameter or larger. Making solvent cement joints shall not be performed and the work shall stop when the temperature, measured in the shade, is 40 degrees F and falling.

C. Joints between PVC drain, waste and vent pipe and cast-iron soil pipe shall be made with approved mechanical compression joints designed for such use.

D. Installation of valves and fittings shall be in accordance with manufacturer's instructions. Particular care shall be taken not to overstress threaded connections. In making solvent cement connections, the solvent cement or primer shall not be spilled on valves. Cement allowed to run from joints shall be cleaned from the pipe and fittings immediately.

E. All piping shall have a sufficient number of unions to allow convenient removal of piping and shall be as approved by the Engineer. PVC pipe shall be installed with at least one expansion joint or loop near the center of each straight run of pipe which is 50-ft or longer with the maximum spacing between expansion joints or loops being 150-ft.

F. Where plastic pipe passes through wall sleeves, the space between the pipe and sleeve shall be sealed with a mechanical sealing element as specified in Section 01180.

G. All plastic pipe to metal pipe connections shall be made using flanged connections. Metal piping shall not be threaded into plastic fittings, valves, or couplings nor shall plastic piping be threaded into metal valves, fittings or couplings. Only socket to thread adaptors shall be used for threaded plastic pipe connections to other threaded devices.

3.02 FIELD TESTING AND FLUSHING

A. Testing and flushing shall be performed per SJCUD Manual of Water, Wastewater, and Reuse Design Specifications, latest edition,.

END OF SECTION

SECTION 15066
STAINLESS STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install, test, complete and ready for operation all stainless steel pipe as shown on the Drawings and as specified herein.

B. Where the word "pipe" is used it shall refer to pipe, fittings, hangers, supports and appurtenances unless otherwise noted.

C. The work includes, but is not necessarily limited to:

1. Furnishing and installing interior, above grade, stainless steel pipe, fittings and specials with screwed, butt welded, or flanged and plain ends.

1.02 RELATED WORK

A. Testing is included in Section 01445.

B. Concrete work is included in Division 3.

C. Field painting is included in Section 09902.

D. Instrumentation and controls, other than those specified herein, are specified under their respective Sections of Division 13.

E. Valves and appurtenances are included in Section 15100.

F. Piping specialties are included in Section 15120.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, the following:

1. Within 30 calendar days following effective date of the Agreement submit the name of the pipe, fitting and appurtenances manufacturers and a list of the material to be furnished by each manufacturer. Also include information on local representative for each manufacturer, if product is sold through a distributor.

2. Shop drawings including piping layouts and schedules, including dimensioning, fittings, expansion joints, locations of valves and appurtenances, joint details, wall penetration details, methods and locations of supports and all other pertinent technical specifications for all piping to be furnished. Shop drawings shall include all data and information required for the complete piping systems. All dimensions shall be based on the actual equipment to be furnished. Types and locations of pipe hangers and/or supports shall be shown on the piping layouts for each pipe submittal. Not all dimensions will be checked by the Engineer, nor will detailed review be performed. Contractor shall be responsible for accurate dimensioning of piping systems.

3. Proposed cleaning method, including pre-cleaning, descaling, chemicals to be used, or mechanical descaling method and final cleaning/passivation

4. Certifications that welders are qualified, in accordance with ANSI B31.1, Paragraph 127.5 for shop and project site welding of pipe work.

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM A312 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.

2. ASTM A530 - Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.

3. ASTM A778 - Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

B. American National Standards Institute (ANSI)

1. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125 and 250.

2. ANSI B16.9 - Factory-Made Wrought Steel Buttwelding Fittings.

3. ANSI B36.19 - Stainless Steel Pipe

C. American Water Works Association (AWWA)

1. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

D. American Society of Mechanical Engineers (ASME)

1. ASME B31.1 - Power Piping.

E. American Welding Society (AWS)

F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Stainless steel pipe and fittings shall be furnished by a single manufacturer who is fully experienced, reputable, qualified and regularly engaged for the last 5 years in the manufacture of the materials to be furnished. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with this Section.

1.06 SYSTEM DESCRIPTION

A. Piping shall be installed in those locations as shown on the Drawings.

B. The equipment and materials specified herein are intended to be standard types of stainless steel pipe and fittings for use in transporting wastewater.

C. Stainless steel piping for the system listed below shall be designed for the following conditions:

1. System: Robena Road Wastewater Booster Pump Station – Above-Grade Piping
   a. Material: Type 316L Schedule 10
   b. Fluid: Raw Wastewater
   c. Operating Pressure: 61 psi
   d. Test Pressure: 150 psi
   e. Temperature: 50 – 90 °F

1.07 DELIVERY, STORAGE AND HANDLING

A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe and fittings. Pipe and fittings shall not be dropped. Pipe and fittings shall be examined before installation and no piece shall be installed which is found to be defective.

B. In handling the pipe, wide cushioned slings or other devices and methods acceptable to the Engineer shall be used. No uncushioned ropes, chairs, wedges or levers shall be used in handling the pipe, fittings and couplings.

C. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe by the Contractor, at the Contractor's own expense. All pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until they are put into service.

PART 2 PRODUCTS

2.01 MATERIALS

A. All stainless steel pipe and fittings shall be fabricated from stainless steel sheet and conform to ASTM A778 Type 316L. Carbon content of Type 316L material shall be 0.03 percent maximum. Finish shall be No. 1 or No. 2B.

B. Pipe shall be die-formed or rolled true to dimension and round. Tolerances for length, inside and outside diameter and straightness shall conform to ASTM A530. The two edges of sheet shall be brought to line so as not to leave a shoulder on the inside of the pipe. Ends of pipe and fittings shall be perpendicular to the longitudinal axis. Longitudinal seams on pipe and fittings shall be welded by either the tungsten gas or the metallic-gas method. The interior welds shall be smooth, even and shall not have an internal bead higher than 1/16-in. All pieces shall be marked with gauge and type of stainless steel and with the initials of the inspector marked on the inside of each piece, at each end.

1. Stainless steel piping for the Robena Road Wastewater Booster Pump Station shall be schedule 10, flanged, one-piece construction as shown on the drawings with no butt-welds.

C. Fittings shall be smooth curve type up to 18-in diameter and mitered type 20-in diameter and greater. Fittings shall conform to ANSI B16.9.

D. All stainless-steel piping shall be flanged. Flanges shall have stub ends or rolled angle rings of the type of stainless steel as the pipeline welded to the pipe end, with suitable gaskets between

the mating surfaces and joined through the use of 125 lb rated back-up flanges, drilled to ANSI B16.1, and made of Type 316 stainless steel. Where the pipe stub is to pass through a sleeve during installation, a split-type back up flange shall be used. Bolts, washers, nuts and other hardware for flange bolting shall be Type 316 stainless steel.

E. Gaskets for flanges shall be per JEA Water and Wastewater Standards, Section 429, latest edition.

F. Flange insulating kits shall be provided and installed for connections between ductile iron and stainless steel pipe, valves, fittings etc.

G. All stainless steel pipe and fittings shall be pickled at the point of manufacture, scrubbed and washed until all discoloration is removed in accordance with ASTM A380.

H. Pipe ends shall be prepared for couplings or other type ends where required by transport and handling limitations, where required by the support layout requirements and where noted on the Drawings. Plain end pipe may be coupled with "Pressfit"-style connectors, for pipe/tubing sizes 1-1/2-in and smaller, manufactured by the Victaulic Co. or by the use of grooved end couplings. Grooving (or built-up ends for Schedule 5s or 10s pipe) shall be of the coupling manufacturers standard type. Contractor is responsible for ensuring rigidity of joints where required. All normal pipe joints at valves, bends, etc, shall be flanged, drilling per ANSI B16.1, Class 125.

I. Shop welding of fabrications shall be done according to the procedures and by welders certified per ASME Section IX. Welds shall be by an inert gas shielding process using only extra low carbon filler metals. Welds shall have a bead height of no more than 1/16-in. Butt welds shall have 100 percent penetration to the interior or backside of the weld joint. Cross-sectional thickness of welds shall be equal or greater than that of the parent metal.

J. Where shown on the Drawings or where approved by the Engineer, plain end pipe shall be joined by all stainless steel flexible couplings. Sleeve type couplings shall be of the Type 316L stainless steel and shall be Style 38 as manufactured by Dresser Manufacturing Division of Dresser Industries; coupling 411 as manufactured by Smith Blair, Inc. or equivalent couplings manufactured by Depend-O-Lok Co.

K. Where shown on the Drawings or where approved by the Engineer, harnessed flanged adapter couplings (HFAC) shall be used to connect plain end pipe equipment, fittings and/or valves. Refer to Section 15120 for HFAC requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. All pipe and fittings shall be installed true to grade and alignment and pipe anchorage and/or restraint shall be provided where required. Manufacturer's instructions shall be strictly followed.

B. All pipe and fittings shall be protected from dirt, dust, oil, grease and other foreign matter during installation to prevent damage to pipe and to assure no foreign matter is left in the piping.

C. To assemble the joints in the field, thoroughly clean all joint surfaces and gaskets, if any, with soapy water before assembly. Bolts shall be tightened alternately, evenly to the manufacturer's

specified torques. Under no condition shall extension wrenches or pipe-over-handle ratchet wrenches be used to secure greater leverage. All electrical bonding or insulation shall be installed as joints are made up.

D. Fittings, in addition to those shown on the Drawings, shall be provided if required. Due consideration shall be given to thermal expansion/contraction over a temperature range of 200 degrees F.

E. When cutting of pipe is required, the cutting shall be done by machine neatly, without damage to the pipe. Cut ends shall be smooth and at right angles to the axis of the pipe.

F. After installation, stainless steel pipe lines shall be washed clean with steam or hot water to remove any foreign material picked up during transport.

3.02 JOINING MECHANICAL AND RESTRAINED JOINTS

A. Restrained joint pipe and fittings shall be installed in the locations shown on the Drawings and as acceptable to the Engineer.

3.03 JOINING FLANGED JOINTS

A. Flanged joints shall be made with gasket, bolts and nut bolts stud with a nut on each end, or studs with nuts where the pipe is tapped. The number and size of bolts shall conform to the same standard requirements as the flange.

3.04 FIELD WELDING

A. Welding in the field shall be done only if approved by the Engineer. Field welds shall be made by welders certified under ASME Section IX and be equal in all respects to shop welds. After field welding has been done, all joints shall be thoroughly cleaned and buffed using deburring and finishing wheels.

3.05 FIELD PAINTING

A. Final field painting is included in Section 09902 except that for all stainless steel pipe, only bands, labels and arrows rather than full pipe painting will be required.

3.06 CLEANING AND CLEANUP

A. After installation, completed lines shall be cleaned with Oakite deoxidizer or similar deoxidizer as recommended by the manufacturer to remove all foreign matter, construction stains or shop markings.

3.07 FIELD TESTING

A. Field Testing of the pipe is specified in Section 01445.

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SECTION 15100
VALVES AND APPURTENANCES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required, and install complete and ready for operation, all valves and appurtenances as shown on the Drawings and/or specified herein.

1.02 RELATED WORK

A. Shop and Finish painting is included in Sections 09902

B. Instrumentation, not specified herein, is included in Division 13.

C. Valves are included in Section 351 JEA Water and Wastewater Standards (January 2020 or latest).

D. Certain items similar to those specified in this Section may be specified to be furnished and installed with individual equipment or systems. In case of a conflict, those individual equipment or system requirements shall govern.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, materials required to establish compliance with this Section.

1. Valve tag number.

2. The manufacturer and supplier.

3. The address at which equipment will be fabricated or assembled.

4. Drawings showing assembly details, materials of construction and dimensions.

5. Descriptive literature, bulletins and/or catalogs of the equipment.

6. The total weight of each item.

7. A complete bill of materials.

8. Additional submittal data, where noted with individual pieces of equipment.

B. Certificates

1. For each valve specified to be manufactured, tested and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate standards, including certified results of required tests and certification of proper installation.

2. For all valves used for potable water piping submit NSF 61 certification.

C. Manufacturer's Installation and Application Data

D. Operating and Maintenance Data

1. Operating and maintenance instructions shall be furnished to the Engineer as provided in Section 01730. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions and other information required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.04 REFERENCE STANDARDS

A. JEA Water & Wastewater Standards

B. ASTM International

1. ASTM A48 - Standard Specification for Gray Iron Castings.

2. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

3. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.

4. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.

5. ASTM A436 - Standard Specification for Austenitic Gray Iron Castings.

6. ASTM A536 - Standard Specification for Ductile Iron Castings.

7. ASTM B30 - Standard Specification for Copper-Base Alloys in Ingot Form.

8. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings

C. American Water Works Association (AWWA)

1. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

2. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-in (50mm through 24-in (600mm) NPS

3. AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants

4. AWWA C800 - Underground Service Line Valves and Fittings

D. American National Standards Institute (ANSI)

1. ANSI B1.20.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).

2. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings

3. ANSI B16.10 - Face-to-Face and End-to-End Dimensions of Valves

E. American Iron and Steel Institute (AISI)

F. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)

1. MSS-SP-82 - Valve Pressure Testing Methods

2. MSS-SP-98 - Protective Coatings for the Interior of Valves, Hydrants and Fittings.

G. National Electrical Manufacturers Association (NEMA)

H. National Sanitation Foundation (NSF)

I. Underwriters Laboratories (UL)

J. Factory Mutual (FM)

K. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Valves and appurtenances shall be products of well-established firms who are fully experienced, minimum 10 years, reputable and qualified in the manufacture of the particular equipment to be furnished.

2. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with this Section as applicable.

3. All units of the same type shall be the product of one manufacturer.

4. All 480 volt motor actuators shall be the product of one manufacturer; Contractor shall coordinate this requirement with vendors who supply actuated valves as part of systems specified in Division 11 and 15.

5. The manufacturer shall be ISO 9001 certified.

B. Certifications

1. The manufacturers shall furnish an affidavit of compliance with Standards referred to herein as specified in Paragraph 1.03C above. Refer to PART 3 for testing required for certain items in addition to that required by referenced standards.

C. Inspection of the units may also be made by the Engineer or other representative of the Owner after delivery. The equipment shall be subject to rejection at any time due to failure to meet any of the specified requirements, even though submittal data may have been accepted previously. Equipment rejected after delivery shall be marked for identification and shall be removed from the job site at once.

1.06 SYSTEM DESCRIPTION

A. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of water, wastewater, sludge, air, and chemicals as noted on the Drawings.

B. Valves, appurtenances and miscellaneous items shall be installed as shown on the Drawings and as specified, so as to form complete workable systems.

1.07 DELIVERY, STORAGE AND HANDLING

A. Reference is made to Section 01600 for additional information.

B. Packing and Shipping

1. Care shall be taken in loading, transporting and unloading to prevent injury to the valves, appurtenances, or coatings. Equipment shall not be dropped. All valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Any damage to the coatings shall be repaired as acceptable to the Engineer.

2. Prior to shipping, the ends of all valves shall be acceptably covered to prevent entry of foreign material. Covers shall remain in place until after installation and connecting piping is completed.
   a. All valves 3-in and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.
   b. Valves smaller than 3-in shall be shipped and stored as above except that heavy cardboard covers may be used on the openings.
   c. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until the valve is installed and put into use.
   d. Any corrosion in evidence at the time of acceptance by the Owner shall be removed, or the valve shall be removed and replaced.

C. Storage and Protection

1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping sections and manufacturer's information for further requirements.

1.08 MAINTENANCE

A. Special tools and the manufacturer's standard spare parts, if required for normal operation and maintenance, shall be supplied with the equipment in accordance with Section 01782 and where noted, as specified herein. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.

B. Provide one Operations and Maintenance manual for each type of valve and operator supplied under this specification in accordance with Section 01730.

C. Included within the Operations and Maintenance manuals, provide a list of all spare and replacement parts with individual prices and location where they are available.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT - GENERAL

A. Reference is made to Division 1 for additional requirements, including nameplates, provisions for temporary pressure gauges, protection against electrolysis and anchor bolts.

B. The use of a manufacturer's name and/or model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

C. Valves and appurtenances shall be of the size shown on the Drawings or as noted and as far as possible equipment of the same type shall be identical and from one manufacturer.

D. Valves and appurtenances shall have the name of the maker, nominal size, flow directional arrows, working pressure for which they are designed and standard referenced, cast in raised letters or via riveted stainless steel nameplate upon some appropriate part of the body.

E. Unless otherwise noted, items shall have a minimum working pressure of 150 psi or be of the same working pressure as the pipe they connect to, whichever is higher and suitable for the pressures noted where they are installed.

F. Joints, size and material - unless otherwise noted or required by the Engineer:

1. Except where noted, all joints referred to herein shall be of the same type, nominal diameter, material and with a minimum rating equal to the pipe or fittings they are connected to.

2. Valves and appurtenances shall be of the same nominal diameter as the pipe or fittings they are connected to.

3. Unless otherwise noted on the drawings, valves and appurtenances shall be of the same material as the pipe or fittings they are connected to.

G. Provide all special adaptors as required to ensure compatibility between valves, appurtenances and adjacent pipe.

H. No alternative materials will be considered for approval unless complete documentation is provided regarding their satisfactory long-term use in similar conditions; in addition, the consideration of any substitution will be considered only if the superiority of the proposed materials is the intent of the substitution, and only if sufficient evidence is provided to document that superiority.

2.02 VALVE ACTUATORS - GENERAL/MANUAL

A. Geared actuators shall be suitable for all weather service, with mechanical shaft seals, shall be permanently greased, or shall have provisions for greasing. Actuators for submerged duty shall be so rated, with certification by manufacturer for submerged service.

B. The valve manufacturer shall supply, mount and test all actuators on valves at the factory. The valves and their individual actuators shall be shipped as a unit.

C. Unless otherwise noted on the Drawings, valves shall be manually actuated; non-buried valves shall have an operating wheel, handle or lever mounted on the operator; those with operating nuts shall have a non-rising stem with an AWWA 2-in nut; At least two tee handles shall be provided for all operating nuts. Unless otherwise noted, operation for all valves shall be CCW open.

D. Except as otherwise shown on the Drawings or specified herein, all valves 3-in diameter or larger, with the valve hand wheel center line located 7-ft or more above the operating floor, shall be provided with chain wheel operators complete with chain guides and hot dipped galvanized steel chain, which loop within 4-ft of the operating floor. These requirements shall supersede positioning lever actuator requirements of manual butterfly valves 6 inch and smaller.

E. All actuators shall be capable of moving the valve from the full open to full close position and in reverse and holding the valve at any position part way between full open or closed.

F. Each operating device shall have cast on it the word "OPEN" and an arrow indicating the direction of operation.

G. Floor boxes for operating nuts recessed in concrete shall be standard cast iron type, cast-in-place, with fastening top, and 316 stainless steel hardware.

H. Stem guides shall be of the adjustable wall bracket type, bronze brushed, with maximum spacing of 10-ft as manufactured by Clow; Rodney Hunt or equal. Extended operating nuts and/or stems shall have universal joints and pin couplings, if longer than 10-ft and a rating of at least five times the maximum operating torque. Stem adaptors shall be provided.

I. Where required by the installation, or as specified, provide the following: extended stem; floor stand and handwheel; position indicator and etched or cast arrow to show direction of rotation to open the valve; resilient, moisture-resistant seal around stem penetration of slab.

J. Gear Actuators

1. Unless otherwise noted, gear actuators shall be provided for the following: plug and ball valves larger than 3-in diameter; where specified and/or indicated on the Drawings; where manual operator effort is greater than 40 lbs rim pull.

2. Actuators shall be capable of being removed from the valve without dismantling the valve or removing the valve from the line.

3. Gear actuators for quarter turn valves shall be of the worm or helical worm gear type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on the output shaft. Where shown on the Drawings, a 2 inch cast iron operating nut shall be provided. Actuators shall conform to AWWA C504 except where more stringent requirements are provided hereinafter. Gearing shall be machine cut steel designed for smooth operation. Bearings shall be permanently lubricated, with bronze bearing bushings provided to take all thrusts and mechanical shaft seals to contain lubricants. Housings shall be sealed to exclude moisture and dirt, allow the reduction mechanisms to operate in lubricant and be constructed of cast iron, ASTM A126, Grade B, or of ductile iron, ASTM A536. Gear housing bodies for thermoplastic valves may be cast aluminum or fabricated steel to reduce weight. Gear actuators shall indicate valve position and have adjustable stops.

4. Manual Input torque to produce required valve operating torque for worm and travelling nut gear operators shall not exceed 80 ft-lbs. In addition, hand wheel rim pull shall not exceed 20 lbs for valve sizes up to 12 inches, 40 lbs for valve size between 14 and 20 inches, 60 lbs for valve size 24 and greater. Minimum hand wheel size shall be 8 inches for up to 12 inch valve size, 12 inches for up to 16 inch valve size, 18 inches for up to 20 inch size.

5. Gear actuators for multi turn valves shall be of the bevel or spiral bevel type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on the output shaft. Gearing shall be machine cut steel designed for smooth operation. Bearings shall be permanently grease lubricated, with dual anti-friction ball bearings on the output shaft and mechanical shaft seals to contain lubricants. The output flange of the primary gear reducer shall be designed to meet an appropriate MSS or ISO standard to allow mounting to the secondary gear reducer. The ring gear shall ride on ball bearings. The stem nut shall be bronze alloy, shouldered, and ride on needle bearings. Housing components shall be o-ring sealed to exclude moisture and dirt, constructed of cast iron, ASTM A126, Grade B, or of ductile iron, ASTM A536. Gear housing bodies for thermoplastic valves may be cast aluminum or fabricated steel to reduce weight. Manual operator input effort to the hand wheel shall be a maximum of 30 lbs for operating the valve from full open to full close, under any conditions. Maximum hand wheel size shall be 24-in diameter.

K. Additional valve actuator requirements are included with the individual valve types and as noted in Paragraph 1.02 above.

L. All position indication and direction of opening arrows shall be embossed, stamped, engraved, etched or raised castings. Decals or painted indications shall not be allowed.

M. Unless otherwise noted, all valves larger than 3-in nominal diameter shall be provided with position indicators at the point of operation.

2.03 VALVE ACTUATORS - POWERED

A. General:

1. Actuators shall be operated on 480 volt power.

2. Actuators shall conform to AWWA Standard C540, insofar as applicable and as herein specified. Actuators shall be O-ring sealed, watertight to standard NEMA 4X/6, submersion to 6 feet for 30 minutes. Actuators installed in vaults below grade and elsewhere subject to submergence shall be watertight to standard NEMA 6P/IP68, 15 ft for 72 hours minimum. Actuators installed in hazardous locations as noted on the Electrical Drawings and/or area classification sheets of the Architectural Drawings shall be FM certified explosion proof for Class 1 Division 1 & 2, Groups C & D and also meet the standard NEMA 4X/6 rating.

3. Valve service/operation shall be as indicated on the P&IDs.

4. 480 Volt powered actuators shall be Rotork IQ/IQM or JEA approved equal. Actuators shall be configured as required to provide for part turn or multi-turn and be coupled with gearboxes as required to obtain the speed and operating torque as required for the valve or gate it controls.

5. Modulating actuators shall contain proportional control unit and be capable of 1200 starts per hour, open-closed valve actuators shall not require a proportional control unit, and be capable of 60 starts per hour.

6. Motor actuated valves shall communicate via Profibus DP. Each shall be provided with a Profibus DP interface card integrated in the actuator that supports DP-V0 and DP-V1 communication.

B. 480 Volt Powered Actuators for Part Turn or Multi-Turn Valve Operation:

1. Operation:
   a. Capabilities shall be provided to position valve (or gate) locally via Local/Off/Remote selector switch and Open/Stop/Close push buttons.
   b. For on/off service, when in remote, actuator shall accept one remote signal to open valve or gate and a second remote signal to close valve or gate.
   c. For modulating service, when in remote actuator shall accept a 4-20mADC position control signal, and shall position valve 0-90 degrees or gate 0-100% of travel in proportion to control signal.
   d. Unless stated otherwise in valve specifications, actuator and gearing size shall be designed to operate valve at a disc speed of one foot travel per minute of operation. For quarter turn valves, valves shall rotate from stop to stop in 30 seconds per foot of throat diameter.

2. Functional:
   a. Motor operated valve controller shall include motor, operator unit gearing, limit switch gearing, limit switches, control power transformer, position transmitter (when required), torque switches, bored and key-wayed drive sleeve for non-rising stem valves, declutch lever and auxiliary handwheel as a self-contained unit. Valve contacts shall be capable of handling the current equivalent of a NEMA 1 size starter.
   b. Reversing starters shall be integral with actuator, and shall be solid-state starters for modulating service. Electro-mechanical reversing starters shall be acceptable for open-close service and shall be mechanically and electrically interlocked.
   c. Limit switches and gearing shall be an integral part of valve control. Limit switch gearing shall be made of bronze or stainless steel and shall be fully lubricated, intermittent type and totally enclosed to prevent dirt and foreign matter from entering gear train. Limit switches shall be of adjustable type capable of being adjusted to trip at any point between fully opened valve and fully closed valve. Limit and torque switches shall be provided for stopping valve in both directions. Mid-travel switches shall be provided as required. Set position shall not be lost if over travel occurs in either manual or electric modes of operation.
   d. Valve position transmitter shall be a gear actuated, two-wire device, producing 4-20 mADC signal proportional to 0-90 degree valve position or to 0-100% of valve travel. Transmitter shall be provided with easily accessible zero and span adjustment potentiometers. Valve actuator shall be provided with a local digital or mechanical indicator integral with operator with a 0-100 percent scale. DC power supply shall be provided integral with operator and powered from 110 volt AC internal transformer. Positioner board shall provide repeatable accuracy to 0.25% of span. There shall be separate trim pots on positioner board for zero, span and dead band adjustment.
   e. Speed of actuator shall be responsibility of system supplier with regards to hydraulic requirements and response compatibility with other components within control loop. Each valve controller shall be provided with a minimum of two limit switch functions,

one for opening and one for closing. Each limit switch will have two normally open and two normally closed contacts. Gear limit switches shall be geared to driving mechanism and in step at all times whether in motor or manual operation. Provision shall be made for two extra sets of limit switches as described above, each to have two normally open and two normally closed contacts. Each valve controller shall be equipped with a double torque switch. Torque switch shall be adjustable and responsive to load encountered in either direction of travel. Limit and torque switch contacts shall be silver inlay type.

f. Each actuator shall include monitor relays to 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.

3. Physical:
   a. Operator shall be equipped with open-stop-close push-buttons, a local-off-remote selector switch and indicating lights mounted on operator. Where operator will not be situated between 2-ft-0-in and 7-ft-0-in above operator platform, and where shown on Drawings provide a separate remote valve operating station.
   b. Motor shall operate on 460 volt, 60 hertz, 3 phase power and shall be sized by actuator manufacturer to provide the required output torque for service intended. Motor shall have Class F insulation, with a duty rating of at least 15 minutes at 40 degrees C ambient temperature. Motor shall be specifically designed and built by actuator manufacturer for electric actuator service. Commercially available motors shall not be acceptable. Actuator shall include a device to ensure that motor runs with correct rotation for required direction of valve travel regardless of connection sequence of the power supply.
   c. Operators utilizing multiple reduction power gearing shall consist of spur, helical, or bevel gearing and worm of hardened alloy steel, and the worm gear shall be alloy bronze. Operators utilizing single-stage reduction shall be single-stage worm gear totally enclosed in a fully lubricated gearcase, with filling and drain plugs. Non-metallic, aluminum, or cast gearing shall not be allowed. Output shaft shall incorporate thrust bearings of the ball or roller type at the base of the actuator.
   d. An operating wheel shall be provided for manual and/or emergency operation, engaged when motor is declutched by a lever or similar means, the drive being restored to power automatically by starting the motor. Operating wheel drive shall be mechanically independent of motor drive, and any gearing shall be such as to permit emergency manual operation, using a 40 pound force in a reasonable time. Clockwise operation of handwheel shall give closing movement of valve unless otherwise stated.
   e. Each actuator shall be supplied with a start-up kit including installation instructions, wiring diagrams, and spare cover screws and seals to provide for losses during commissioning.
   f. Continuous mechanical dial indication of valve and position shall be provided. Mechanical dial position indicator shall be in step with actuator at all times in both hand wheel and motor operation. For modulating applications, mechanical dial position indicator shall include graduations of 0-100 percent scale.

4. Wiring and Terminals:
   a. Internal wiring shall be of tropical grade PVC insulated stranded cable of 5 amp minimum rating for control circuits and of appropriate size for the motor 3 phase power. Each wire shall be clearly identified at each end.

b. Terminals shall be of stud type embedded in a terminal block of high tracking-resistance compound. The 3-phase power terminals shall be shrouded from control terminals by means of an insulating cover.
c. Terminal compartment shall be separated from inner electrical components of actuator by means of a watertight seal. Terminal compartment of actuator shall be provided with three threaded cable entries.
d. Each actuator shall be provided with a commissioning kit consisting of a wiring diagram and installation and operation manual. A separate wiring diagram shall be provided inside the terminal cover. No special tools, devices or parts shall be required for commissioning.
e. Actuators shall have separately sealed motor and control compartments. Operators shall have space heaters in their limit switch, motor, and control compartments.

5. Remote Control Stations:
   a. Where shown on Drawings, or where specified in Equipment Specifications, valve actuators shall be furnished with control stations suitable for mounting remotely from, but, in vicinity of actuator. Remote mount control station shall include a Local - Off - Remote selector switch, Open - Stop - Close pushbuttons and Open - Close indicating lights. Control station operators shall be heavy duty devices mounted in a cast iron, cast aluminum, or stainless steel NEMA 4X enclosure suitable for wall mounting. Wire gage and device quality shall meet or exceed the requirements of Division 16. Local - Off - Remote selector switch shall have auxiliary contacts for remote indication of switch position. Local - Off - Remote selector switch shall have provisions for padlocking in the "Off" position. Additional functionality and/or devices to those specified above are detailed on Instrumentation P&IDs and/or Electrical Control Schematic drawings. Refer to Drawings for confirmation of scope of the Remote Control Stations.

6. Performance Test:
   a. Each actuator shall be shop performance tested, and individual test certificates shall be supplied without additional charge to Owner. Test certificates shall be submitted prior to shipment of valve actuators. Test equipment shall simulate a typical valve load, and the following parameters shall be recorded:
      1) No load current.
      2) Current at maximum torque setting.
      3) Stall current.
      4) Torque at maximum torque setting.
      5) Stall torque.
      6) Test voltage and frequency.
      7) Flash test voltage.
      8) Actuator output speed.

2.04 RUBBER FLAPPER SWING CHECK VALVES

A. The Rubber Flapper Swing Check Valve shall have a heavily constructed ductile iron body and cover. The body shall be long pattern design (not wafer) with integrally cast-on end flanges. The flapper shall be Buna-N having an “O” ring seating edge and be internally reinforced with steel.

B. Flapper to be captured between the body and the body cover in a manner to permit the flapper to flex from closed to full open position during flow through the valve. Flapper shall be easily

removed without need to remove valve from line. Check Valves to have full pipe size flow area. Seating surface to be on a 45 degree angle requiring the flapper to travel only 35 degrees from closed to full open position, for minimum head loss and non-slam closure.

C. Buna-N Flapper (hi-strength coated fabric – coated both sides with 70 Duro) which creates an elastic spring effect, molded internally, to assist the flapper to close against a slight head to prevent slamming.

D. Valve designed for 250 psi working pressure for wastewater.

E. A top mounted valve position limit switch shall be provided to indicate when the valve is fully closed and open. The indicator shall have continuous contact with the disc under all operating conditions to assure accurate disc position indication. The limit switch shall be Honeywell model no. 914CE20-3. The switch shall be rated NEMA 4X with an SPDT relay (120VAC@5A) for remote indication.

F. The Valve Manufacturer shall have been regularly engaged in the design and manufacture of Rubber Flapper Swing Check Valves for at least five years and shall submit a list of at least five separate installations in service for a minimum of five years for engineer approval prior to release to manufacture.

G. The valve shall come with a hold open device for backflushing. The hold open device shall be operable without removing the check valve or taking the pump out of service.

H. Materials of construction shall be certified in writing to conform to ASTM specifications as follows:

Body & Cover	ASTM A536 Grade 65-45-12 Ductile Iron
Rubber Flapper	Buna-N

I. Valve to be APCO Series 100 Rubber Flapper Swing Check Valve, as manufactured by Valve & Primer Corporation, Schaumburg, Illinois, U.S.A.; Val-Matic 500 Series or approved equal.

2.05 BALL VALVES

A. All ball valves shall comply with requirements included in JEA's Water and Sewer Standards Manual, Section 351 – Water Valves & Appurtenances January 1, 2020 or most recent.

2.06 PLUG VALVES

A. Plug valves shall be as specified in JEA's Water and Wastewater Standards – Section 430 January 1, 2020 or most recent.

B. Buried plug valves shall be equipped with the necessary components to be retrofitted with automated actuators in the future

2.07 WASTEWATER AIR RELEASE VALVES AND COMBINATION AIR VALVES

A. Air Release valves and combination air valves for wastewater service shall be as specified in JEA's Water and Wastewater Standards – Section 430 January 1, 2020 or most recent.

1. Air release valves for the booster, jockey, and emergency diesel pump discharge piping shall be Model S-020 by A.R.I. USA Inc. or equivalent by JEA approved equal. Sizes shall be as indicated on Drawings.

2. Air release valves at the magnetic flow meter assembly shall be 3-inch, Model D-023 NS by A.R.I. USA Inc. or equivalent by JEA approved equal.

2.08 SURFACE PREPARATION AND SHOP COATINGS

A. Notwithstanding any of these specified requirements, all coatings and lubricants in contact with potable water shall be certified as acceptable for use with that fluid.

B. If not specified herein, coatings shall comply with the requirements of Section 09901. In case of a conflict, the requirements of this Section govern.

C. If the manufacturer's requirement is not to require finished coating on any interior surfaces, then manufacturer shall so state and no interior finish coating will be required, if acceptable to the Engineer.

D. The exterior surface of various parts of valves, operators, floor-stands and miscellaneous piping shall be thoroughly cleaned of all scale, dirt, grease or other foreign matter and thereafter one shop coat of an approved rust-inhibitive primer such as Inertol Primer No. 621 shall be applied in accordance with the instructions of the paint manufacturer or other primer compatible with the finish coat provided.

E. Unless otherwise noted, interior ferrous surfaces of all valves shall be given a shop finish of an asphalt varnish conforming to AWWA C509, (except mounting faces/surfaces) or epoxy conforming to AWWA C550 with a minimum thickness of 6 mil.

F. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating. Mounting surfaces shall be especially coated with a rust preventative.

G. Special care shall be taken to protect uncoated items and plastic items, especially from environmental damage.

2.09 FACTORY INSPECTION AND TESTING

A. Factory inspection, testing and correction of deficiencies shall be done in accordance with the referenced standards and as noted herein.

B. See Division 1 for additional requirements. Also refer to PART 1, especially for required submission of test data to the Engineer.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. All valves and appurtenances shall be installed per the manufacturer's instructions in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the Engineer before they are installed.

B. Install all brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Drawings, or otherwise required. Before setting these items, check all Drawings and figures which have a direct bearing on their location. The Contractor shall be responsible for the proper location of valves and appurtenances during the construction of the work excluding skid mounted valves provided by the OSS.

C. All materials shall be carefully inspected for defects in construction and materials. All debris and foreign material shall be cleaned out of openings, etc. All valve flange covers shall remain in place until connected piping is in place. All operating mechanisms shall be operated to check their proper functioning and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to the Owner.

D. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified, and the Contractor shall certify such. Also note additional requirements in other parts of this Section.

E. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing the same procedures as specified under the applicable type connecting pipe joint and all valves and other items shall be installed in the proper position as recommended by the manufacturer. Contractor shall be responsible for verifying manufacturers' torqueing requirements for all valves.

3.02 INSTALLATION OF MANUAL OPERATIONAL DEVICES

A. Unless otherwise noted, all operational devices shall be installed with the units of the factory, as shown on the Drawings or as acceptable to the Engineer to allow accessibility to operate and maintain the item and to prevent interference with other piping, valves and appurtenances.

B. For manually operated valves 3-in in diameter and smaller, valve operators and indicators shall be rotated to display toward normal operation locations.

C. Floor boxes, valve boxes, extension stems and low floor stands shall be installed vertically centered over the operating nut, with couplings as required and the elevation of the box top shall be adjusted to conform to the elevation of the finished floor surface or grade at the completion of the Contract. Boxes and stem guides shall be adequately supported during concrete placement to maintain vertical alignment.

3.03 INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

A. See also Division 1. Take care not to over pressure valves or appurtenances during pipe testing. If any unit proves to be defective, it shall be replaced or repaired to the satisfaction of the Engineer.

B. Functional Test: Prior to plant startup, all items shall be inspected for proper alignment, quiet operation, proper connection and satisfactory performance. After installation, all manual valves shall be opened and closed in the presence of the Engineer to show the valve operates smoothly from full open to full close and without leakage. Valves equipped with electric, pneumatic or hydraulic actuators shall by cycled 5 times from full open to full closed in the presence of the Engineer without vibration, jamming, leakage, or overheating. Pressure control and pressure relief valves shall be operated in the presence of the Engineer to show they perform their

specified function at some time prior to placing the piping system in operation and as agreed during construction coordination meetings

C. The various pipe lines in which the valves and appurtenances are to be installed are specified to be field tested. During these tests any defective valve or appurtenance shall be adjusted, removed and replaced, or otherwise made acceptable to the Engineer.

D. Various regulating valves, strainers, or other appurtenances shall be tested to demonstrate their conformance with the specified operational capabilities and any deficiencies shall be corrected or the device replaced or otherwise made acceptable to the Engineer.

3.04 CLEANING

A. All items including valve interiors shall be inspected before line closure, for the presence of debris. At the option of the Engineer, internal inspection of valve and appurtenances may be required any time that the likelihood of debris is a possibility. All pipes and valves shall be cleaned prior to installation, testing disinfection and final acceptance.

END OF SECTION

SECTION 15120
PIPING SPECIALTIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete test, and make ready for operation all piping specialties required by the work of this Contract. Specific piping materials, systems and related installation and testing requirements shall be coordinated with the related sections in Divisions 2, 13 and 15. The items shall include the following:

1. Unions
2. Flanged Joints
3. Dielectric Connectors
4. Plugs and Caps
5. Miscellaneous Adaptors
6. Vents and Drains
7. Service Clamps
8. Quick Connect Couplings
9. Flexible Connectors
    a. Sleeve Couplings
    b. Flange Adapters
    c. Flexible Connectors
10. Harnessing and Restraints
11. Appurtenances and Miscellaneous Items
12. Color Coding and Labeling

1.02 RELATED WORK

A. Pipeline color coding and labeling is included in Section 09902

B. Piping materials and systems are included in other Sections of Division 15.

C. Specialties and apparatus furnished with equipment and systems are included in individual Sections in Divisions 11 and 14.

D. Valves are included in Section 15100

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, general submittals for piping, piping systems and pipeline appurtenances are listed below. It is not intended that all submittals listed below be provided for all piping materials and systems. Refer to individual System or Piping Sections for specific submittals.

B. Shop Drawings and Product Data

1. Piping layouts with specialties/.

2. Location of pipe hangers and supports.

3. Location and type of backup block or device to prevent joint separation.

4. Large scale details of wall penetrations and fabricated fittings.

5. Catalog cuts of specialties, joints, couplings, harnesses, expansion joints, gaskets, fasteners and other accessories.

6. Catalog cuts of all pipeline appurtenances specified herein.

7. Brochures and technical data on coatings and linings and proposed method for application and repair.

C. Samples

D. Design Data

E. Test Reports

1. Certified shop tests showing compliance with appropriate standard.

2. Field test reports, signed by Contractor.

F. Certificates

1. Copies of certification for all welders performing work in accordance with ANSI B31.1.

G. Manufacturers' Installation (or application) instructions.

H. Statement of Qualifications

I. Manufacturers Field Report

J. Project Record Document

K. Operation and Maintenance Data in accordance with Section 01730.

L. Warranties

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM A36 - Standard Specification for Carbon Structural Steel.

2. ASTM A126 - Standard Specification for Gray Iron Casting for Valves, Flanges and Pipe Fittings.

3. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts.

4. ASTM A278 - Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 Degrees F.

5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

6. ASTM A325 - Standard Specification for Strength Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

7. ASTM A536 - Standard Specification for Ductile Iron Castings

8. ASTM A575 - Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.

9. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

10. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

B. American National Standards Institute (ANSI)

1. ANSI A13.1 - Scheme for the Identification of Piping Systems.

2. ANSI B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form)

3. ANSI B18.2 - Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws.

4. ANSI B31 - Code for Pressure Piping.

5. ANSI B31.1 - Power Piping

C. American Society of Mechanical Engineers (ASME)

1. ASME B2.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).

2. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

3. ASME B16.5 - Pipe Flanges and Flange Fittings

D. American Welding Society (AWS)

1. AWS B3.0 - Welding Procedure and Performance Qualifications

E. American Water Works Association (AWWA)

1. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3-in through 48-in (75mm Through 1200mm), for Water and Other Liquids.

2. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

3. AWWA C219 - Bolted Sleeve-Type Couplings for Plain-End Pipe

4. AWWA C606 - Grooved and Shouldered Joints.

5. AWWA Manual M11 - Steel Pipe - A Guide for Design and Installation.

F. Plumbing and Drainage Institute (PDI)

1. WH 201 - Water Hammer Arrestors

G. Underwriters Laboratories (UL)

H. Factory Mutual (FM)

I. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. All materials shall be new and unused.

B. Install piping to meet requirements of local codes.

C. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified.

D. Coordinate dimensions and drilling of flanges with flanges for valves, pumps and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.

E. Reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner and acid solder.

F. Pipe-joint compound, for pipe carrying flammable or toxic gas, must bear approval of UL or FM.

G. Unless otherwise specified, pressures referred to in all Piping Sections are expressed in pounds per square inch, gauge above atmospheric pressure, psig and all temperature are expressed in degrees Fahrenheit (F).

1.06 DELIVERY, STORAGE AND HANDLING

A. During loading, transportation and unloading, take care to prevent damage to pipes and coating. Carefully load and unload each pipe under control at all times. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to ensure no injury to pipe and lining. Cover or cap all pipe ends while pipe is in storage, until it is made a part of the work.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Specific piping materials and appurtenances are specified in the respective Piping or System Sections. The use of a manufacturer's name and/or model number is for the purpose of establishing the standard of quality and general configuration desired.

B. Equipment shall be of the size shown on the Drawings or as noted and as far as possible equipment of the same type shall be identical and from one manufacturer.

C. Equipment shall have the name of the maker, nominal size, flow directional arrows (if applicable), working pressure for which they are designed and standard referenced specifications cast in raised letters or indelibly marked upon some appropriate part of the body.

D. Unless otherwise noted, items shall have a minimum working pressure of 150 psi or be of the same working pressure as the pipe they connect to, whichever is higher and suitable for the pressures noted where they are installed.

2.02 UNIONS

A. Unions shall be brass or bronze unions for joining nonferrous pipe; malleable brass or bronze-seated iron or steel unions for joining ferrous pipe; PVC unions for joining PVC pipe;.

2.03 PLUGS AND CAPS

A. Provide standard plug or cap as required for testing; plugs, caps suitable for permanent service.

B. Plug or cap or otherwise cover all piping work in progress.

2.04 MISCELLANEOUS ADAPTORS

A. Between different types of pipe and/or fittings special adapters may be required to provide proper connection. Some of these may be indicated on the Drawings or specified with individual types of pipe or equipment. However, it is the Contractor's responsibility to ensure proper connection between various types of pipe, to structures and between pipe and valves, gates, fittings and other appurtenances. Provide all adapters as required, whether specifically noted or not.

B. As required, these adapters shall be suitable for direct bury, with proper dielectric insulation and as a minimum, if metallic (not stainless steel or galvanized), with two coats of Coal Tar Epoxy.

2.05 SERVICE CLAMPS

A. Service clamps for outlet sizes up to 2-in shall be per JEA's Water and Wastewater Standards, Wastewater Valves and Appurtenances – Section 430, January 1, 2019 or most recent.

B. Service clamps for outlet sizes 4-in through 12-in where the outlet size is not greater than half the size of the main pipe shall have ductile iron bodies and a neoprene circular cross section O-ring gasket confined within the body. Outlet shall be AWWA C110 flange or AWWA C111 mechanical joint as required for the application. Straps shall be alloy steel, minimum 1/4-in by 1-1/2-in in cross section and fabricated with 3/4-in threaded ends. Service clamps shall be Fig. A-10920 or A-30920 by American Cast Iron Pipe Company or equal.

2.06 QUICK CONNECT COUPLINGS

A. Couplings shall be of the cam and groove type consisting of a male adapter conforming to MIL-C-27487. Male adapters shall be designed to receive a female coupler without requiring threading, bolting, or tools. Connections shall remain tight and leakproof under pressures up to 150 psig. Each adapter shall be furnished with a dust cap complete with a 18-in long security chain of corrosion resistant material. Couplings shall be by Civacon, a Division of Dover Corporation; Ever-tite or equal.

B. Coordinate the exact quick connect coupling to be provided with the Owner to verify compatibility with Owner equipment.

C. Adapters shall be furnished in accordance with the Drawings, or as required by the installation.

2.07 FLEXIBLE CONNECTORS

A. Sleeve Couplings

1. Provide plain end type ends to be joined by sleeve couplings as stipulated in AWWA C219.
    a. Join welds on ends by couplings without pipe stops. Grind flush to permit slipping coupling in at least one direction to clear pipe joint.
    b. Outside diameter and out-of-round tolerances shall be within limits specified by coupling manufacturer.
    c. Provide lugs in accordance with ASTM A36.
    d. Provide hardened steel washers in accordance with ASTM A325.
    e. Plastic plugs shall be fitted in coupling to protect bolt holes.
    f. Nuts and bolts
        1) Provide bolts and bolt-studs in accordance with ASTM A307 and ANSI B1.1 with hexagonal or square heads, coarse thread fit, threaded full length with ends chamfered or rounded.
        2) Project ends 1/4-in beyond surface of nuts.
        3) Hexagonal nuts with dimensions in accordance with ANSI B18.2 and coarse threads in accordance with ANSI B1.1.

2. Middle ring of each mechanical coupling shall have a thickness at least equal to that specified for size of pipe on which coupling is to be used and shall not be less than 10-in long for pipe 30-in and larger and not less than 7-in long for pipe under 30-in in diameter.

a. Omit pipe stop from inner surface of middle rings of couplings whenever necessary to permit removal of valves, flowmeters and other installed equipment.
b. Provide pipe stops in other couplings.

3. Clean and shop prime with manufacturer's standard rust inhibitive primer.

4. Furnish gaskets of a composition suitable for exposure to the fluid service.

5. Where shown on the Drawings, anchor sleeve-coupled joints with harness bolts. Weld harness lugs to steel pipe.
   a. Joint harness bolts shall be of sufficient length, with harness lugs placed so that coupling can be slipped at least in one direction to clear joint. Provide harnesses of sufficient number and strength to withstand test pressure as recommended in AWWA M-11.
   b. Each harness shall have a minimum of two 5/8-in diameter bolts.

6. Unless otherwise specified with the individual type of pipe, sleeve couplings (mechanical couplings) shall be Victaulic Depend-O-Lok E x E (unrestrained) or F x F (self-restrained); ITT (formerly Smith Blair) Style 411; Dresser Style 38, similar models by Baker or equal, with the pipe stop removed.

7. Similar insulation type couplings shall be provided at the face of buildings, between different type metals or where otherwise noted.

8. In addition to those locations noted on the Drawings, sleeve couplings shall be provided on all piping where it connects with a structure or buried directly under a structure at the structure's expansion joints. Special treatment will be required where pipe is encased in concrete, utilizing minimum 3-in thick styrofoam placed perpendicular to the horizontal centerline of the coupling.

2.08 HARNESSED FLANGE ADAPTOR COUPLINGS (HFAC)

A. Provide HFACs meeting the requirements of AWWA C219 as applicable and with tie rods. Provide HFACs as shown on the Drawings and called out as HFAC. All connecting hardware shall be type 316 stainless steel. The spigots and flange adapters shall be of all Type 316 stainless steel construction. The HFAC shall be a complete assembly consisting of a spigot piece, flange adapter, tie rods and Buna-N gaskets. The tie rod restraint system shall be capable of withstanding the full pressure thrust that the pipe system can develop at no more than 50% of the yield strength of the tie rod material. The design pressure rating of the HFACs shall be a minimum of 150 psig. HFACs shall be Baker Dismantling Joint by Baker Coupling Co. or equal.

2.09 HARNESSING AND RESTRAINT

A. Where harnessed couplings or adapters are noted, they shall conform to AWWA Manual M11 except as modified by the Drawings or this Section.

B. Unless otherwise noted, size and material for tie rods, clamps, plates and hex nuts shall be as shown on the Drawings, or, if not shown on the Drawings, shall be as required in AWWA Manual M11. Manufactured restraining clamp assemblies shall be as manufactured by Stellar Corporation, Columbus, OH, or equal.

C. Restrained joints (such as welded, locking mechanical joints) shall be of the type specified with the individual type of pipe. If not specified, restrained (locking) mechanical joint pipe shall be of the manufacturer's standard design utilizing a locking device (ring or ears) integrally cast with the pipe.

D. For up through 18-in diameter ductile iron pipe only, the following may be used as an alternative to other restraint system:

1. The optional mechanical joint restraints shall be incorporated in the design of a follower gland. The gland shall be manufactured of ductile iron conforming to ASTM A536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts as specified with the pipe.

2. The restraint mechanism shall consist of numerous individually activated gripping surfaces to maximize restraint capability. The gripping surfaces shall be wedges designed to spread the bearing surfaces on the pipe. Twist-off nuts, sized same as tee-head bolts, shall be used to ensure proper actuating of restraining devices. When the nut is sheared off, standard hex nut shall remain.

3. The mechanical joint restraint device for ductile iron pipe shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1.

4. The mechanical joint restraint devices shall be of the type listed below or equal.

5. For Ductile Iron Pipe: EBAA Iron, Inc. Megalug 1100 series for up to 12-in only.

2.10 APPURTENANCES AND MISCELLANEOUS ITEMS

A. All gaskets, glands, bolts, nuts and other required hardware shall be provided for connection of piping and appurtenances. Bolts and nuts shall be high strength, Type 316 stainless steel if submerged, buried, or subject to splashing and cadmium plated otherwise, with tee-head and hexagon nut. All other hardware shall be of the size, type and number as required and recommended by the piping or appurtenance manufacturer and as specified herein.

B. All gaskets for flanges shall be full face and suitable for 150 degrees F operating temperature, and the fluids carried. See also Division 1.

C. Plugs, caps and similar accessories shall be of the same material as the pipe and of the locking type, unless otherwise noted.

D. Unions shall be of the same material as the pipe, except for dielectric connections.

E. Special protective tape shall be fabric reinforced petroleum tape by Denso Inc., Houston, TX or equal.

2.11 FLANGE INSULATING GASKET KITS (FOR STAINLESS STEEL TO DUCILE IRON CONNECTIONS)

A. Flange insulating kits shall be used at all flanged connections of two dissimilar metals, including but not limited to connections of flanged stainless steel pipe to flanged ductile iron pipe and valves.

B. Flange insulating kits shall be as acceptable to the Engineer, as manufactured by PSI or equal.

C. Insulated sleeve couplings and flange adaptors shall be similar to those units as specified elsewhere.

2.12 COLOR CODING AND LABELING

A. General

1. Provide a complete color coding system consisting of preprinted labels and banding by Brady; Seton or equal. Field painting shall be specified in Section 09902. Painting and coding shall comply with the requirements of the PROCESS PIPING SCHEDULE.

2. Final selection of all colors shall be verified with the Owner.

3. Piping system identification shall comply with the requirements of ANSI A13.1.

4. Colors listed are general. Actual colors will be selected based on a comparison to the existing plant color codes, except as otherwise indicated; samples shall be furnished for all pipe paint colors; with chips from existing piping where new service lines are connecting.

5. Banding
   a. Unless special spacing is listed in schedule, apply banding to pipe at connections to equipment, valves, branch fittings, at wall, floor, or ceiling boundaries and at intervals not greater than 36-ft.

6. Labels and Directional Arrows
   a. Apply labels with directional arrows at connections to equipment, valves, branch fittings, at least one wall, floor, or ceiling boundary within a room and at intervals not greater than 36-ft.
   b. At each label, arrows indicating direction of flow shall point away from label. If flow may be in both directions, use double headed arrows.
   c. Lettering shall bear the full pipe system name as scheduled.
   d. Lettering height shall be as follows:

Outside Pipe Diameter	Minimum Letter Height
3/4-in to 1-1/4-in	1/2-in
1-1/2-in to 2-in	3/4-in
2-1/2-in to 6-in	1-1/4-in
8-in to 10-in	2-1/2-in
Over 10-in	3-1/2-in

   e. Two labels minimum each room, crawl space or compartment, unless otherwise approved.

PART 3 EXECUTION

3.01 GENERAL

A. All dirt, scale, weld splatter, water and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.

B. All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint.

C. Test Connections

1. Provide 1/2-in female NPT test connection equipped with 1/2-in brass plug on all pump suction and discharge lines. Where indicated on the Drawings, test connections should be equipped with bar stock valve and gauge. Provide test connections at all steam traps. The connection shall be located on the discharge side of the trap between the trap and the first valve. It shall consist of a 1/2-in branch connection terminated with a gate valve.

D. Installation of Expansion Joints and Flexible Connectors

1. Piping systems shall be aligned prior to installation of expansion fittings. Alignment shall be provided by fitting a rigid pipe spool in place of the expansion joint. Prior to testing of the piping system, the pipe spool shall be replaced with the specified expansion or flexible fitting.

2. In addition to the locations noted on the Drawings and in Part 2, expansion fittings and anchors shall be located and spaced as specified by the Expansion Joint Manufacturer's Association. The expansion joints/flexible connectors shall not be installed during times of temperature extreme or in a fully compressed or fully expanded condition.

E. Installation of Sleeve Couplings

1. Unless otherwise required by the manufacturer's instructions, prior to installation of sleeve couplings, the pipe ends shall be cleaned thoroughly for a distance of at least 12-in. Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6-in from the end, the middle ring shall be placed on the already installed pipe and shall be inserted into the middle ring flair and brought to proper position in relation to the pipe already installed. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares.

2. After the bolts have been inserted and all nuts have been made up fingertight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferably by use of a torque wrench of the appropriate size and torque for the bolts.

3. The correct torque as indicated by a torque wrench shall not exceed 75 ft-lb for 5/8-in bolts and 90 ft-lb for 3/4-in bolts.

4. If a wrench other than a torque wrench is used, it should be no longer than 12-in so that when used by the average person the above torque values shall not be exceeded.

5. To prevent sleeve couplings from pulling apart under pressure, a suitable harnessing or flange clamp assembly shall be provided and installed where shown on the Drawings, directed by the Engineer or required elsewhere under Division 15 concerning anchorage.

6. Note the additional locations required for sleeve couplings in Part 2. Also note Contractor's responsibility for locating, providing and installing restraints.

F. Installation of Split Couplings

1. Prior to assembly of split couplings, grooves or shoulders of the pipe as well as other parts shall be thoroughly cleaned. The ends of the pipes and outside of the gaskets shall be moderately coated with manufacturer's recommended lubricant, petroleum jelly, cup grease, soft soap, or graphite paste and the gasket shall be slipped over one pipe end. Lubricant shall be compatible with potable water application. After the other pipe has been brought to the correct position, the gasket shall be centered properly over the pipe ends with the lips against the pipes. The housing sections then shall be placed.

2. Ensure that the joints are fully extended after the rings are in place and prior to tightening the bolts. After the bolts have been inserted, the nuts shall be tightened until the housing sections are firmly in contact, as required by the manufacturer, without excessive bolt tension or strain on the pipe.

G. Installation of Pipeline Appurtenances

1. All pipeline appurtenances shall be installed as required and in accordance with the manufacturer's recommendations, as acceptable to the Engineer.

2. Gauges, meters and similar in-line items shall be isolated from testing pressures in excess of the rated pressure of the assembly.

3. Use Teflon tape on all screwed fittings.

H. Installation of Unions

1. Use unions to allow dismantling of pipe, valves, and equipment.

I. Welding

1. Welding shall be in accordance with ANSI B31 and AWS B3.0.

2. Install welding fittings on all welded lines. Make changes in direction and intersection of lines with welding fittings. Do not miter pipes to form elbows or notch straight runs to form tees, or any similar construction. Do not employ welder who has not been fully qualified in above specified procedure and so certified by approved welding bureau or similar locally recognized testing authority.

J. Installation of Flanged Joints

1. Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped. Use number and size of bolts conforming to same ANSI Standard as flanges. Before flanges pieces are assembled, remove rust resistant coating from machined

surfaces, clean gaskets and smooth all burrs and other defects. Make up flanged joints tight, care being taken to prevent undue strain upon valves or other pieces of equipment.

3.02 TESTING

A. Test all pipelines for water/gas tightness as specified in the Piping or System Sections. Furnish all labor, testing plugs or caps, pressure pumps, pipe connections, gauges and all other equipment required. Testing shall be performed in accordance with one or more of the testing procedures appended to this Section as specified in each Piping or System Section. All testing shall be performed in the presence of the Engineer.

B. Repair faulty joints or remove defective pipe and fittings and replace as approved by the Engineer. Retest.

END OF SECTION

SECTION 15140
PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals and install a complete system of pipe hangers, supports, concrete inserts and anchor bolts including all metallic hanging and supporting devices for supporting non-buried piping as shown on the Drawings and as specified herein.

B. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility for providing them. Pipe supports indicated on the Drawings are shown only to convey the intent of the design for a particular location and are not intended to represent a complete system.

1.02 RELATED WORK

A. Concrete is included in Division 3.

B. Miscellaneous metal is included in Section 05500.

C. Field painting is included in Division 9.

D. Pipe and fittings are included in respective sections of Division 15.

E. Valves and appurtenances are included in Section 15100.

F. Hangers and supports pertaining to HVAC and Plumbing systems are included in their respective Sections.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, complete sets of shop drawings of all items to be furnished under this Section. Submittals shall include complete layouts, schedules, location plans and complete total bill of materials for all pipe support systems.

B. Submittals shall include a representative catalog cut for each different type of pipe hanger or support indicating the materials of construction, important dimensions and range of pipe sizes for which that hanger is suitable. Where standard hangers and/or supports are not suitable, submit detailed drawings showing materials and details of construction for each type of special hanger and/or support. Provide detailed information on anti-seize compound.

C. Submittals shall include complete piping drawings as submitted for each piping submittal indicating type of hanger and/or support, location, magnitude of load transmitted to the structure and type of anchor, guide and other pipe supporting appurtenances including structural fasteners.

D. Types and locations of pipe hangers and/or supports shall also be shown on the piping layouts for each piping submittal as specified in the respective Division 15 pipe sections. Service

conditions for each piping system, including service temperatures, and operating and test pressures, are tabulated in the piping sections.

E. Submit complete design data for pipe support systems to show conformance with this Section.

1.04 REFERENCE STANDARDS

A. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):

1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture.

2. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.

B. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.

2. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

C. American National Standards Institute (ANSI):

1. ANSI B31.1 - Power Piping.

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. All hangers, supports and appurtenances shall conform to the latest applicable requirements of ANSI B31.1, except as supplemented or modified by the requirements of this Section.

B. All hangers, supports and appurtenances shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for all supporting equipment, with the exception of springs, shall be five times the ultimate tensile strength of the material, assuming 10-ft of water-filled pipe being supported.

C. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, submit certification stating that such requirements have been complied with.

1.06 DELIVERY, STORAGE AND HANDLING

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

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

C. Finished metal surfaces not galvanized, that are not of stainless steel construction, or that are not coated, shall be grease coated, to prevent rust and corrosion.

PART 2 PRODUCTS

2.01 GENERAL

A. All of the equipment specified herein is intended to support the various types of pipe and piping systems shown on the Drawings. It shall be the responsibility of the Contractor to develop final details and any details associated with special conditions not already covered to meet the system conditions (in particular system temperatures and pressures) specified in the respective Division 15 pipe sections.

B. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, fittings and other pipe appurtenances and to support and secure the pipe in the intended position and alignment. All supports shall be designed 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. Structural steel members required to brace any piping from excessive dislocation shall conform to the applicable requirements of Section 05500 and shall be furnished and installed under this Section.

C. The 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.

D. Where flexible 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. No fixed or restraining supports shall be installed between a flexible coupling and the piece of equipment.

E. All pipe and appurtenances connected to the equipment shall be supported in a manner to prevent any strain from being imposed on the equipment or piping system.

F. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for interior pipe supports shall be furnished with galvanized finish, hot dipped or electro-galvanized coated, except where field welding is required, where cold-applied galvanizing may be used. Interior clamps on plastic pipe shall be plastic coated. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for exterior pipe, submerged pipe and pipe within outdoor structures shall be of Type 316 stainless steel.

G. Supports shall be sufficiently close together such that the sag of the pipe is within limits that will permit drainage and avoid excessive bending stresses from concentrated loads between supports.

H. All uninsulated non-metallic piping such as PVC shall be protected from local stress concentrations at each support point. Protection shall be provided by galvanized steel protection shields or other method as approved by the Engineer. 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. Protection shields shall have an 18-gauge minimum thickness, not be less than 12-in in length and be securely fastened to pipe with stainless steel or galvanized metal straps not less than 1/2-in wide.

I. All insulated pipe shall be furnished with a rigid foam insulating saddle at each pipe support location as specified under respective pipe insulation. Provide protection shields as specified in at each support location.

J. All stainless steel piping shall be isolated from all ferrous materials, including galvanized steel by use of neoprene sheet material and protection shields, similar to above methods.

K. Pipe supports shall be provided as follows:

1. Ductile iron piping shall be supported at a maximum support spacing of 10-ft with a minimum of one support per pipe section at the joints.

2. Insofar as is possible, floor supports shall be given preference. Typical concrete supports are shown on the drawings. Base elbow and base tees shall be used where possible.

3. Support spacing for stainless steel piping 2-in and smaller diameter shall not exceed 5 ft.

4. For all stainless steel piping, provide neoprene isolators between the pipe and support components.

5. Supports for multiple PVC plastic piping shall be continuous wherever possible. Individually supported PVC pipes shall be supported as recommended by the manufacturer except that support-spacing shall not exceed 3-ft. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays such as the Electray Ladder by Husky-Burndy; the Globetray by the Metal Products, a Division of United States Gypsum, or equal. Ladder shall be of galvanized steel construction. Rung spacing shall be 12-in. Tray width shall be approximately 6-in for single runs and 12-in for double runs. 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, Model M-CAC; Husky-Burndy, Model SCR or equal. Spacing between clamps shall not exceed 9-ft. The cable trays shall provide continuous support along the length of the pipe. Individual clamps, hangers and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

6. All vertical pipes shall be supported at each floor or at intervals of not more than 12 ft by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to insure rigid construction. All vertical pipes passing through pipe sleeves shall be secured using a pipe collar.

7. Pipe supports shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.

8. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or as specified herein. No piping shall be supported from other piping or from metal stairs, ladders and walkways, unless specifically directed or authorized by the Engineer.

9. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split 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.

10. Effects of thermal expansion and contraction of the pipe shall be accounted for in the pipe support selection and installation.

L. Unless otherwise specified herein, pipe hangers and supports shall be standard catalogued components, conforming to the requirements of MSS-SP-58 and -69; and shall be as manufactured by Grinnell Co., Inc., Providence, RI; Carpenter & Patterson, Inc., Woburn, MA; F&S Central, Brooklyn NY; Elcen Metal Products Co., Franklin Park, IL and Unistrut Northeast, Cambridge, MA or equal. 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.

M. Required pipe supports for which the supports specified in this Section are not applicable shall be fabricated or constructed from standard structural steel shapes, concrete and anchor hardware similar to items previously specified herein and shall be subject to the approval of the Engineer.

N. Expansion anchors shall be equal to Kwik-Bolt as manufactured by the McCullock Industries, Minneapolis, MN or Wej-it by Wej-it Expansion Products, Inc., Bloomfield, CO. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1-in behind the steel reinforcement.

O. Hanger rods shall be hot rolled steel, machine threaded and galvanized after fabrication. The strength of the rod shall be based on its root diameter. Hanger rods shall be attached to concrete structures using concrete inserts similar to F&S, Figures 180, 571 or 150; or continuous concrete inserts per F&S. Inserts shall be malleable iron, or steel with galvanized finish. Beam clamps, C clamps or welded beam attachments shall be used for attaching hanger rods to structural steel members. Where necessary and approved by the Engineer, expansion anchors shall be used for attaching to concrete structures.

2.02 SINGLE PIPE HANGERS

A. 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.

B. Except as otherwise specified herein, pipe hangers shall be steel, of the adjustable clevis type similar to Grinnell, Figure No. 65, 260 and 590 as required.

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 No. 69-68, 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.

2.03 SINGLE AND MULTIPLE PIPE SUPPORTS

A. Single pipes located in a horizontal plane close to the floor shall be supported by one of the methods as shown on the Drawings and as specified herein.

B. Pipes 3-in in diameter and larger shall be supported by adjustable stanchions similar to F&S, Figure 427. Stanchions shall provide at least 4-in adjustment and be flange mounted to floor.

C. Pipes less than 3-in in diameter shall be held in position by supports fabricated from steel "C" channel, welded post base similar to Unistrut, Figure P2072A and pipe clamps similar to Unistrut, Figures P1109 thru P1126. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected together by horizontal member of sufficient load capacity to support pipe. Wherever possible supports shall be fastened to nearby walls or other structural member to provide horizontal rigidity. More than one pipe may be supported from a common fabricated support.

D. Where shown on the Drawings, pipe shall be supported using concrete anchor posts. Pipe shall be securely fastened to the posts using suitable metal straps as required and as approved.

2.04 WALL SUPPORTED PIPES

A. Single or multiple pipes located adjacent to walls, columns or other structural members, whenever deemed necessary, shall be supported using welded steel wall brackets similar to Carpenter and Patterson, Figure No. 69-78, 84, or 134; or "C" channel with steel brackets similar to Unistrut pipe clamps. All members shall be securely fastened to wall, column, etc., using double expansion shields or other method as approved by the Engineer. Additional wall bearing plates shall be provided where required.

B. Pipe shall be attached to supports using methods specified herein to meet the intent of this Section.

2.05 BASE ANCHOR SUPPORT

A. Where pipes change direction from horizontal to vertical via a bend, a welded or cast base bend support shall be installed at the bend to carry the load. The base bend shall be fastened to the floor, pipe stanchion, or concrete pedestal using expansion anchors or other method as approved by the Engineer.

B. Where shown on the Drawings, pipe bends shall be supported using concrete anchor posts. Pipes shall be securely fastened to the concrete supports with suitable metal bands as required and approved by the Engineer. A felt insert shall be used to isolate the piping from the poured concrete.

2.06 VERTICAL PIPE SUPPORTS

A. Where vertical pipes are not supported by a Unistrut system as specified in Paragraph 2.08 below, they shall be supported in one of the following methods.

1. For pipes 1/4-in to 2-in in diameter, an extension hanger ring shall be provided with an extension rod and hanger flange. The rod diameter shall be as recommended by the manufacturer for the type of pipe to be supported. The hanger ring shall be steel or PVC clad depending on the supported pipe. The hanger ring shall be equal to Carpenter & Paterson, Figure No. 81 or 81CT. 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-in in diameter extended pipe clamps similar to Carpenter and Patterson, Figure No. 267 may be used. The hanger shall be attached to concrete structures using double expansion shields, or to steel support members using welding lugs similar to Carpenter and Patterson, Figure No. 220.

3. Pipe riser clamps shall be used to support all vertical pipes extending through floor slabs. Riser clamps shall be steel similar to Carpenter and Patterson, Figure No. 126. Insulation shall be removed from insulated pipes prior to installing riser clamps. Insulation shall not be damaged by clamp installation.

4. Unless otherwise specified, shown, or specifically approved by the Engineer, vertical runs exceeding 12-ft shall be supported by base elbows/tees, clamps, brackets, wall rests and pipe collars, all located as required to ensure a rigid installation.

2.07 SPECIAL SUPPORTS

A. 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 10-ft. The support system shall consist of a framework suitably anchored to floors, ceilings or roofs.

B. 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. All components shall be of steel.

C. For piping 3-in and smaller, the framework shall be as manufactured by the Unistrut Corporation; Globe-Strut as manufactured by the Metal Products Division of U.S. Gypsum or equal. For piping larger than 3-in, the support frame shall be fabricated from structural steel shapes and secured through the use of expansion anchors.

D. The assemblies shall be furnished complete with all nuts, bolts and fittings required for a complete assembly including end caps for all unistruts members.

E. The design of each individual framing system shall be the responsibility of the Contractor. Shop drawings, as specified above shall be submitted and shall 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.

F. Supports not otherwise described in this Section shall be fabricated or constructed from standard structural steel shapes in accordance with applicable provisions of Section 05500, 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 the Engineer.

1. Pipe support systems shall meet all requirements of this Section and all related Sections.

2. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure is designed.

2.08 SURFACE PREPARATION AND SHOP PRIME PAINTING

A. All surfaces shall be prepared and shop painted as part of the work of this Section. Surface preparation and shop painting shall be as specified in Section 09901.

PART 3 EXECUTION

3.01 INSTALLATION

A. Proceed with the installation of piping and supports only after any building structural work has been completed and new concrete has reached its 28-day compressive strength.

B. The installation of pipe support systems shall in no way interfere with the operation of the overhead bridge cranes, monorails, access hatches, etc.

C. The installed systems shall not interfere with maintenance and operational access to any equipment installed under this Section, or any other related Section.

D. All pipes horizontal and vertical, requiring rigid support shall be supported from the building structure by approved methods. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or as specified herein. No piping shall be supported from metal stairs, ladders and walkways unless specifically directed or authorized by the Engineer.

E. All pipe supports shall be designed with liberal strength and stiffness to support 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. Prior to installation, all pipe supports shall be approved by the Engineer.

F. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings and sleeve type couplings (within four pipe diameters) and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.

G. Inserts for pipe hangers and supports shall be installed on forms before concrete is placed. Before setting these items, all Drawings and figures shall be checked which have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.

H. Continuous metal inserts shall be embedded flush with the concrete surface.

I. Apply anti-seize compound to all nuts and bolts. Supports installed without the approved compound shall be dismantled and correctly installed, at no additional cost to the Owner.

3.02 TESTING

A. All pipe support systems shall be tested for compliance with this Section. After installation, each pipe support system shall be tested 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 or augmented under this Section to the satisfaction of the Engineer.

END OF SECTION

SECTION 15500
HVAC

PART 1 GENERAL

1.01 SCOPE OF WORK

A. These Sections and Drawings cover(s) the requirements of the HVAC Work to be performed and shall not void any of the requirements specified under the General Conditions or General Requirements.

B. The areas where work is to be accomplished are specified and shown in the following:

1. Specification Sections

15500	HVAC
15990	Testing, Adjusting, and Balancing

2. Drawings

H-1	HVAC Symbols and Abbreviations
H-2	Robena Road Pump Station Electrical Building HVAC Plan
HD-1	HVAC Schedules
HD-2	HVAC Details

C. The requirements specified herein shall be modified only if specified otherwise for particular application in other Divisions.

D. This HVAC specification is incomplete without the information contained on the Drawings and in the Schedules on the Drawings.

E. Work included under the "Scope of Work" of this HVAC Section includes all labor, material, equipment, tools and services necessary to furnish, deliver, unload, install, test and place in satisfactory operation, the equipment, services and systems as called for under the HVAC Section(s) including any incidental work not shown, or not specified but which can reasonably be inferred as belonging to the various systems and necessary in good practice to provide complete and fully operational systems. Cutting and patching is included in this Section and shall be done as described in Division 1 unless otherwise indicated.

F. Equipment shall consist of the following:

1. Split system units, condensing units, air handling units, and filters

G. The following work descriptions are not intended to in any way limit the above broad statement, but are intended as a more specific mention of the most important items included therein.

1. Electrical Building: Provide split system electrical room air conditioning systems, including all associated equipment, controls, ductwork, air distribution devices, and piping.

H. Outdoor Design Conditions

Summer:	94ºF Dry-bulb, 77ºF Wet-bulb
Winter	29ºF Dry-bulb
Site Elevation (Approximate)	25.6 ft. Above Sea Level

I. Indoor Design Conditions

Space Designation	Summer Space Temp. °F	Outdoor Air Vent.	Winter Space Temp °F	Outdoor Air Vent.
Electrical Room	80 ± 5°F	N/A	Ambient	N/A

J. This section is incomplete without the information contained in the HVAC equipment schedules on the Drawings. Provide equipment of the type, size, capacity and arrangement as shown on the Drawings and as scheduled. Equipment shall consist of the particular components listed in the schedules in addition to those components normally required for the type of unit. The order of component assembly will be as stated in the schedule. Particular attention must be paid to the remarks and notes in the schedules and on the Drawings.

K. All ductwork, piping, and equipment shown on the Drawings is intended to be approximately correct to scale, but figured dimensions and detailed drawings of the actual equipment furnished shall be followed in every case. The Drawings shall be taken in a sense as diagrammatic. Size of ductwork and piping are shown, but it is not the intent to show every offset or fitting, nor every hanger or support, or structural difficulty that may be encountered. To carry out the intent and purpose of the drawings all necessary parts to make a complete working system ready for use shall be furnished without extra charge. The Construction Contractor shall be responsible to coordinate the system installation and routing with the work of all trades.

L. Furnish and install all HVAC Systems in accordance with all requirements of the Florida Mechanical Code, the Florida Building Code, all other applicable codes and standards and the requirements of this specification.

1.02 RELATED WORK

A. Cutting and patching is included in Division 1, except for items specified herein.

B. Temporary, cooling, heating, electric power and lighting is included in Division 1.

C. Trenching, excavation and backfill is included in Division 2, except for items specified herein.

D. Concrete work is included in Division 3, except for required HVAC anchor bolts, sleeves and templates which shall be furnished under this Section.

E. Structural steel and miscellaneous metal is included in Division 5, except for supplementary steel required for HVAC hangers, equipment supports, anchors and guides, which shall be furnished under this Section.

F. Painting is included in Division 9, except for factory finished HVAC equipment, HVAC shop painting and HVAC identification labeling.

G. Electrical field wiring is included in Division 16, except for field wiring for automatic temperature controls as specified herein or as shown on the HVAC Drawings.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data for the following:

1. Catalog cuts and data sheets for all equipment.

2. Design calculations for record purposes, signed and sealed by a professional engineer hired by the Construction Contractor as specified in 1.08, Engineering Services. Engineering services shall be provided as required in Part 2.

3. Automatic control drawings with composite wiring diagrams, including bills of material and descriptions of operation for all systems. Panel layouts and name plate lists for all local and central panels. Data sheets for all control system components.

4. Complete damper schedules for damper submittals including the following for each type or model of damper to be furnished for the project: materials of construction for blades, frames, bearings, linkages and seals; flow and leakage characteristics; typical operating torque requirements or characteristics; options to be furnished; general installation and maintenance instructions. Damper schedules shall include damper type; unit served; damper service; damper size; duct size; drive linkage location; installation arrangement (flanged or in duct) and damper operator type.

5. For all air handling units, submit, in accordance with Section 01300 and 15500, the following:
   a. Unit data sheets; to include catalog data, a description of the proposed unit, size, type, arrangement, and materials of construction.
   b. For belt drive equipment, provide drive data indicating sheave sizes, belt size, number and length.
   c. Each submittal shall include pertinent equipment dimensional data, heating and cooling coil operating data. Submit, in accordance with Sections 01300 and 15500, all data and the unit schedules. The submittal shall include fan data sheets with a description of the proposed fan, fan size, type, arrangement, materials of construction, weight, motor horsepower, motor type, power supply, and frame size. Provide catalog data and selections for vibration isolators, include materials of construction. For belt drive equipment; provide drive data indicating the sheave sizes, belts size, number and length. Each submittal shall include pertinent equipment dimensional data, fan performance (operating data) information, and a performance curve showing the fan operating point and range. Minimum curve size shall be 8-in by 6-in. Faxed copies of curves are not acceptable. A list of accessories to be furnished shall be included on each submittal. Copies of operating and maintenance manuals shall be submitted. Significant dimensional differences between the specified equipment and the proposed equipment shall be noted on the equipment submittal. The Construction Contractor shall provide data to show the dimensionally different equipment will fit within the space and still provide suitable clearance. Where corrosion resistance is required, provide conformation of material suitability for the specified service.
   d. For heating sections, provide information on type of heating, air entering and leaving conditions, air pressure drop, heating media entering and leaving conditions and flow

or consumption, and pressure drop. Provide size, type, arrangement, materials of construction, and operating weight.

e. For cooling sections, provide information on type of cooling, air entering and leaving conditions, air pressure drop, cooling media entering and leaving conditions, flow, and pressure drop. Provide size, type, arrangement, materials of construction, and operating weight.
f. For condensing sections provide information on number and type of compressors, type of refrigerant and refrigerant charge, and controls provided and operating weight. Provide electrical data for power and controls. For condensing coils, provide air entering and leaving conditions, air pressure drop, size, type, arrangement, and materials of construction.
g. Pertinent data on standard filters: types and sizes, quantity of modules required for each filter type, efficiency ratings performance data and manufacturer catalog cutsheets.
h. List of accessories to be furnished shall be included on each submittal.
i. Provide a recommended list of spare parts to be provided.

6. Where called for on the schedules, provide certified test data for the fan.

7. Detailed equipment, ductwork and piping layout drawings; minimum scale 1/4-in = 1-ft-0-in for interior systems and equipment, dimension clear service spaces for motors and drives, filter, coils and spacer section access doors, and ductwork access panels and doors. (Site layout drawings and roof plans showing HVAC equipment and systems may be prepared and submitted at scales smaller than 1/4-in = 1-ft-0-in, subject to Engineer's prior approval.)

8. Standard shop and field installation details for transitions, elbows, takeoffs, discharge nozzles, turning vanes, access panels and doors, volume control and splitter dampers and extractors.

9. Piping and appurtenances, materials and joining methods. Pipe hanger materials and methods.

10. Ductwork materials, joining methods, reinforcing and material gauges. Where options are allowed by SMACNA, the proposed option shall be clearly defined. Indicate proposed materials and methods for ductwork and equipment hangers.

11. Prepare dimensional comparisons between proposed equipment and scheduled equipment when the proposed equipment is dimensionally larger than that scheduled. Do not propose dimensionally larger equipment from an alternate manufacturer for installation in confined areas, or when the installation of alternate equipment will result in reduction of service access below that recommended by the manufacturer.

12. Prepare layouts showing size, arrangement, and routing of field fabricated refrigerant piping for split-systems and air handling units with remote condensers. Include a letter from the AC system manufacturer indicating their approval of the proposed sizing and routing.

13. For units that will be shipped exposed, provide a description of the protective packaging that will be used during transit.

14. When special hangers, supports, anchors, or hold downs are required that are not covered by standards provide signed and sealed calculations and details for record purposes.

15. All submittals shall contain a statement that Section 15500 and all other referenced Sections have been read and complied with. The certification statement shall be made by all of the following that are applicable; the Construction Contractor, sub-contractor and the vendor. The statement shall be an individual statement for each party involved, and shall be included with every submittal and resubmittal.

16. Submit air system testing, adjusting and balancing reports for review and approval.

17. Operation and Maintenance Data
    a. Submit to the Engineer as provided in Section 01730, Operating and Maintenance Manuals. The following information shall be considered a minimum. Where applicable, provide information required for specific pieces of equipment.
        1) Personnel familiar with the operation and maintenance of the specific information shall prepare manuals.
        2) Equipment shall be identified with the Engineers Equipment Numbers and Identification as shown in the Schedules and on the Drawings.
    b. Contents - Each volume shall contain the following minimum contents:
        1) Installation including instructions for unpacking, installing, aligning, checking and testing. Foundation data, allowable piping loads, and electrical design shall be included.
        2) Operating Instructions to provide pre-operational checks, start up and shut down, and description of all control modes. Include emergency procedures for all fault conditions and actions to be taken for all alarms. Procedures for long term storage shall be included.
        3) Maintenance shall include preventive, and corrective. Schedules for test of other functions are to be included. Provide a list of tools required to service the equipment. Trouble shooting instructions to include a trouble-shooting guide shall be included.
    c. Spare Parts List
    d. Shop Drawing Data to include performance curves, data sheets, flow diagrams, wiring diagrams, and descriptive drawings.

18. Submit the following for each insulation by System: manufacturer's product data showing conformance with this Section for all required insulation, jackets, covers, coatings, adhesives, fasteners, supports and appurtenances; complete manufacturer's instructions for installation of all required items.

19. All materials deliveries must have accompanying manufacturer's certifications attesting to satisfactory results of product testing showing conformance with this Section.

20. Provide a recommended list of spare parts to be provided.

21. In general, corrections or comments or lack there of, made relative to submittals during review shall not relieve the Construction Contractor from compliance with the requirements of the drawings and specifications. Submittals are for review of general conformance with the design concepts of the project and general compliance with the contract documents. The Construction Contractor is responsible for the final design conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating the work of all trades, and performing the work in a safe and satisfactory manner.

1.04 REFERENCE STANDARDS

A. These standards shall be considered as minimum requirements. This is a general list and not all standards listed are necessarily referenced elsewhere in this Section. Specific requirements of this Section and/or Drawings shall have precedence. In case of conflict between published requirements, the Engineer shall determine which is to be followed.

B. Abbreviation and the title of Federal, State and industry standards, technical societies, associations and institutes and other organizations which may be used are as follows:

1. Associated Air Balance Council (AABC)
2. American Conference of Governmental Industrial Hygienists (ACGIH)
3. Air Diffusion Council (ADC)
4. American Bearing Manufacturers Association (ABMA)
5. Air Movement and Control Association (AMCA)
6. American National Standards Institute (ANSI)
7. Air Conditioning and Refrigeration Institute (ARI)
8. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
9. American Society of Mechanical Engineers (ASME)
10. American Society for Testing and Materials (ASTM)
11. Factory Mutual (FM)
12. Institute of Electrical and Electronic Engineers (IEEE)
13. National Institute of Standards and Technology (NIST)
14. National Environmental Balancing Bureau (NEBB)
15. National Electrical Code (NEC)
16. National Electrical Manufacturers Association (NEMA)
17. National Fire Protection Association (NFPA)
18. Occupational Safety and Health Administration (OSHA)
19. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
20. Underwriters Laboratories (UL)

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Provide single source supplier/installer responsibility for the following systems or services:

1. Thermal Insulation

2. Testing and Balancing

3. Air Conditioning Equipment

B. Provide single source supplier/installer responsibility for systems where specified in other related Sections.

C. Services of Manufacturer's Representative

1. Provide services of a manufacturer's service engineer or test engineer, as required in Section 01170, specifically trained on type of equipment supplied or service provided. Submit qualifications of service engineer for approval. Man-day requirements listed below are exclusive of travel time and do not relieve Construction Contractor of obligation to provide sufficient service to place equipment in satisfactory operation.
   a. Testing and Balancing - Spot check HVAC system flows and system inspection during the first year of operation at Owner's request exclusive of repair, malfunction, or other trouble-shooting service calls. 2 Man-days.
   b. Air Conditioning Systems. 1 Man-day.

D. The insulation materials to be furnished under this section shall be essentially the standard products of manufactures regularly engaged in the manufacture of insulation systems.

E. Several manufacturers are indicated as acceptable for each type of insulation in these specifications. The insulation sub-contractor shall be responsible for determining that all insulation supplied for the project is suitable for installation in the spaces indicated. The insulation sub-contractor shall also insure that all materials used are compatible and in compliance with applicable codes and standards.

F. All equipment of a given type included in this section shall be furnished by or through a single manufacturer or as specified on the schedules

G. Inspection by the Engineer’s representative or failure to inspect shall not relieve the Construction Contractor of responsibility to provide materials and perform the work in accordance with the documents.

H. The Owner and Engineer reserve the right to sample and test any materials after delivery and to reject all components represented by a sample that fails to comply with the specified requirements.

I. An authorized representative of the manufacturer shall perform the initial startup of the equipment. The Owner and Engineer shall witness startup. The use of local sales representatives to perform this work is not acceptable, unless the manufacturer provides documented evidence that the sales representative has been specifically trained for this work.

J. All rotating parts of equipment shall be statically and dynamically balanced at the factory.

1.06 DELIVERY, STORAGE AND HANDLING

A. All materials shall be inspected for size, quality and quantity against approved shop drawings upon delivery.

B. Delivery schedule of all equipment shall be coordinated with the Construction Contractor. Equipment ready for shipment prior to the agreed-on shipping date shall be stored without cost to the Owner by the manufacturer.

C. All materials shall be suitably packed for shipment and long term storage. Each package shall be labeled to indicate the project and the contents of each package. Where applicable, equipment numbers shall be marked on the container.

D. All equipment shipped that is exposed such as on a flatbed truck shall be protected during transit. The equipment shall be protected from moisture, road salt, dirt and stones or other materials thrown up from other vehicles. Electrical components shall be protected as above, but with special attention to moisture. The method of shipment protection shall be defined in the submittals.

E. Instruction for the servicing and startup of equipment in long term or prolonged storage shall accompany each item.

F. All materials shall be stored in a covered dry location off of the ground. When required to protect the materials they shall be stored in a temperature-controlled location.

1.07 COORDINATION

A. The Drawings indicate the extent and general arrangement of the systems. If any departures from the drawings or specifications are deemed necessary, details of such departures and the reasons therefore shall be submitted as soon as practical for review. No such departures shall be made without the prior written concurrence of the Engineer.

B. The Construction Contractor shall coordinate the location and placement of all concrete inserts and welding attachments with the structural engineer.

C. The Construction Contractor shall assume full responsibility for coordination of the HVAC systems, including; scheduling, and verification that all structures, ducts, piping and the mounting of equipment are compatible.

D. The Construction Contractor shall not install any equipment or materials until the Owner and Engineer have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Construction Contractor's risk.

1.08 ENGINEERING SERVICES

A. When engineering services are specified to be provided by the Construction Contractor, the Construction Contractor shall retain a licensed professional engineer to perform the services. The engineer shall be licensed at the time the work is done and in the State in which the project is located. If the State issues discipline specific licenses, the engineer shall be licensed in the applicable discipline. In addition, the engineer shall be experienced in the type of work being provided.

B. All work is to be done according to the applicable regulations for professional engineers, to include signing, sealing and dating documents. When submittals are required by a professional engineer, in addition to state required signing and sealing, a copy of the current wallet card or wall certificate indicating the date of expiration shall be included with the submittal.

1.09 SPARE PARTS

A. Spare parts shall include all special items on the manufacturer's standard list of spare parts

B. In addition to special items, the following spare parts shall be provided:

1. Furnish all special tools required for normal operation and proper servicing of the equipment.

2. Spare parts shall include all items on the manufacturer's standard list of spare parts and the following for each unit:
   a. One complete set of drive belts for each piece of belt driven equipment.
   b. One complete set of gaskets for each unit.

3. Provide a minimum of 1 or 5 percent of the total units rounded to the next full unit whichever is greater for each size and rating of the following components.
   a. Thermostats
   b. Control relays
   c. Damper operators
   d. Control transmitters
   e. Control transformers

4. Provide a minimum of 4 or 10 percent of the total units rounded to the next full unit whichever is greater for each size and rating of the following components.
   a. Panel light bulbs
   b. Fuses

C. Pack spare parts in containers suitable for extended storage without deterioration of the parts. Containers shall be clearly labeled designating contents, pieces of equipment for which intended and equipment identification numbers.

1.10 UL LISTING

A. All materials, equipment and system components of the HVAC system must be UL Listed. If factory UL listing of all system components is not available, the manufacturer must include in their scope of supply, ALL expenses associated with getting the complete installation UL field labeled, by a UL representative. This includes all hourly or per diem costs and expenses of the UL representative, all costs to bring the system or specific components, within UL field labeling compliance, and all costs of the manufacturer’s representative.

1.11 MAINTENANCE

A. Maintain and service all equipment and systems until the particular equipment or the system has been accepted by the Owner.

B. Maintenance shall include compliance with the manufacturers operating and maintenance instructions as well as periodic cleaning or replacement of air handling system filters.

C. Compile records of all maintenance and lubrication work performed on Owner or Construction Contractor furnished equipment. Maintain records at the construction or installation site and make available at all times for review by the Owner or Engineer. At the request of the Owner or Engineer submit copies of these records to the Owner for information and/or review.

D. Provide all special tools required for normal maintenance. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.

E. Provide to the Owner a list of all spare and replacement parts with individual prices and location where they are available. Prices shall remain in effect for a period of not less than 1 year after start-up and final acceptance.

1.12 DEFINITIONS

A. Particular terminology used under this Section is defined as follows:

1. Traffic Level and Personnel Level - Areas, including process areas, equipment rooms, boiler rooms and other areas where insulation may be damaged by normal activity and local personnel traffic. Area extends to 8-ft above floor, walkways, platforms and stairs, and horizontally 3-ft beyond the edge of walkways, platforms, and stairs.

2. Exposed Piping and Ductwork - Piping and ductwork visible from the floor level and includes all piping and ductwork in equipment rooms, boiler rooms, etc.

3. Concealed Piping and Ductwork - Piping and ductwork not visible from the floor level and includes piping and ductwork above hung ceilings and in shaftways.

4. Supply Air Ductwork - Ductwork carrying air from a fan or air handling unit to the space or spaces to which it will be introduced. This air may have been heated or cooled or in the case of ventilation system the air would be neither heated nor cooled. Supply air ductwork extends from the fan or air handling unit to the registers, grills or diffusers at the end of the ductwork.

5. Return Air Ductwork - Ductwork carrying air from the space it was supplied to back to a fan or air handling unit. Return air ductwork extends from the registers or grills at the end of the ductwork to the air handling unit or connection with an outdoor air intake duct.

6. Exhaust Air Ductwork - Ductwork carrying air from a space to a fan and then to be discharged to the outdoors. Exhaust air ductwork extends from the registers of grills at the end of the ductwork to the fan. From the fan exhaust ductwork extends to the discharge point, exhaust air damper, or exhaust air plenum, whichever comes first.

7. Relief Air Ductwork - Ductwork carrying air from a space without a fan to be discharged to the outdoors. Relief air ductwork extends from the registers or grills at the end of the ductwork, to the discharge point, relief air damper, or relief air plenum, whichever comes first.

8. Outdoor Air Ductwork - Ductwork carrying untreated air from the outside to a fan or air handling unit. Outdoor air ductwork starts at the intake point, outdoor air damper, or outdoor air plenum, whichever comes last. The outdoor air ductwork extends to the fan, air handling unit, or connection with a return air duct, whichever comes first.

9. Mixed Air Ductwork - Ductwork that can carry either return air or outdoor air or a combination of both. Mixed air ductwork starts at the connection of the return air and outdoor air ducts and extends to the fan or air handling unit.

10. Outdoor Air Plenum - A plenum that extends from the opening in the skin of the structure to the outdoor air duct. If the outdoor air damper is directly at the intake or there is no outdoor air damper, the plenum will extend to the first size reduction. If the outdoor air damper is not at the intake, the plenum will extend to the outdoor air damper.

11. Exhaust Air Plenum - A plenum that extends from the opening in the skin of the structure to the exhaust air duct. If the exhaust air damper is directly at the discharge or there is no exhaust air damper, the plenum will extend from the last size reduction. If the exhaust air damper is not at the discharge, the plenum will extend to the exhaust air damper.

12. Relief Air Plenum - A plenum that extends from the opening in the skin of the structure to the relief air duct. If the relief air damper is directly at the discharge or there is no relief air damper, the plenum will extend from the last size reduction. If the relief air damper is not at the discharge, the plenum will extend to the relief air damper.

13. Ventilated Spaces - Areas supplied with outdoor air on a continuous or intermittent basis. The outdoor air may be heated and/or cooled or untreated.

14. Heated Spaces - Areas where heat is supplied to maintain a minimum temperature during the heating season.

15. Unheated Spaces - Areas where heat is not applied and there is no minimum temperature during the heating season.

16. Conditioned Spaces - Areas that are provided with heating and mechanical cooling.

17. Non-Conditioned Spaces - Areas that are not provided with mechanical cooling.

18. Indoor Piping - Piping within a building that is not exposed to the weather.

19. Outdoor Piping - Piping that is not within a building and which is exposed to the weather.

20. Indoor Ductwork - Ductwork within a building that is not exposed to the weather.

21. Outdoor Ductwork - Ductwork that is not within a building and is exposed to the weather.

22. Hot Ductwork - Ductwork carrying air with a temperature above the surrounding space temperature.

23. Cold Ductwork - Ductwork carrying air with a temperature below the surrounding space temperature.

24. Hot/Cold Ductwork - Ductwork carrying air with a temperature that can be either above or below the surrounding space temperature.

25. Thermal Conductivity - The rate of heat flow through unit area of a homogeneous substance under the influence of unit temperature gradient in the direction perpendicular to the area. Units-BTU per (hour)(sq ft)(degrees F temp. difference)(per inch thickness).

26. Flues/Stacks/Breeching - Ductwork carrying products of combustion to atmosphere.

PART 2 PRODUCTS

2.01 ELECTRICAL EQUIPMENT

A. Electric Motors

1. Electric motors in NEMA frame sizes shall conform to the requirements in Section 16150 unless otherwise specified herein.

2. The motor manufacturer shall confirm that motors used to power equipment are provided with bearings that will provide a bearing life equal to the driven equipment or better. Confirmation shall be included with shop drawing submittal.

3. Motors will be selected to be non-overloading over the entire operating range of the equipment. A safety factor of 25 percent will be added to all motors up to and including 50 horsepower. A safety factor of 15 percent will be added to all motors over 50 horsepower. Motors indicated on the schedules are to be considered a minimum. This sizing is not to limit compliance with the above requirements

B. Electrical Equipment

1. Electrical equipment which is furnished under this Section shall meet the requirements specified in Division 16:
   a. Disconnect switches, motor starters and combination motor starters (starters with disconnecting means and short circuit protection) shall be as specified in Section 16191.
   b. Cord-connected controls for hazardous areas shall be provided with intrinsically safe relays, which shall be as specified in Section 16191.
   c. Raceways, boxes, fittings and supports shall be as specified in Section 16110.
   d. Wires and cables shall be as specified in Section 16120.

C. Electrical enclosures and panels to include automatic temperature control panels and components shall be suitable for the environment and electrical classification for the space they are located in. The type of enclosure for the various spaces shall be as specified in Division 16. Refer to the electrical drawings for the space classifications.

D. Where noted in the HVAC equipment schedules, or when shown on the Drawings, provide fan speed control switches and integral unit thermostats.

2.02 EQUIPMENT VIBRATION ISOLATOR AND MOUNTINGS

A. General

1. Unless otherwise specified in this Division all machinery or vibrating mechanical equipment shall be isolated from the building structure by vibration isolators with a minimum deflection as specified. Operating equipment that can transmit objectionable vibration and noise must be installed with special types of vibration isolators such as flexible connectors to ductwork, piping and wiring. In more critical areas and under particular conditions, additional vibration isolators shall be installed as specified in other related Sections in this Division, or in specific equipment schedules.

2. All equipment shall be provided with attachment points for floor or suspended mounting that will safety transmit all loads including seismic to the supports.

3. The vibration isolator manufacturer shall be responsible for the proper selection of vibration isolators suitable for the particular application. Selection of the vibration isolator shall include the following factors.
   a. Equipment Weight
   b. Equipment operating frequencies
   c. Type of building support structure

4. All floor mounted vibration isolators shall be bolted to the floor or framing on which they rest. Bolts shall be arranged to prevent transmission of vibration through the bolts.

5. All isolation devices for a single piece of equipment shall be selected for a uniform static deflection according to distribution of weight in the equipment.

6. All pieces of equipment that have a variation in weight during operation or maintenance such as, but not limited to, cooling towers and hoppers, shall have built-in vertical limit restraints to limit motion to a maximum of 1/4-in.

7. Isolators exposed to the weather, in rooms classified on electrical drawings as damp, wet, or corrosive or where called for on the Drawings shall be provided with corrosion protection. Steel parts other than springs shall be galvanized. Parts subject to wear, rubbing, shall be non-corrosive material such as rubber or stainless steel. Springs and hardware shall be cadmium plated or otherwise provided with an approved coating.

8. After installation of equipment, isolators shall be adjusted for proper loading and distribution of weight.

B. Types - The following types of vibration isolators may be used.

1. Isolation Types for Floor Mounting
   a. Single elastomer-in-shear isolators, molded mound shaped element designed for 1/4-in deflection under the imposed static load. Double elastomer-in-shear isolators shall be two such elements assembled in series or a molded element designed to provide 1/2-in deflection under the imposed static load. Elastomer-in-shear isolators shall be properly housed to prevent bulging and shall be provided with adequate facilities for bolting to equipment and floor slab.

b. Heavy load pads shall be 1-1/4-in thick and shall consist of a high load capacity elastomer pad and sandwiched between two 1/8-in thick steel load distribution plates capable of supporting loads up to 250 psi. For large pad area, steel plates of suitable thickness shall be provided to distribute the load.
c. Light load pads shall be neoprene corrugated single, laminated double or laminated with 1/2-in thick fine granular composition cork sandwiched between two 1/4-in layers of corrugated, oil resistant neoprene. Pads shall be capable of loading to 50 psi.

2. Unless specifically noted in other sections of the specification or on specific equipment schedules, all equipment will be provided with vibration isolation as defined by the following table:

Type of Equipment	Vibration Isolation Type	Minimum Deflection for Slab on Grade Inches	Minimum Deflection for up to 20-ft floor span inches	Minimum Deflection for 20-ft to 30-ft Floor Span Inches	Minimum Deflection for 30-ft to 40-ft Floor Span Inches
Condensing Units	Neoprene	0.25	--	--	--
Air Handling Units	Neoprene	0.25	--	--	--

C. Rigidly Mounted Equipment

1. When equipment does not require vibration isolation, it shall be firmly attached to the building structure. Bolts and support structure shall include allowances for seismic loads as required by the applicable building codes to include shear and moment loads.

2.03 FLAME AND SMOKE RATINGS

A. All materials, including adhesives, surface coatings, sealers, assemblies of several materials, insulation, jacketing, finish, etc., shall have flame spread ratings not over 25 (fire resistive), and smoke development ratings not over 50, as established by tests conducted in accordance with ASTM E84, NFPA 255, and UL 723.

B. These requirements apply to all circumstances whether the materials are field applied or applied by a manufacturer in his/her shop, or elsewhere, prior to delivery to the project.

2.04 NOISE CRITERIA

A. The selection of pumps, fans, air handling equipment, air conditioners, heating ventilating and air conditioning machinery and mechanical equipment and the installation of the system components such as duct work and piping shall be such as not to exceed to maximum permissible noise for non-equipment spaces as defined in Table 2, Design Guidelines for HVAC System Noise in Unoccupied Spaces contained in the 1995 edition of the ASHRAE Application Handbook. Under no conditions shall the noise created by equipment exceed the levels of permissible noise exposures of occupational areas as established by the OSHA and other Federal, State and local safety and health standards, codes and ordinances.

B. The equipment supplier shall provide actual data for the equipment submitted. If the space does not meet the required criteria, and the noise level of the equipment is found to be the cause, the equipment supplier shall be responsible for the modifications required to correct the condition.

2.05 BEARINGS

A. General - Furnish equipment bearings suitable for the intended equipment service. Furnish bearings designed to carry both thrust and radial loads for equipment designed for all angle operation.

B. Provide extended lube lines with pressure relief equipped grease fittings for all bearings which are not readily accessible from outside the equipment.

C. Bearings for all equipment in the schedule below shall have heavy-duty grease lubricated self-aligning ball or roller bearings. Bearings shall have ample thrust provision to prevent end play during the normal life of the bearing. Unless specifically noted otherwise, all fans shall have bearings for both the equipment and motors with the following ABMA L-50 life.

1. Fans over 3000 cfm - 100,000 hours.

2. Fan impellers greater than 10-in diameter

D. For systems with bearings requiring L-50 lives of 200,000 hours or greater, the equipment supplier shall provide calculations for both the equipment bearings and the motor bearings to confirm the bearing selections. For belt drives, the calculations shall include the effect of the sheave size, number of belts, the sheave location on the shaft, and the location of the motor to the driven sheave.

E. Provide seals for bearings installed in airstreams, exposed outdoors, and for applications in corrosive or dusty atmosphere.

F. Provide bearings suitable for high temperature service where heat fan construction is required.

2.06 HANGERS, SUPPORTS, AND ANCHORS

A. General

1. Furnish supports, hangers and other devices necessary to support and anchor firmly and substantially the piping, equipment and ductwork described in this Section. Piping and duct support systems shall include restraints as required by the applicable building codes to withstand seismic and wind loading. Design shall be provided by a licensed professional engineer hired by the Construction Contractor as specified in Part 1. Signed and sealed calculations shall be submitted for record purposes.

2. All equipment, ductwork, piping, and supports that are installed outdoors shall be designed and installed to meet wind loadings as required by the Florida Mechanical Code, the Florida Building Code, all other applicable codes, and the requirements of this specification. Design services shall be provided by a licensed professional engineer as specified in Part 1. All equipment shall be furnished with factory supports and/or tie downs to properly secure the equipment to applicable structure, equipment pad, etc.

3. For all outdoor equipment, each equipment manufacturer shall provide a signed and sealed letter certifying that their equipment's unit integrity and anchoring system meet the requirements of the Florida Mechanical Code and the Florida Building Code.

4. All equipment shall be provided with lugs or brackets to allow the equipment to be firmly fastened to the structure. The lugs and brackets shall be sized to withstand the expected seismic and wind loads for the area and type of application. Location of the attachments shall be based on the equipment being hung or base mounted as shown on the Drawings and the schedules.

5. Design of hangers, supports, anchors and hold downs shall include the effect of all loads applied to the equipment, pipe or duct as well as the load of the component. These loads include, but are not limited to wind, seismic and internal dirt or liquid buildup.

6. Provide Type 316 stainless steel hanger rods, hangers, supplementary steel, anchors and guides in outdoor exposed applications.

B. Hangers and Suspension

1. Furnish and install all miscellaneous metalwork in accordance with Division 5 requirements.

2. Where C-clamp type hangers are used, furnish with a retainer strap.

3. Hangers shall not be supported from roof decking or bulb tees. Where required, provide supplemental steel to span between the building structures.

4. All piping supported at a maximum of 10-ft-0-in intervals. Hangers or rings, sized to fit outside the insulation.

5. All piping 2-in diameter and smaller supported by pipe rings or bands with one 3/8-in adjustable steel rod hanger and one concrete insert.

6. Anchor piping mains where indicated or wherever necessary to limit pipe expansion and to prevent vibration. Furnish anchors constructed of steel securely bolted to masonry and welded to pipes.

7. Rectangular, Round and Flat-Oval Ductwork - Spacing and size of hangers shall be as called for in the SMACNA standards, except as detailed below:
   a. Rectangular ductwork 48-in wide and larger shall be supported by two adjustable threaded rods.
   b. The following methods of hanger attachment to the building structure are NOT allowed. The numbers and letters refer to hanger methods shown in Figure 4-1, 4-2 and 4-3 of the 1985 edition of the HVAC Duct Construction Standards Metal and Flexible as published by SMACNA.
      1) "T" wrap around straps of open web joist.
      2) "W" bent over band on open web joist.
      3) "14" Friction clamps
      4) "17" Bent wire in metal deck.

8. All hanger and fastener material shall be of same finish as ductwork which they serve, e.g., galvanized, aluminum, black steel, etc. When a material other than the duct construction material must be used, the material used must be as corrosion resistant or greater than the duct material.

9. Perforated band iron or wire for supporting ducts shall not be permitted.

10. Support flexible duct by band hangers, 1-in wide minimum, attached so as not to crush the ductwork. The use of wire to hang flexible ductwork shall not be permitted.

11. Duct supports at flexible connections shall be adjustable.

2.07 PAINTING AND COATINGS

A. Unless otherwise specified, all machinery and factory finished equipment such as pumps, fans, air handling units, air conditioning units, and other items of manufacture shall be hot dipped galvanized or will have a factory applied finish, color as standard with the manufacturer. Components fabricated from stainless steel do not require a coating finish unless otherwise specified. All tanks, supporting steel, hangers, rods and all other uncoated or non-galvanized steel other than standard piping and fittings shall have a shop coat consisting of a suitable primer and finish coat. If not factory applied, the prime coat shall be as specified in Division 9. All items not factory or shop primed prior to installation shall be suitably cleaned of rust and mill scale by wire brushing, sanding, or other means and prime painted, immediately after installation.

B. The Contractor shall be responsible for the repair of all defects, blemishes, holidays and the like apparent in manufactures coatings and shall ensure that the materials used for such repair shall match and be compatible with the manufacturer's standard color, coatings and practices. Surfaces to be repaired or recoated are to be prepared as recommended by the paint or coating supplier. Care shall be taken not to paint over nameplates.

C. Furnish touch up paint for the various types of equipment furnished and deliver unopened paint to the Owner at completion of the project. The amount of touch-up paint supplied shall be sufficient to cover 15 percent of the applicable painted surfaces or one pint, whichever is greater.

D. Where specified, or called for on the following schedule, special corrosion resistant/protective coatings shall be provided. Whenever a protective coating is specified, the equipment shall be coated both inside and out. Whenever necessary to provide full coverage of the equipment, the equipment shall be completely disassembled to allow proper preparation and coating application. Any component that would block the coating process shall be removed. Equipment provided with gaskets or liners shall be coated before the application of the gasketing or liner. The equipment Vendor shall test rotating equipment after coating to confirm dynamic balance. If work needs to be done to correct the equipment balance, the integrity of the coating must be corrected after such work.

E. Ductwork connections to units that require corrosion resistant coatings shall be made with flanges. Flanges shall be factory drilled before coating. Resilient washers suitable for the environment shall be used to protect the coating from the bolts in the flange. The use of self-tapping screws or other fastening methods that will damage the coating are not acceptable.

F. All items to be provided with a protective coating shall have the following data on the coating included with the unit submittal. Submittal shall include vendor data sheets on the specific coating being used, corrosion resistance data sheets, detailed application data sheets to include surface preparation procedures. For baked coatings submit a letter from the coating manufacturer, that the company doing the actual coating operation is an approved coating company. When an equipment supplier provides the coating, the information shall be supplied by the coating manufacturers.

G. Inspection and Preparation of Coil prior to Cleaning and Coating

1. Coil shall be inspected for fin damage. Bent fins shall be straightened using the proper fitting fin comb. Tubes and tube "U" bends shall be inspected for dents, punctures or pinched areas. Where possible, and with equipment manufacturer's approval bent, punctured, pinched tube or "U" bend areas shall be repaired and leak tested by coating vendor's A/C technician prior to coating. Vendor shall securely seal all open tubes to prevent the infiltration of dirt, water, cleaning and coating solutions into the tube. The header tube shall be fitted with a Schrader valve and the coil placed under no less than 5 and no greater than 50 psi nitrogen blanket throughout the cleaning and coating process. The charge shall be recorded and verified following coating to ensure the coil was not damaged allowing cleaning or coating solutions to infiltrate the tube side.

H. Cleaning and Conditioning of the Coil Fin and Tube Surfaces Prior to Coating

1. Following initial preparation of the coil, the coil shall be thoroughly cleaned using a non-etching and non-oxidizing detergent solution having less than 10- ppm chlorides, and formulated for use on ferrous and non-ferrous metals to remove shop soils, dirt, grease and oils from the surface of the coil fins, tubes and casings. Following the detergent cleaning the coil shall be thoroughly rinsed using clean filtered water to flush off soils removed by the detergent. The surface to be water break free when rinsed ensuring a clean surface. A non-oxidizing chemical solution sealer shall then be applied to enhance adhesion and provide secondary corrosion protection. The coil shall then be dried at temperatures up to 220 degrees F until thoroughly dry prior to applying the coating.

I. Coatings shall be of the following types:

1. MANUFACTURER STANDARD COATINGS
   a. Coating material shall be manufacturer's standard as specified in the schedule below. Surfaces shall be prepared, primed and coated as required by the coating supplier. Heat curing shall be provided where required by the coating supplier.

2. BAKED PHENOLIC (for heat transfer coils, dipped)
   a. Coating material Husky Coil Coat and Husky E-Vap Coat from Bronz-Glow. Coil shall receive corrosion protection treatment from a qualified coating vendor through application of vendor's in-house dip coating process. The coating material applied by this process shall have passed a minimum 3,500-hour salt spray test in accordance with ASTM B-117.85. Coating solution shall provide effective corrosion protection throughout the entire pH range of 1.0 to 14.0. Coating material shall consist of a synthetic polyelastomer material having properties of a minimum 5,000 psi tensile strength, 400% or greater flexibility, 250% or greater elasticity to prevent chipping, cracking or flaking, have negligible (less than ½ of 1%) effect on heat transfer coefficients, coating shall contain a UV inhibitor rating at 10 year Florida sun

protection and coating shall be of a type that can be repaired in the field in the event of damage to the coating. The protective coating shall be applied by dip application (complete immersion) of the coil into the coating solution. Following curing of the coating the dry mill thickness of the coating shall be not less than 1 or greater than 1½ dry mills. Following dip coating the coil fin edges shall be sprayed to enhance fin edge coverage then the coating shall be cured at temperature of not greater than 200°F until fully cured.

J. Coatings shall be factory applied by the equipment manufacturer/supplier. If this is not possible, coating shall be applied by a specialty shop under contract to the equipment manufacturer/supplier.

1. Corrosion protection shall be provided, by an authorized coating vendor for each applicable unit component as specified herein. A "Certificate of Coating Compliance" shall be issued by the coating vendor verifying use of the specified products and processes. Coating vendor shall supply owner a written "Owner's Coated Coil Cleaning Service and Maintenance Manual". The afore mentioned certificate and manual shall be submitted upon completion of the project with all other closing documents.

2. Prior to shipment or installation of a coil into a cabinet coil shall be pressure tested to 110% of operating pressure and held for 45 minutes to ensure no leaks have occurred. Coil shall then be evacuated and placed under nitrogen blanket or installed in the cabinet.

3. When coil is being shipped as a single unit vendor shall protect coil tubes from soil or moisture infiltration by shipping coil under a nitrogen blanket of not less than 5 psi on the fluid side. Coil shall be tagged advising coil is under nitrogen blanket and psi rating of the nitrogen blanket.

4. Following installation of coil into the cabinet coating vendor's a/c technician shall place coil under a 200-400-micron vacuum to ensure integrity of coil and absence of moisture within the coil.

5. Coil shall be issued a registration number and number shall be affixed to the coil by means of a non-removable polymer seal. Coating vendor shall maintain a job warranty file for each coil coated for the period of the warranty.

6. After coating application is completed, the equipment manufacturer/supplier shall test the equipment and certify system operation prior to releasing the equipment to the job site.

K. Any holidays, runs, sags, blisters, or inclusions in the coating are unacceptable and will be corrected. With the approval of the engineer, small areas no more than 4-in by 4-in may be corrected in the field. Larger faults shall be returned to the coater to be repaired. The faulty material shall be removed by sanding and in the case of blisters, the edges feathered. The material used for recoating shall be manufactured by the same manufacturer as the original coating and shall be suitable for field repairs. The touch up material shall have the same corrosion resistance as the original coating, and if the original coating required an ultraviolet protection, the same protection will be provided as part of the repair. The final mil thickness of the repaired coating shall be equal to the originally specified thickness. Where baked coatings have been damaged, the repair shall be made with heat applied to the repaired surface to cure the coating. After curing a solvent test as recommended by the manufacturer shall be used to confirm that the coating is cured.

L. The coating manufacturer shall supply direct to the engineer, a set of coupons showing the final appearance of the cured coatings. Any coating that does not match the supplied coupons will be rejected.

2.08 TESTING, ADJUSTING AND BALANCING

A. Furnish the services of an AABC or NEBB certified agency for the testing, adjusting and balancing of all HVAC air systems installed under this Section.

B. The testing, adjusting and balancing agency shall be independent of all suppliers, installers and contractors on the project.

C. Refer to Section 15990 Testing, Adjusting, and Balancing for additional requirements.

2.09 INSULATION

A. Provide insulation adhesives, coatings and vapor barrier materials, which are compatible and recommended, for use by the insulation manufacturer. Submit a certified statement from the insulation manufacturer attesting to their approval of the adhesives, coatings, and vapor barrier materials. The following adhesives and coatings, as manufactured by Foster Div.; H.B. Fuller Co. or Childers Products Co. are representative of approved products that meet the above requirements. (Other manufacturers who demonstrate to the Engineer that their products are equivalent are acceptable.)

1. Lagging adhesive: 30-36, CP50, AMV-1.
2. Vapor barrier coating: 30-35, CP30.
3. Vaporseal adhesive: 85-75, CP82.
4. Duct adhesive: 85-20, CP82.
5. Sealing compound adhesive: 30-45, CP70.
6. Weatherproof mastic: 35-01, CP10-1.

B. Closed cell foam type insulation applications include, but are not limited to:

1. Refrigerant Piping – Suction Lines
   a. Insulation Material - Preformed flexible closed cell foam pipe insulation, minimum density 5.5 lbs/cu ft, maximum "K" factor of 0.27 at 75 degrees F mean temperature.
   b. Provide a field applied 0.016-inch aluminum jacket secured with stainless steel straps for all piping.
2. Condensate Drain Piping – Air Conditioners
   a. Insulation Material - Preformed flexible closed cell foam pipe insulation, minimum density 5.5 lbs/cu ft, maximum "K" factor of 0.27 at 75 degrees F mean temperature.
   b. Provide a field applied 0.016-inch aluminum jacket secured with stainless steel straps for all piping.
3. Acceptable manufacturers shall be Armstrong Corp; Manville Corp.; or equal.

C. Fiberglass board type insulation shall include but not be limited to the following:

1. Exposed rectangular single wall ductwork and plenums.
   a. Insulation Material - Fibrous glass insulation, minimum density 3 lbs/cu ft and a maximum "K" factor of 0.24 at 75 degrees F mean temperature.
   b. Facing - Factory applied vapor barrier 0.02 perm, consisting of glass fiber scrim reinforced laminated facing of 2 mil aluminum foil and kraft paper.

2.10 PIPE AND FITTINGS

A. Condensate Drains

1. Pipe - Copper tube ANSI H23.1 Type K or ANSI H23.6 Type DWV hard drawn. Fittings - Soldered cast brass or wrought copper drainage fittings ANSI B16.29.

2. Solder - 95 percent tin and 5 percent antimony per ASTM B32, Alloy 95TA.

B. Refrigerant Piping

1. Pipe - Type ACR copper, precleaned, inert gas filled, and capped. Fittings - Soldered wrought copper.

2. Pipe - Type K soft drawn copper, precleaned, inert gas filled, and capped. Fittings - Soldered wrought copper.

3. Solder - Hard silver solder with a minimum melting point of 1,300 degrees F. Fit up and solder joints while using an inert gas purge.

2.11 AIR HANDLING UNITS

A. In general, all air handling units, package, thru the wall type and split systems shall be factory assembled with cabinet fan, heating and/or cooling section, filters, dampers, access sections with hinged access doors, motor, motor base, drive, drive guard and vibration isolators.

1. Units shall be designed to provide an integrated assembly when all of the components are assembled. All transition sections and filler pieces required between sections are to be provided as part of the unit.

2. Support brackets or rails are to be provided with the unit. Type of support is to be as required by the schedules and as shown on the Drawings, e.g. hung, floor mounted, etc. All air handling units shall be provided with lugs, brackets or field supplied devices to allow the unit to be firmly bolted to the structure or fastened to specified vibration isolators. The lugs, brackets or field supplied devices shall be sized to withstand the expected seismic loads for the area and type of application. Location of the attachments shall be based on the equipment being hung or base mounted as shown on the Drawings and the schedules.

3. Units not mounted on vibration isolators shall have all rotating components internally isolated from the main unit with vibration isolators.

4. Ductwork connections to units that require corrosion resistant coatings shall be made with flanges. Flanges shall be factory drilled before coating. Resilient washers suitable for the

environment shall be used to protect the coating from the bolts in the flange. The use of self-tapping screws or other fastening methods that will damage the coating are not acceptable.

B. Casings

1. Casings shall be galvanized sheet steel construction with structural framing members as required. Pressure class rating shall be for the total fan static pressure. All sections of the unit shall be of the same pressure class.

2. The housing shall be constructed of formed and reinforced metal panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed and continuous seam welded corners. Unit shall be double-wall construction with insulation sandwiched between the panels. Provide with structural framing as required. Interior of unit shall be flush with no internal standing seams or framing extending into the air stream. Seal all seams with high performance polyurethane sealant. Materials of construction shall be as called for in the schedules. The housing shall be coated internally and externally with a gray polyurethane enamel for corrosion resistance. Pressure class rating shall be for the total fan static pressure. All sections of the unit shall be of the same pressure class.

3. Where specified on the schedules, and in all units with heating and/or cooling sections, the unit shall be insulated. All sections including, but not limited to, return plenum, coils, filter, spacers, access sections, fan cabinet, mixing box and by-pass sections, shall be insulated. Insulation shall be 1-in mat faced or neoprene coated fiberglass liner, 1-1/2-pound minimum density, installed with stick clips and adhesives to prevent erosion of the insulation.

4. Provide gasketed access doors for servicing all components. Access doors shall have a positive-pressure locking latch to provide an airtight seal. Bolts, nuts and shafts for door latches, handles and hinges shall be stainless steel.

5. Where suspended from structure, horizontal units shall be supported on channel supports or provided with brackets.

6. Holes shall be provided in the base rails for rigging shackles to facilitate overhead rigging and forklift slots shall be provided to facilitate maneuvering.

7. Units for outdoor installation shall comply with the following:
   a. Materials of construction shall be corrosion resistant, or provided with a corrosion resistant coating system for weather protection.
   b. The casing shall enclose all components for weather protection, with gasketed access doors provided for all sections to facilitate maintenance. Doors shall have provision for key locking to prevent unauthorized tampering.
   c. Top of housing shall be constructed to prevent buckling and ponding of water.

C. Fan Section

1. Fans shall be centrifugal cabinet fans with belt or direct drive as scheduled. Extended external lubrication fittings shall be provided.

2. On belt driven fans, mount motor on an adjustable slide base, equipped with jack screws.

3. Where scheduled, backwardly curved wheels shall be air foil type.

4. All fans shall be statically and dynamically balanced before shipment.

5. Whenever possible, fans shall be AMCA certified for sound and air performance, per AMCA 210-85 and AMCA 330-86.

6. Where called for on the schedules, fans shall be of spark resistant construction. On spark resistant fans, bearings shall not be placed in the air stream. Construction shall conform to AMCA 99-0401-82 Classification.

7. Fan bearings shall be furnished as specified elsewhere in this Section.

D. Cooling Section

1. Cooling coil section shall be insulated, and provided with drain pan, coil support slide rails and coil closure plate. Coil mounting shall minimize air by-pass around the coil. Provide insulated drain pan with a corrosion resistant lining and drain connections on both ends of the drain pan.

2. Refrigerant cooling coils shall be cartridge type with copper tubes, aluminum fins, galvanized steel frame, copper suction header and distribution tubes. Fins shall be mechanically attached to the tubes. Coils shall be pressure and leak tested at 300 psig with air under water. Coils shall be certified per ARI Standard 410.

E. Filters

1. See makeup and air handling unit schedules for filter types by unit.

2. Filter Box shall have tracks for the specified filter types, except roll filters, to allow filter replacement from either side. Sealing material shall be provided at tracks and ends to prevent air by-passing the filters.

3. Disposable Filters shall be framed filters, 1-in or 2-in thickness (as scheduled). Filter pressure drop for clean filters at 300 fpm face velocity shall be 0.2-in wg for 1-in thick and 0.15-in wg for 2-in thick filters. Filter shall have 30 to 35 percent efficiency on ASHRAE test standard 52-76. Manufacturers shall be American Air Filter Co., Flanders, or Purolator.

4. A total of three complete sets of filter media shall be provided for each unit.

F. Condensing Unit

1. Condensing unit shall consist of casing, compressor(s), refrigerant piping system, condenser, condenser fans and drives and factory wired controls and panel.

2. All rotating components shall be internally isolated with vibration isolators from the main unit.

3. Condensing unit for split systems shall be designed and constructed for mounting remote from its associated air handler with field fabricated interconnecting refrigerant piping, including associated specialties.

4. Refrigerant compressors shall be of the type, number, and capacity specified on the schedules. Compressors shall be provided with unloading or hot gas by-pass as required by the schedule. Compressor shall include suction strainer, crank case oil sight glass, oil strainer and oil heater and forced feed lubrication. Compressor controls shall include three-phase manual reset overload protection, hi-low refrigerant pressure cutout, manual reset low oil pressure cutout, non-cycle pump down relay. In addition, multiple compressor units shall have a compressor sequence switch.

5. Air cooled condenser shall have propeller or centrifugal fans as shown on the schedules. Exposed fans shall be provided with fan guards. Coils shall have copper tubes, aluminum fins, galvanized steel frame and copper headers. Fins shall be mechanically attached to the tubes. Coils shall be pressure and leak tested at 425 psig with air under water.

G. A complete refrigerant piping system shall be factory fabricated and installed in the unit. Each compressor shall be provided with a complete and independent refrigerant piping system.

1. Piping shall be Type K copper tubing with joints silver brazed. Brazing shall be done with an inert gas purge. Suction lines shall be insulated with closed cell foam insulation. Hot gas piping shall be insulated to protect personnel as required.

2. Valves shall be bronze body brazed connection and shall include compressor and condenser relief valves, condenser liquid line service valve, refrigerant charging valve, compressor discharge, suction service valves, liquid line solenoid and thermal expansion valve.

3. Complete refrigerant system shall be cleaned, leak tested and charged with refrigerant.

4. Size of field fabricated piping for split systems shall be determined by the equipment manufacturer.

H. Unit Control Panel

1. For split system units, factory wired control panel shall be furnished and mounted on the unit. Panels shall include all controls required in other sections and all safety controls and interlocks, heavy duty fused visible break disconnect, control devices, motor starters and terminal strip for remote wired devices. Control type and sequence shall be as specified in other related Sections or on the Drawings. Control voltage shall not exceed 120 Volts. A complete wiring diagram shall be permanently attached to the inside of the unit.

2. Furnish electric heater section controls as scheduled and in accordance with the controls specified under Electric Duct Heaters, elsewhere in this Section.

3. Where specific area classifications are called for or shown on the electrical drawings, all equipment and wiring shall be in conformance with the requirements for that classification.

4. The type of enclosure shall be as specified in Division 16.

I. Accessory Sections

1. Accessory sections shall be as shown on the Drawings and Schedules, and as required for the unit type.

2.12 DUCTWORK

A. Sheet metal ductwork shall be constructed of the materials specified using the gauges or thicknesses and reinforcing called for by SMACNA for the material specified. Unless otherwise specified, all components of duct systems shall be constructed of the same material as the ductwork. This is to include braces and turning vanes.

1. Aluminum ductwork shall be constructed of 3003H-14 alloy B&S Gauges.

B. Ductwork shall be constructed of the following materials and to the following standards:

System	Location	Static Pressure	Construction Material	SMACNA Standard
Supply/Return	Electrical Room	±2-in WG	AL	M&F

Abbreviations

M&F - SMACNA HVAC Duct Construction Standards - 1st Ed. - Metal & Flexible

AL = Aluminum

C. Design of ductwork shall include all loads applied to the ductwork, in addition to the load of the duct. These loads include but are not limited to wind, snow and internal dirt or liquid buildup.

D. Construction

1. All ductwork shall be substantially built with joints and seams smooth on the inside and given a neat appearance on the outside. Inside surfaces and joints shall be smooth and free from pockets, burrs and projections. All joints shall be substantially air tight with laps made in the direction of air flow and no flanges projecting into the air stream. All changes in direction and duct transitions shall be shaped to permit the easiest possible air flow.

2. Pressure Classes
   a. Pressure classes for determination of sheet metal gauge and reinforcing shall be as defined by the latest issue of the SMACNA standards for duct construction.
   b. For ductwork with a static pressure higher than 2-in water gauge, pressure class shall be as shown on the Drawings. For ductwork with a static pressure 2-in water gauge or less pressure class shall be equal to the maximum pressure indicated for the fans or air handling units on the Schedules and the pressure class shall be the same for the entire length, including branches, of the specific duct system.

3. Rectangular Ductwork
   a. Ductwork shall be constructed as shown on the Drawings in accordance with the specified SMACNA Construction Standard, latest edition.

b. Cross-breaking shall conform to SMACNA Standard. Cross-breaking shall be applied to the sheet metal between the standing seams or reinforcing angles. The center of the cross-break shall be of the required height to assure rigidity for each panel.
c. All square elbows for rectangular ductwork shall be provided with turning vanes unless otherwise noted on the Drawings. Turning vanes shall be as detailed in the SMACNA Manual and or as shown on the Drawings.
d. Alternate Construction (Rectangular Only) - Factory-fabricated joint systems may be offered as an alternate form of construction. The system offered shall meet all requirements of SMACNA. Alternate joint systems shall be "Ductmate System" as manufactured by Ductmate Industries, Inc., installed in accordance with the manufacturer's recommendations. The system shall be sealed for zero leakage and angle attachment to the main duct section shall be by tack welding. The use of screws is not allowed.

4. Volume Dampers
   a. Dampers shall be standard opposed or parallel multi-blade type on 2-in channel frame, flanged connection with external damper position indicator, manual adjustment, and position locking arrangement. Damper blades shall not exceed 6-in in width. Dampers shall be constructed of the same material as the ductwork, or of a material of equal corrosion resistance. Balancing and balancing/shutoff dampers shall be opposed blades and shutoff dampers shall be parallel blade.
   b. Locking quadrants shall have a positive method of holding the damper in its selected position such as a bolt through both the quadrant and the lever arm. Systems using springs or other devices that can vibrate loose are not acceptable.
   c. Where manual dampers are used for shut-off service, dampers shall have a replaceable butyl rubber or bulb vinyl seals provided with the damper. Install seals along the top, bottom and sides of the frame and along each blade edge.

5. Access Doors
   a. Access doors shall be 24-in by 24-in minimum, except where the duct size is less than 26-in, where the largest door that will fit the duct will be used. Unhinged access panels are not acceptable, except where shown on the Drawings. Access doors shall be of the same material as the duct, pan type construction for metal ductwork, with smooth edges and fitted seals, constructed and installed for air-tight fit with ease of opening and closing. Doors shall be substantially butt hinged, with heavy sash locks and substantial door pulls. Door openings and door frames shall be reinforced with bar stock or angle. Where ductwork is installed with duct liner or exterior duct insulation, the access door shall be of the insulated type. Access doors may be factory fabricated. Where ductwork is constructed of aluminum or stainless steel, access door hardware shall be of similar material.

6. Fasteners
   a. Sheet metal screws, drive cleats, cinch bands and other fasteners shall be fabricated from materials with an equal of greater corrosion resistance than the ductwork in which they are installed. Where a material other than the duct material is used, it shall be approved by the Engineer before installation.

2.13 DIFFUSERS, REGISTERS AND GRILLES

A. General

1. All diffusers, registers and grilles shall be of the shape, sizes, capacity and type as shown on the Drawings. Refer to the Air Distribution Device Schedule on the Drawings

2. On all duct openings that do not have a specific diffuser, register, grill or mesh covers, provided a wire mesh cover.

3. Finish – Unless, otherwise specified, diffusers, registers and grilles shall have the following finish. All diffusers, registers and grilles located in ceilings shall have a baked white enamel finish except where the ceiling system has an exposed aluminum support grid. Where the ceiling has an exposed aluminum support grid, the diffusers, registers and grilles shall have a baked aluminum enamel finish. All diffusers, registers and grilles not located in ceilings shall have baked aluminum enamel finish.

B. Wire Mesh Covers

1. Where wire mesh covers are called for on the Drawings, the wire mesh and support frame shall be Type 316 stainless steel. Unless otherwise noted, the wire mesh shall be 0.5-in mesh.

2. The wire mesh shall be contained in a metal frame. The mesh shall be firmly attached to the frame to prevent it being pulled out of the frame by casual contact. The frame shall be a minimum of 16-gauge sheet metal or the minimum gauge for a flange based on SMACNA, whichever is greater. The frame shall be on both sides of the mesh creating a sandwich with the mesh in the middle. Fastenings shall go through the frame on both sides of the cover.

2.14 ATC EQUIPMENT

A. Area Classification

1. Where specific area classifications are called for or shown on the electrical drawings, all equipment and wiring shall be in conformance with the requirements for that classification as specified in Division 16. Special attention shall be given to hazardous areas specifically "Class I Div. 1 Group D" and "Class I Div. 2 Group D" to comply with code requirements for equipment selection and installation procedures.

B. Room Thermostats

1. Electric room thermostat shall be of the heavy duty all metal type, provided with concealed adjustment and exposed thermometer.

2. Temperature sensors shall be of the wire-wound resistive element type (RTD) using either nickel or platinum alloy as the resistive element. All temperature sensors shall have an end to end (element to readout display) accuracy of plus or minus 0.5 degrees F.

3. Room thermostat and temperature sensors mounted on exterior walls shall be provided with insulated mounting plates.

4. All room thermostats and sensors shall be mounted 5-ft-6-in above finish floor except where otherwise indicated on the Drawings or specified herein.

5. Electric thermostats in corrosive areas shall be installed in electric boxes with remote stainless steel bulbs.

C. Photo Electric Type Smoke Detectors (Four Wire Type)

1. Furnish and install photo electric type smoke duct detectors in the supply air duct and return air duct or plenum of each air handling.

2. The detector housing shall be listed per UL 268A specifically for use in air handling systems. The detector shall operate at air velocities of 500 to 4000 feet per minute. The detector housing shall be equipped with an integral mounting base capable of accommodating either photo electronic or ionization detector heads. It shall be capable of local testing via remote testing station. The duct detector housing shall incorporate an airtight smoke chamber in compliance with UL 268A, Standard for Smoke Detectors for Duct Applications. The housing shall be capable of mounting to either rectangular or round ducts without brackets. An integral filter system shall be included to reduce dust and residue effects on detector and housing, thereby reducing maintenance and service.

3. Detectors shall be provided with two sets of contacts to provide smoke alarm signals. One is to be used by the ATC systems, and the second is for use in Division 16 for interface to fire alarm system.

4. Remote test switch and alarm indicator stations shall be furnished for all duct smoke detectors as specified above. The installation and wiring of the remote stations will be provided under this Section. The remote test stations shall be wall mounted within the visible location of the smoke detector and easily accessible from the floor. Alarm indicator stations shall activate a visible and audible signal upon smoke detector activation. Alarm indicator stations shall also activate a visible or audible signal identified as AIR DUCT DETECTOR TROUBLE upon smoke detector trouble conditions. Alarm indicator stations shall be mounted in a location approved by the Authority having jurisdiction.

5. Provide all necessary relays, transformers and other devices as required.

6. Where multiple units serve the same space, the smoke detectors shall be wired such that any smoke detector will shut down all units serving the space.

D. Miscellaneous Devices - Provide all the necessary relays, limit switches, positioners, clocks, transformers, etc., to make a complete and operable system. Locate these devices on local ATC panel unless specified otherwise.

E. Name Tags - All sensing devices, transmitters, controllers, not mounted in a clearly labeled panel, or which are not an obvious part of a clearly labeled device, shall be provided with an engraved plastic plate containing the name, function and system or system number for the device.

F. Set points on thermostats and temperature controllers, shown on the Drawings are indicative only and devices shall be adjustable above and below such set points. If a set point is not stated, the control range of devices shall be suitable for the intended service. Range of devices shall be

approximately 50 percent greater in both directions than span of variable, with a minimum of 25 degrees and a maximum of 110 degrees F for air systems.

G. Field Wiring

1. All field wiring, other than power wiring, between control cabinets (A.T.C. control), control devices, unitary control panels and control terminals in motor control centers shall be furnished under this Section and shall conform to the requirements of Division 16.

2. Refer to the electrical drawings for NEMA enclosure types, other than NEMA 1, by room or location designation such as "Damp", "Wet", "Corrosive", "Class - Div. - Group -".

3. Installation of all conduit, wire, sleeves, outlet boxes, insulating bushings, system cabinets, terminal boxes, pull boxes, junction boxes, inserts, anchors, system devices, etc, shall be in accordance with the appropriate requirements of Division 16 and in accordance with the requirements of the current edition of the local codes for signal systems and electrical systems.

4. Run wiring in rigid steel conduit except in dry locations above ceilings and wood or metal stud framed partition walls, where EMT may be used. Conduit, boxes and fittings and their installation and testing shall be as specified in Section 16110.

5. Wire, with the exception of DDC cable and thermostat wire, shall be copper type THHN/THWN insulated for 600 Volts. Wire and its installation and testing shall be as specified in Section 16120.

6. In the event of any conflict among referenced codes, current editions of the applicable local codes shall take precedence for interpretation of "Signal System" installation requirements.

7. Installation of sensor wiring in finished areas shall be concealed whenever possible. Where concealed wiring is not possible, written approval for exposed work must be obtained from the Engineer prior to installation.

8. Coordination Issues

9. Contacts shall be rated 120 Volts, 10 Amperes, 60 Hz for inductive and resistive loads.
   a. Line voltage thermostats will be furnished under this Section and installed and wired under Division 16.
   b. Alarms from the HVAC systems that provide a signal to the central control system will be furnished and installed under this Section. The alarms shall be provided with two sets of contacts. One set will be wired by the electrical contractor for the instrumentation system. The second contact will be used to for future use.
   c. Wiring from smoke detectors provided under this Section to the building fire alarm systems will be provided under Division 16.
   d. Refer to electrical drawings for details of wiring at motor control panels. Provide all interconnecting wiring to start and stop motors.

2.15 SEQUENCE OF CONTROLS

A. General

1. HVAC equipment will operate with the following sequences of operation.

2. The following will apply to all sequences.
   a. All sequences are reversible unless otherwise noted.
   b. Manual reset of control functions with manual reset will be at the local control panel unless otherwise noted.
   c. Where required to prevent nuisance shut downs of systems, provide time delay of sensors to allow system start-up before the sensors are activated. This would include, but not be limited to, low temperature freeze protection on 100 percent outdoor air units and flow sensors on all systems.

B. ATC contractor shall coordinate with equipment supplier regarding control components. Control Sequences for Constant Volume Direct Expansion Units:

1. Electrical Room Air Conditioning Unit with Space Thermostat Control
   Units AHU/ACCU-1, AHU/ACCU-2
   a. When smoke is sensed by the smoke sensor, all other control functions shall be overridden and the supply fan shall be off, and an alarm light in the smoke sensor shall be activated. Smoke sensors shall be manually reset. When multiple air handling units serve the same space, any smoke detector shall shut all units down in that space.
   b. When the unit thermostat on/off switch is placed in the off position, the temperature controls shall be inactivated, the supply fan and condensing unit shall be off.
   c. When the unit thermostat is placed in the on position and the system fan on/auto switch is in the on position, the temperature controls shall be activated, and the fan shall run continuously.
      1) When the space temperature sensed by the space thermostat is above the cooling set point, the condensing unit shall be on in cooling mode.
      2) When the space temperature sensed by the space thermostat is below the cooling set point, the condensing unit shall be off.
   d. When the unit thermostat is placed in the on position and the system fan on/auto switch is in the auto position, the temperature controls shall be activated.
      1) When the space temperature sensed by the space thermostat is above the cooling set point, the condensing unit shall be on in cooling mode, and the supply fan shall be on.
      2) When the space temperature sensed by the space thermostat is below the cooling set point, the condensing unit shall be off, the supply fan shall be off.
   e. The space thermostat shall have an adjustable set point. The initial cooling set point for AHU-1 shall be 80°F. The initial cooling set point for AHU-2 shall be 85ºF. Contractor shall instruct the Owner to alternate set points in order to alternate unit operation equally on a six-week cycle.
   f. Dual compressor units shall have two stages of cooling.
   g. Provide a high temperature switch. Set point shall be 95°F. Switch shall send a high space temperature alarm signal to the instrumentation system. See Electrical and Instrumentation drawings for additional details. Coordinate interface with instrumentation system supplier.

PART 3 EXECUTION

3.01 INSTALLATION

A. The Construction Contractor shall start up each piece of equipment and system and shall make all adjustments so that the system is placed in proper operating condition.

B. The Construction Contractor shall not install any equipment or materials until the Owner and Engineer have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Construction Contractor's risk.

C. Equipment

1. Install equipment in accordance with manufacturer's recommendation. Provide piping and ductwork connections in accordance with the requirements as specified elsewhere in this Section.

2. When units are shipped disassembled, field connect all sections together as shown on the Drawings to form single air handling unit. Seal all joints with gaskets and/or sealants.

3. Do not operate equipment without filters. Do not run equipment with dirty filter pressure drop more than twice clean filter pressure drop. A total of three complete sets of filters shall be provided. The first set is to be installed for start-up, test and balancing. The second set shall be installed after final cleanup and acceptance by the Owner. The third set shall be turned over to the Owner as a spare.

4. The Construction Contractor shall start up each piece of equipment and system and shall make all adjustments so that the system is placed in proper operating condition.

D. Insulation - General

1. Do not apply insulation prior to testing and acceptance of piping, ductwork and/or equipment. Insulation shall not be applied to damp or frosty surfaces. Clean dust, dirt, grease and moisture from surfaces of pipe and ducts before applying insulation or insulation adhesives. Install all insulation in a neat and workmanlike manner. Nameplates and equipment certification and data tags affixed to any piece of apparatus must remain exposed to view. Where two layers of insulation are used, stagger all joints both ways. Secure each layer independently. Continue insulation through walls, partitions, floors and pipe sleeves.

2. The recommendations and instructions of the manufacturers of products used in the work are hereby made part of this Section except as they may be superseded by other requirements of this Section.

3. Adhesives, coatings and vapor barrier materials shall be applied as specified by the manufacturer. Do not apply these materials when ambient temperature is above or below the maximum and minimum ambient temperature respectively, specified as limits by the manufacturer. In general, these limits are 90 degrees F and 40 degrees F, however, the limitations are to be checked for each product.

4. All penetrations through a vapor barrier for hangers, instruments, etc, shall be sealed to provide a complete vapor barrier. The use of staples or other fasteners that penetrate the vapor barrier shall not be permitted.

5. Insulation systems that require a vapor barrier shall be installed with an intact vapor barrier that covers the entire pipe, duct, or piece of equipment to be insulated. All edges of insulation that do not abut another piece of insulation shall have the vapor barrier extended, and sealed to the item being insulated. All penetrations through the insulation such as for thermowells, test ports, dampers, nameplates, or other items shall have the vapor barrier extend over the edges of the insulation and sealed to the item being insulated. Where items are mounted on ductwork a standoff shall be provided to protect the vapor barrier. The vapor barrier shall be sealed to the standoff.

6. For insulated items exceeding 100 square feet, or 20 feet in length, extend the vapor barrier to the item being insulated to reduce the area or length within a single enclosed area to the dimensions listed above.

E. Piping Insulation Cold Piping Closed Cell Foam

1. Apply insulation in thicknesses indicated. Joints shall be sealed using self-sealing seams or adhesive.

2. Fittings shall be covered with the same insulation, mitered to fit.

3. Installation - Apply insulation in the thickness indicated. Attach insulation to sheet metal duct. Joints shall be made to have compression fit with the joints sealed with adhesive. Manufacturer's installation instructions shall be followed. Adhesives and coatings shall be provided by the insulation manufacturer and shall be compatible with the insulation. Insulation shall be provided with a protective finish for outdoor use in accordance with manufacturer's recommendations.

Service	Pipe Size	Insulation Thickness
Refrigerant/Condensate Piping	All sizes	1 – in.

F. Ductwork Insulation

1. For purposes of insulation, flexible ductwork shall be treated as sheet metal ductwork.

2. Provide all cold ductwork with a vapor barrier. Where the method of attachment causes penetrations of the vapor barrier, seal such penetrations with vaporseal adhesive and vapor barrier tape.

3. Clips, pins, washers, staples, and other metal components shall be of the same material as the duct to be insulated. Where items of the same material are not available, a material of equal corrosion resistance may be used. If a different material of equal corrosion resistance is to be used, it must be approved by the Engineer.

4. All outside corners of ductwork in the traffic level shall be protected by sheet metal angles. Angles shall be 22-gauge galvanized steel with 2-in legs. When the duct is constructed of materials other than galvanized steel, the protective angle shall be fabricated of the same

material as the duct, or of equal corrosion resistance. If a different material of equal corrosion resistance is to be used, it must be approved by the Engineer. Angles shall be attached to the outside of the vapor barrier with adhesive. The entire inside surface of the corner angle shall be coated with adhesive before being installed.

5. All joints in insulation shall be compressed 0.25-in. Corner insulation shall be lapped with the overlap extending over the full thickness of the insulation layers. Open spaces in joints are not acceptable. A minimum of two layers of insulation shall be used when the required insulation thickness is greater than 2-in. Joints in adjacent layers shall be staggered a minimum of 3-in.

6. All ductwork shall be insulated.

G. Ductwork Insulation - Fiberglass Board Type

1. Exposed Rectangular Single Wall Ductwork and Plenums.
   a. Installation - Apply insulation in the thickness listed below. Fasten insulation to sheet metal duct with weld pins or approved adhered pins and clip washers. Place pins on 12-in centers located near edge of insulation and with a minimum of two rows per side. Impale insulation on pins. Attach clip washers so that they rest on the surface of the insulation without indent. Cut off pins flush with surface of washers. Seal penetrations with aluminum vapor barrier coating. Groove insulation to cover standing seams or stiffeners. Extend vapor barrier facing continuously over standing seams or stiffeners to provide continuous seal. Seal joints and edges with 4-in wide strip of factory furnished vapor barrier facing adhered with vapor barrier adhesive or approved vapor barrier duct sealing tape to provide a continuous vapor barrier.
   b. Insulation Thickness - Exposed Rectangular Single Wall Ductwork and Plenums.
      1) All ducts 2-in

H. Installation of Ductwork

1. Fabricate and erect all ductwork where shown on the Drawings, as specified herein and in accordance with SMACNA requirements. Rigidly support and secure ductwork in an approved manner. Install hangers plumb and securely suspended from supplementary steel or inserts in concrete slabs. Sufficiently thread lower ends of hanger rods to allow for adequate vertical adjustment. Do not use building siding and metal decking to hang ductwork.

2. Wherever ducts are divided, maintain the cross-sectional area. All such changes must be approved and installed as directed by the Engineer or as approved on shop or erection drawings.

3. During installation, close the open ends of ducts to prevent debris and dirt from entering. Install work in accordance with the overall approved progress schedule and in cooperation with all other trades so there will be no delay to other trades.

4. Provide the unused portion of external louvers (where it is not used as a fresh air intake or exhaust) with a blank-off constructed of 0.0625-in aluminum. Provide blank-off panels with aluminum reinforcing angles to prevent buckling and secured to the exterior wall with aluminum angles and rustproof fasteners on not more than 12-in centers. Provide caulking completely around the outside edge of the angle and the aluminum.

5. Install automatic dampers when supplied by other trades.

6. Cross-break sheet metal in accordance with SMACNA duct construction standard. Apply cross-breaking to the sheet metal between the standing seams or reinforcing angles. The center of the cross-break shall be of the required height to assure each panel section being rigid.

7. Cross-break steamlined ducts on top only and adequately brace internally.

8. Beading as specified in SMACNA will be acceptable in lieu of cross-breaking.

9. The Drawings of the air ducts and air risers show the general location for installation of the ducts and risers. Should additional offsets or changes in direction be made, these changes must be considered in the original bid and shall be installed at no additional cost to the Owner.

10. All necessary allowances and provisions shall be made in the installation of the ducts for the structural conditions of the building. Ducts shall be transformed or divided as may be required. Wherever this is necessary, maintain the cross-sectional area. All of these changes, however, must be approved and ducts installed as directed by the Engineer or as approved on shop or erection drawings.

11. The taper of all transformations shall be not more than 15 degrees.

12. Secure casing to curbs according to SMACNA Duct Construction Standards.

13. Provide baffle plates as required to prevent stratification and to provide proper operation of controls.

14. Where ducts are constructed of materials other than galvanized steel the reinforcing members shall be of the same material as the ductwork.

15. The use of button punching or snap locks on ductwork constructed of aluminum shall not be permitted.

I. Hangers

1. The use of wire to hang flexible ductwork shall not be permitted.

2. Ductwork shall not come in contact with any of the ceiling construction or any other equipment in the ceiling cavity.

J. Sealing of Ductwork

1. General – Unless, otherwise indicated, seal all ductwork joints and seams using sealant in accordance with the instructions of the sealant manufacturer and this Section. All transverse seams, joints and fitting connections, both shop and field assembled, shall be sealed in accordance with this Section. Not more than one longitudinal seam shall be unsealed in each section of duct.

2. Application of Sealant - Thoroughly clean all seams, joints, etc, of dirt, oil, grease, or other coatings which might interfere with the adhesion of the duct sealant before the sealant is applied.

3. Uncured sealant may be forced into the slotted side of the seam or joint before shop or field assembly, and the joint or seam completed while the sealant is still uncured. Excess sealant shall be removed from both the inside and outside of the duct before it sets.

4. Duct Tape - Use of duct tape alone for sealing ductwork is prohibited. Duct tape may be used primarily for the purpose of retaining the uncured duct sealant in seams and joints until it has cured. Duct tape shall not be applied to the inside of any duct nor shall it be applied to standing type joints at any time. All duct tape used shall be compatible with the sealant.

5. Sealant shall be either in liquid form or a mastic with a maximum flame spread of 25 and a maximum smoke developed rating of 50 when tested in accordance with ASTM E84, NFPA 255 and UL 723.

6. Sealing systems shall be suitable for the environment. The following schedule is to be used to select the sealant.
   a. Indoor, dry galvanized round and rectangular duct is to be sealed with Iron Grip 601 or equal.
   b. Indoor, dry, stainless steel, aluminum and PVC coated is to be sealed with FTA 20 adhesive and DT-Tape gypsum or equal.
   c. All other areas unless otherwise noted are to be sealed with FTA 50 adhesive and DT-Tape gypsum or equal.
   d. All sealers listed or manufactured by Hardcast Inc. and are to define the type of sealer. Other equal sealants are acceptable.

K. Ductwork Fittings and Accessory Items

1. Duct Elbows - Rectangular ductwork where full radius elbows cannot be installed, provide abrupt elbows equipped with shop-installed hollow, air foil turning vanes.

2. Flexible Connectors
   a. Install flexible connectors at all duct connections to fans, fan units or blowers, air handling units and air conditioning units. Make connections substantially air tight at all seams and joints.
   b. Where the construction of the flexible connection or vibration isolator results in a cross sectional area of the connection which is less than 90 percent of the adjacent ductwork, the size of the connection shall be increased to provide a cross sectional area equal to or greater than 90 percent of the adjacent duct.
   c. Provide flexible duct connections at both the intake and discharge connections for all fans and air handling units except as noted below:
      1) Wall and roof fans that have integral motor/fan wheel isolation.
      2) Air handling units where the fan is isolated from the intake and discharge connections by internal flexible connections or separations, and the unit is mounted without vibration isolators between the unit and the support structure.

3. Dampers
   a. Install manual volume control dampers wherever it may be necessary to regulate air volume for system air balancing and where shown on the Drawings.
   b. Install splitter dampers, where shown on the Drawings, to regulate air volume for system air balancing. Splitter dampers shall be single blade, end pivoted type, manual adjustment and position locking arrangement.
   c. Factory-fabricated volume extractors shall be used at all supply air diffusers.
   d. An access door, of ample size to permit maintenance and resetting of damper blades, shall be installed at each opposed blade damper, splitter damper and volume extractor so located for easy access to the damper blades.

4. Access Doors
   a. Provide access doors at the following locations (minimum requirements):
      1) Automatic dampers - linkage side.
      2) Duct mounted temperature controllers.
      3) Freeze-stats.
      4) Fire dampers.
      5) Smoke detectors.
      6) Filter banks.
   b. Where access doors are required in ductwork located above ceilings, coordinate the location of the access doors to clear the ceiling support system and to be accessible through the ceiling grid.

L. Grilles, Registers and Diffusers

1. The location of diffusers, registers and grilles shall be as shown on the Reflected Ceiling Plans. Where diffusers, registers and grilles are not located in the ceiling, there are no Reflected Ceiling Plans provided, the location shall be as shown on the ductwork drawings. The exact location of these devices shall be determined in the field in cooperation with the other trades.

2. Install all devices in an approved manner in accordance with the manufacturer's recommendation.

3. When exposed ducts pass through finished floors, walls or ceilings, provide angle collars completely covering space around duct.

M. Quality of Ductwork Installation

1. All ductwork shall be free from pulsation, chatter, vibration or objectionable noise. After system is in operation, should these defects appear, correct by removing, replacing or reinforcing the work. Sound levels shall not exceed the minimum requirement as specified in ASHRAE 1980 Systems Volume, page 35.16, Table 23. No discreet tones will be allowed.

2. The maximum allowable leakage of low pressure system shall be 5 percent of air volume.

N. Plenums

1. Seal fresh air inlet and exhaust air plenums at louvers or otherwise subject to weather entrainment watertight at all bottom joints and seams and up all vertical seams for a minimum of 12-in. After application, remove excess sealant before it sets hard. Where

possible, pitch fresh air inlet and exhaust air plenums down towards the louver. Where it is not possible to pitch the plenum, provide a 1-in capped drain connection at the low point of the plenum.

O. Test Ports

1. Where shown on the Drawings and where required for testing and balancing, provide instrument insertion ports. Size and location of ports shall be coordinated with the Construction Contractor performing air balancing. Seal ports with plastic snap lock plugs. When the ductwork will be insulated, extend the port to the face of the insulation and seal the vapor barrier to the port. When the ductwork is lined, extend the port into the duct to the inner surface of the duct liner.

2. In round ductwork provide 2 ports 90 degrees on centers. In rectangular ductwork provide ports are required by AABC or NEBB for a full traverse measurement.

3. As a minimum, ports shall be provided in the following connections:
   a. All duct mains.
   b. All duct branches unless all connections are diffusers, registers, or grilles and the total can be calculated by summing the readings for all of the connections.
   c. All connections to tanks or hoods where there is no other access for taking a measurement.

4. A main duct is defined as one of the following:
   a. A duct serving five or more outlets.
   b. A duct serving two or more branch ducts.
   c. A duct emanating from a fan or plenum.
   d. All remaining ducts are considered branch ducts.

P. Piping

1. Pipe and Fittings
   a. Install piping in a neat manner with lines straight and parallel or at right angles to walls or column lines and with risers plumb. Run piping so as to avoid passing through ductwork or directly under electric light outlets and/or interference with other lines or extending beyond furring lines as determined by Architectural Drawings. Accomplish all work using the best methods and procedures of recognized pipe fabrication in a good and workmanlike manner in accordance with the latest revision of applicable ANSI Standards, ASME Codes and PFI Standards.
   b. Cut pipe square, not upset, undersize or out of round. Carefully ream ends and clean before installing.
   c. Bending of pipe shall not be permitted. Use fittings for all changes in direction.
   d. Do not remove end caps on pre-cleaned pipe until immediately before assembly. Cap all open ends immediately after completion of installation.
   e. Thoroughly clean all piping interiors after installation and keep them clean by approved temporary closures on all openings until the system is put in service. Closures shall be suitable to withstand the hydrostatic test.

2. Soldering (Copper Tubing)
   a. After cutting, thoroughly clean all surfaces to be soldered to a metal-bright finish, free from dirt, grease or other material before fluxing and soldering. Perform this cleaning

by using emery cloth, sandpaper or steel wool. Clean the outside end of the tubing for a length of 1/2-in greater than the depth of the fitting. Clean the inside of the fittings in a similar manner. Apply non-corrosive flux and assemble the joint. Acid solder or acid flux will not be accepted.

b. Heat the surfaces to be joined slowly and uniformly to the melting point of the solder. Maintain the surface being soldered above the melting point of the solder for sufficient time to draw the solder completely into the joint. When the solder congeals to a plastic state, remove the excess metal with a cloth brush, leaving a fillet around the end of the fitting. Full penetration of the solder uniformly throughout the entire socket is required. Allow the soldered joints to cool in still air until only warm to the hand, after which the work may be quenched.

c. Any type of crack, pinhole, area of incomplete penetration, or similar defect will not be accepted. Peening for closing up defects shall not be permitted.

d. Use heating torches of sufficient size for heating of large fittings prior to soldering. Multiple tips or ring burners for use on combination torches may be used.

e. Remove all external and internal loose solder and flux after joint cools.

3. Refrigerant Piping

a. Before and during silver soldering refrigerant piping, purge the assembly of pipe and fittings with dry nitrogen, to avoid formation of oxidation scale on inside of pipe during soldering.

b. Where specially prepared, Type R, cleaned or charged refrigerant piping is not available for equipment interconnection, with the Engineer's or Owner's Representative's approval, the following procedure must be completed. Clean the interior of field assembled refrigerant piping after joining in four steps as follows:

1) Draw a clean lintless cloth through the piping to remove coarse dirt and dust.

2) Draw clean lintless trichlorethylene saturated cloth through the piping until cloth is not discolored with dirt.

3) Draw a clean cloth saturated with compressor oil through the piping.

4) Complete cleaning by drawing a clean, dry, lintless cloth through the piping.

c. Pressure test and charge immediately after cleaning.

3.02 FIELD TESTING

A. Testing and Balancing

1. General - Test, adjust and balance all HVAC systems. If required by the Engineer, tests shall be made during the progress of the work to demonstrate the strength, durability and fitness of the installation. Furnish all instruments, ladders, lubricants, test equipment and personnel required for the tests; including manufacturer's representatives for testing and start-up of all Construction Contractor supplied equipment. Before testing and balancing, all systems shall be cleaned as specified. Submit four copies of records of all tests, measurements, settings of throttling devices and nameplate data to the Engineer.

2. Final Tests - Perform tests of all systems as required by the Engineer prior to final acceptance of the systems for the purpose of demonstrating satisfactory functional and operating efficiency as well as adjustment. During this period, check the setting of all automatic controls and take sufficient measurements to ensure that conditions are correct and that capacities are adequate to meet the specified requirements. Systems will not be considered complete until all tests have been concluded to the satisfaction of the Engineer and all other parties having jurisdiction. In event of leakage or defects, repeat tests until all

faults are corrected. Perform the general operating tests under as near design conditions as possible.

3. Perform all testing, adjusting and balancing under the supervision of a qualified heating, ventilating and air conditioning engineer employed by the air balance and testing agency. Testing agency, engineer, and technicians shall be AABC or NEBB certified. Reporting forms for testing and balancing shall be as recommended by the AABC or NEBB.

4. Coordination of the test shall be the responsibility of the balancing sub-contractor. Access to the site, availability of service representatives, and tenant acquiescence will be considered in the determination of both the testing schedule and the witnessed recheck of the balancing.

5. Refer to Section 15990 for additional requirements.

B. Piping Pressure Testing

1. Pipe Testing Procedure
   a. The equipment to which any piping system is attached shall not be subject to any line tests. Either remove or blank off items which may be damaged by the test pressure. The test pressures apply to the piping materials as specified, but shall not be assumed to apply to piping specialties, accessories, or equipment including safety heads, rupture discs, relief valves, expansion joints, instruments or filters.
   b. Prior to pressure testing, take the following precautions:
      1) Do not apply insulation over piping prior to completion of testing.
      2) Lines containing check valves shall have the source of test pressure located on the upstream side. Set the control valves in the open position for the duration of the test.
      3) Block up all piping supported by springs temporarily to a degree sufficient to sustain the test liquid load.
   c. Test the piping system at the pressure indicated in the individual pipe material specification section or 1-1/2 times normal working pressure, whichever is greater for the respective systems. Leakage or loss of head will not be acceptable.

2. Condensate Drains Testing

Test Press.	Medium	Duration	Allowable Loss
10 Feet Column	Water	2 hrs	None
10 Inch Mercury	Air	15 min.	None

3. Refrigerant Piping Testing

Test Press.	Medium	Method
To suit Refrigerant used	Inert gas and refrigerant	Electronic leak detector

4. Following the completion of acceptable leak testing, evacuate and charge the completed refrigeration system in accordance with the manufacturer's recommendations.

3.03 START-UP AND TEMPORARY OPERATION

A. Properly maintain and service all equipment and systems until the particular equipment or the system has been accepted by the Owner.

3.04 BALANCING OF ROTATING EQUIPMENT

A. All machines shall be balanced both statically and dynamically by the manufacturer within the limits of best commercial practices. The term machine, as used above, is to be considered as any piece of equipment, which contains rotating components. All machines furnished shall have operating speed not exceeding 80 percent of the first critical speed.

3.05 PAINTING

A. The Construction Contractor shall be responsible for the repair of all defects, blemishes, holidays and the like apparent in manufacturer's coatings and shall ensure that materials used for such repair shall match or be compatible with the manufacturer's standard color, coatings and practices. Do not paint over nameplates.

3.06 ACCEPTANCE OF AUTOMATIC CONTROL SYSTEM

A. During the acceptance inspections, the manufacturer shall provide the required personnel to operate the system and show complete functionality. The manufacturer will also provide the required communication devices to allow simultaneous observations at multiple points. In general, each system will be run through its complete operating sequence.

B. Systems that are found to be operating incorrectly will be bypassed and not corrected during the inspection. If multiple systems are found to not be operating, the inspection will be canceled and rescheduled at the manufacturer's expense.

3.07 CLEANING

A. Leave all piping, ductwork and equipment in a thoroughly cleaned condition. Thoroughly flush all piping to remove all foreign materials prior to any cleaning procedure. All flushing and cleaning shall be to the satisfaction of the Engineer. Furnish, install and remove all temporary piping and equipment used in the cleaning and flushing operations.

B. Maintain all ductwork, fans, coils, air filters, outlets and other parts of the ductwork systems in a clean condition during installation.

C. Clean complete ductwork systems prior to testing and air balancing. Secure cheese cloth over all openings of the ductwork system for entrapment of dirt during the cleaning operation.

END OF SECTION

SECTION 15600
FUEL SYSTEM

PART 1 GENERAL

1.01 SCOPE

A. The work of this section includes all labor, materials and equipment required for the installation and testing of the fuel and fuel piping systems complete and ready for operation.

1. The system will include a 1000 gallon above ground fuel storage tanks as indicated on the drawings, a complete fuel piping system for the tanks, generator, and emergency diesel pump, fuel storage tank monitoring systems, concrete pads, and all accessories as indicated for each tank and fuel piping system. The systems will convey diesel fuel between the generator and emergency diesel pump and the fuel storage tanks.

1.02 RELATED WORK

A. Related work specified in other sections:

1. JEA Water and Sewer Standards Manual Section 472 Emergency Generator (less than 750 KW).

2. JEA Facilities Standards.

3. Section 16216 - Diesel Engine Driven Generator (Self-Contained With Weatherproof Sound Attenuated Enclosure)

4. Concrete work is included in Division 3.

5. Field painting is included in Division 9.

6. Electrical and Instrumentation work, except as otherwise specified herein, is included in Division 16.

1.03 REQUIREMENTS OF REGULATORY AGENCIES

A. All work shall conform to the applicable requirements of the city, county, state and federal codes. Where the requirements of such agencies are more stringent than specified herein, abide by such requirements and consider this specification as supplementary to those requirements.

B. The tank systems including coating and sealants must be accepted by the US Environmental Protection Agency. All work shall conform to the applicable requirements of the following: Federal Register and the Federal Resource Conservation Recovery Act law (RCRA).

C. All work shall conform to the applicable requirements of the following: National Fire Protection Association (NFPA) 30 - Flammable and Combustible Liquids Code, NFPA 321 - Basic Classification of Flammable and Combustible Liquids, and NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.

D. All work shall conform to the applicable requirements of the following: Department of Environmental Protection, the Florida Building Code, and Local Ordinances.

E. The tank shall meet the current requirements of Underwriters Laboratories (UL) Standard 142 and UL 2085 and all requirements of the Florida Administrative Code 62-762. All components of the fuel distribution system shall be UL listed, unless otherwise specified, or approved by the Engineer.

F. The tank and fuel systems shall be designed and fabricated according to best practices and methods available to date.

G. Electrical Components, Devices, and Accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.04 QUALIFICATIONS

A. Installer shall have had supervisory experience with five similar fuel systems in the past three years and shall hold a valid pollution control contracting license if required by the State of Florida, Department of Environmental Protection or the local jurisdiction. A copy of the license shall be submitted to the Engineer and to the local authorities, prior to proceeding with construction. Written confirmation from the applicable authorities shall be provided to verify that a pollution control contracting license is not required.

B. Tank installers shall be certified in writing by the tank manufacturer as being qualified to install the equipment. A copy of the certificate shall be submitted, prior to proceeding with construction.

1.05 SUBMITTALS

A. Complete shop drawings shall be submitted, including certification of shop test to the Engineer for review, in accordance with Section 01300.

1. The shop drawings shall include sufficient information to demonstrate compliance with the specified tank design standards, including copies of applicable sections of the specified design standards, manufacturer's catalog data and descriptive literature for the tank, fully dimensioned shop layout drawing (1/4" = 1' scale or larger) showing all piping, manholes, valves, equipment connections, tank outline dimensions, platform and stair dimensions, nozzle locations and foundation requirements, recommended tank installation and test procedures.

2. The shop drawings for pipe, fittings, and each item listed in the Specifications shall include manufacturer's catalog data and descriptive literature, fully dimensioned shop layout drawing (1/4" = 1' scale or larger) showing all piping, manholes, valves, equipment connections, nozzle locations and installation clearance requirements.

3. Submit all manufacturer's recommended installation and test procedures for all equipment including tanks, piping, etc.

4. Submit manufacturer's Test Reports (vessel fabrication, coating integrity and tank leakage, etc) for each tank and specific service application.

5. Submit manufacturer's warranty for each tank, all fuel components, containment piping and specific service application.

6. Operation and Maintenance Manuals shall be submitted in accordance with Section 01730.

1.06 ENGINEERING SERVICES

A. When engineering services are specified to be provided by the Contractor, the Contractor shall retain a licensed professional engineer to perform the work. The engineer shall be licensed at the time the work is done and in the state in which the project is located. If the state issues discipline specific licenses, the engineer shall be licensed in the applicable discipline. In addition, the engineer shall be experienced in the type of work being provided.

B. All work is to be done according to the applicable regulations for professional engineers, to include signing, sealing and dating documents. When submittals are required by a professional engineer, in addition to state required signing and sealing, a copy of the current wallet card or wall certificate indicating the date of expiration shall be included with the submittal.

1.07 PRODUCT HANDLING

A. Deliver materials and equipment to project site in manufacturer's original, unopened containers with labels intact and legible. Labels shall indicate manufacturer's name and model number. Store equipment in dry protected area. All damaged items shall be replaced with new at no additional cost to Owner.

B. Piping shall be supplied to the site with sealed end caps which shall remain in place until installation. Tanks shall be delivered to the site with all openings sealed which shall remain in place until installation. The tanks shall be properly supported during transportation to the site and during installation in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.01 ABOVEGROUND FUEL OIL STORAGE TANK AND ACCESSORIES

A. Rectangular Steel Storage Tanks

1. Steel primary and steel secondary tanks shall be listed by UL as an aboveground tank for flammable and combustible liquids and manufactured in accordance with UL 142 and UL Standard 2085 with a two-hour fire rating.

2. The steel primary tanks shall be fabricated from minimum 3/16-inch thick steel plate.

3. Each tank shall be insulated for fire resistance and protected against ballistic and impact penetration.

4. Emergency Vent: as required by NFPA 30 with no size reduction allowed for insulation.

5. Normal Vent: independent of the emergency vent as required by NFPA 30.

6. Steel Tank Openings: threaded and located in the top of tank.

7. Each Steel Tank shall be provided with two (2) lugs for connecting ground conductors for lightning protection in accordance with NFPA 780.

8. Each Steel tank shall be pressure tested at the tank factory at 4 psi per UL 142.

9. Secondary steel tank shall be painted with a primer coat and finish coat of an industrial epoxy coating. The coating shall be impervious to diesel fuel, weather resistant, and UV protected.

10. Secondary containment shall be capable of unobstructed liquid and vapor monitoring. Containment space shall be vacuum or pressure tested pursuant to industry standard.

11. The interstitial space between inner and outer tanks shall be filled with light weight thermal insulation or reinforced concrete.

12. Leak detection shall be facilitated by a polyethylene membrane around the primary tank or porous fill material.

13. Integral steel supports shall be provided for each tank.

14. Each tank shall have appropriate warning signs as required by the local and state jurisdictions.

15. Each steel tank shall have an integral seven-gallon UL listed spill containment system, as a part of the tank, with internal reservoir and normally closed UL listed drain port. Spill containment system shall be provided with water tight gaskets at all openings. This includes containment housing cover, fill port cover, drain valve, and stick port cover.

16. Each tank shall be placed on reinforced concrete pad made to manufacturer's specifications.

17. Hurricane Restraints and Flood Restraints shall be designed and installed per the requirements of the Florida Building Code with Amendments. Design services shall be provided by a licensed Engineer as described in Paragraph 1.06. Signed and sealed calculations shall be submitted for record purposes.

18. The tank design shall have been in manufacturing production and commercial use for a minimum of five (5) years.

19. The tanks shall be Envirovault as manufactured by Phoenix Products, Convault or Fidelity Manufacturing.

20. Tank size shall be 1000 gallons.

21. The fuel tanks shall be left 90 percent full of diesel fuel at the conclusion of the contract as part of the Contractor Scope of Services. Refer to Paragraph 3.05.D.

B. Tank Accessories

1. A mechanical level gauge system shall be provided to indicate the liquid level within the tank. The level gauge shall have a direct reading indicator mounted on top of the tank. The tank shall include all openings required for the level gauge system. Gauge shall be Krueger At-A-Glance Type D Direct Reading Gauge.

2. A mechanical leak gauge system shall be provided to indicate leaks in the annular/interstitial space of the double wall above ground fuel tank. The leak gauge shall have a direct reading indicator mounted on top of the tank. The tank shall include all openings required for the leak gauge system. Gauge shall be Krueger Type D Leak Detection Gauge.

3. Provide stairs with 24” x 24” platform at the top, to provide access to the top of the tank. Stairs shall have handrails on both sides and at all platform sides. Stairs shall be aluminum construction and painted with one coat of epoxy corrosion resistant paint, color to be selected by the Owner. Refer to the Drawings for required location of stairs for each tank.

4. The tank fabricator shall provide ports and accessories with the tank as shown on the drawings and listed below.

5. All ports shall be steel pipe with male threaded fittings.

6. All ports except for those with capped accessories shall be provided with threaded caps.

7. The following equipment shall be furnished along with the necessary piping and fittings required to provide a complete diesel fuel piping system.
   a. Vent piping shall be 3-inches.
   b. Vent cap shall be 3-inches and shall be constructed of aluminum with removable brass screen, EBW Model 800-203-01.
   c. A single poppet foot valve, EBW model 75-105-01 shall be installed inside the aboveground tank at the fuel intake line at a location 6” above the bottom of the tank.

C. Fuel Level/Leak Monitoring Equipment

1. General
   a. Each tank will be furnished with a complete electrical monitoring system and associated equipment including but not limited to tank alarm, tank level detection and real time monitoring, tank leak detection, and associated modules for the entire fuel level/leak detection system shown on the drawings and specified herein. The system shall be the Greenleaf Solar Gauge EFG-8000-I with EFC-420.1 4-20mA data converter. The system shall include provisions for remote monitoring of the alarm conditions, tank level detection, and tank leak detection including all required terminals, switches, and transmitters.
   b. The control unit shall be housed in a NEMA 4 equivalent plastic steel enclosure. All probes and sensors shall be rated for outdoor service.
   c. The control unit shall be solar powered with battery back-up.
   d. A minimum of four (4) programmable relay outputs shall be provided. At least one output shall be designated as a common system alarm/fault. The tank level shall be provided with a 4-20 mA outputs for level monitoring each tank at a remote monitoring PLC. Tank manufacturer shall coordinate with the Instrumentation System Supplier to provide all required signals for the Instrumentation System. Refer to instrumentation drawings for additional signal requirements.
   e. The supplier shall be responsible for coordinating and providing all necessary components for a fully functional fuel level and leak detection monitoring system. Any additional components required for a complete system shall be included whether specifically noted or not.
   f. Provide complete piping and electrical schematic diagrams for the entire system in the shop drawing submittals.

2. Tank Level/Leak Detection
   a. All necessary tank level and leak detection probes shall be provided. The system shall include provisions for remote monitoring of the level detection system including all required terminals, switches, transmitters, and local wiring.

3. Double Wall Interstitial Leak Sensing
   a. Double wall interstitial leak sensing shall be capable of detecting the presence of any liquid in the annulus of the aboveground storage tanks.

4. Tank Alarm Horn and Light
   a. A local audible electronic horn and flashing amber light alarm system shall be furnished to indicate a trouble condition. Horn and light shall be NEMA 4 suitable for outdoor installations.

2.02 PIPE AND FITTINGS AND FUEL SYSTEM ACCESSORIES

A. Fuel, vent, and level gauge piping shall be Schedule 40, Type 316 stainless steel welded in conformance with ASTM A-312 and ASTM A-774 stainless steel socket and buttweld fittings.

B. Flexible piping at tank and equipment connections shall be constructed of a seamless flexible plastic liner with corrosion resistant type 316 stainless steel wire braid reinforced cover, stainless steel collars, and stainless steel fittings meeting SAE 100R17 requirements.

C. Provide all piping, valves, unions, filters, strainers, and other accessories as shown on the Drawings and/or as required for a complete system.

   1. Fire safe ball valves shall be three-piece design with stainless steel body and end caps, stainless steel ball and stem, reinforced Teflon seats and seals, and socket welded ends. Valves shall be of fire safe design and shall utilize secondary metal seating surfaces to ensure shut-off if the primary seats are destroyed by fire. Fire safe ball valves shall be Contromatics or Jamesbury.

   2. An anti-siphon valve, EBW model 605-300-01 shall be installed at the aboveground tank in the fuel intake line, at a location approximately 6” above the top of the tank, or as required by the valve manufacturer. Valve shall be suitable for the final elevations of the aboveground tank and generator as installed.

   3. Unions shall be Type 316 stainless steel with fully ground faces. Where threaded unions are required, all threaded connections shall utilize Hercules Chemical Company Inc. multipurpose heavy Teflon “Tape Dope” and “Megaloc and/or Real-tuff.”

   4. Manual strainers shall be "Y" type, capable of removing solids 0.01-inch diameter and larger. The strainer body shall be Type 316 stainless steel construction, and shall conform to the latest revision of ASTM A278 (1993), Class 30. Strainer elements, including woven wire mesh, shall be constructed of stainless steel. The design of the strainer body shall be such that the cleanout plug and screen may be easily removed to permit inspection and cleaning without disassembly of the inlet and outlet piping. End connections shall be ANSI screwed pipe threads. Provide three spare screen elements for each strainer furnished. The strainers shall be designed for a maximum operating pressure of 150 psig. They shall be as manufactured by GA Industries Inc., Pittsburgh, PA or approved equal.

   5. Refer to Section 16216 for fuel filter and oil water separator.

D. All piping and supports that are installed outdoors shall be designed and installed to meet wind loadings as required by the Florida Building Code, all other applicable codes, and the requirements of this specification. Design services shall be provided by a licensed Engineer as

described in Paragraph 1.06. Signed and sealed calculations shall be submitted for record purposes.

E. All piping and tank supports, including hangers, brackets, fasteners, and miscellaneous metals shall be Type 316 Stainless Steel.

F. Joint compound for steel pipe threaded connections shall be a non-hardening, non-solvent joint sealer.

G. Fire Suppression Kits:

1. Contractor shall furnish a packaged fire suppression kit including 10 lb. extinguisher with vinyl jacket.

H. Provide a Core Engineered Solutions Spill Kit, Model EP-SKL-2, Or Equal, including socks, pillows, wipers, mat pads, labels, Emergency Response Guidebook, and instruction manual.

I. Finish painting shall be provided as specified in Division 9 - Finishes and as specified herein.

1. Tank exterior shall be factory painted prior to shipment. Painting shall be two coats of epoxy powder coating suitable for outdoor corrosive environment and approved by Owner.

2. All non-stainless steel pipe fittings and nipples on the tank shall have a suitable primer and finish coat of epoxy powder coating suitable for outdoor corrosive environment and approved by Owner.

3. All colors to be selected by the Owner.

4. The Contractor shall provide minor field touch-up painting of fuel tank after completed installation. Surface preparation shall be in accordance with factory paint system. Any major defects or damage shall be inspected and repaired by the Manufacturer.

5. One quart of paint and a brush shall be provided to the Owner for field touchup painting.

PART 3 EXECUTION

3.01 INSTALLATION

A. General

1. Equipment shall be installed in accordance with the manufacturer's recommendations.

2. All materials and equipment shall be new and free from defects or damage and shall be installed in accordance with the approved recommendations of the manufacturer to conform to the contract documents. The installation shall be accomplished by workmen skilled in this type of work. Equipment shall be erected in a neat manner, shall be aligned, leveled and adjusted to provide satisfactory operation. Installation shall be such that connection and disconnection of piping and accessories can be readily made and so that all parts are easily accessible for inspection, operation, maintenance and repair. Minor deviations from indicated arrangements to provide proper access may be made.

3. Tank installers shall be certified in writing by the tank manufacturer as being qualified to install the equipment. A copy of the certificate shall be submitted to the local authorities prior to proceeding with construction.

4. Fuel storage tanks shall be grounded.

5. The Contractor shall install all warning and safety signs required by the local Fire Marshal and as specified herein.

B. Fuel Piping

1. All pipes shall be cut accurately to measurements established at the site and shall be worked into place without forcing or bending.

2. Piping shall be installed to minimize the quantity of piping joints. Provide unions and/or flexible connections at all equipment connections.

3. Joints shall be fabricated in accordance with standard industry practices and manufacturer's instructions. All joints shall be welded except where flanged or threaded connections to equipment or valves are required.

4. Aboveground steel piping shall be grounded. Where fittings cause a break in the electrical continuity of the system approval jumpers shall be provided.

5. Refer to Part 2 for requirements for piping mounted outdoors, and for wind restraint requirements.

C. Flexible Fuel Piping

1. Provide flexible piping connectors at all day tank connections, all generator connections, all storage tank connections and all equipment connections.

2. Flexible connections shall be a minimum of 12-inches long or as required for equipment removal or maintenance. Protect flexible connectors where physical damage may occur due to adjacent equipment, other piping, wiring, or where subject to possible damage from operating personnel.

D. Leak and Level Sensor Installation

1. Install all level and leak sensing equipment, monitoring panel interface modules and all wiring, conduit, junction boxes, sealing fittings and other material required for a complete operating system.

2. Install all monitoring equipment in accordance with the manufacturer's instructions including compliance with hazardous locations as defined in the National Electrical Code as locally amended and local codes having jurisdiction.

3. Provide instrument identification (tagging), calibration and manufacturer services.

3.02 CLEANING

A. At the conclusion of the work thoroughly clean all pipelines to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period.

B. If defective piping or joints are discovered at this time, they shall be repaired or replaced by the Contractor at no cost to the Owner.

3.03 PERMITS

A. Contractor shall contact the local public health department, DEP, and the local building department for necessary inspections and to obtain required operating permits in the Owner's name.

B. The entire system including the tanks, piping, equipment, and leak detection system shall be inspected and approved by DEP.

C. Contractor shall obtain written approval of the installation from the local fire official of jurisdiction.

3.04 PROTECTIVE COATINGS

A. Finish painting shall be provided as specified in Division 9 - Finishes and as specified herein.

3.05 TESTING

A. Piping shall be tested in strict accordance with the manufacturer's testing requirements. Piping system shall be tested upon completion of the roughing-in before setting equipment. Piping shall be subjected to an air test of 10 psig maximum. The entire system shall be pressure tested with fuel at 25 psig and proved tight at this pressure for a period of four (4) hours. Defective work or material shall be replaced and retested. The system shall be test plugged or capped prior to testing to prevent test pressure from reaching any equipment or storage tank.

B. Storage tanks and piping shall be precision tested by a state qualified tester.

C. Storage tanks shall be pressure tested at 5 psi and all fittings soaped for a period of at least 12 hours prior to placing tanks. Tanks under test pressure shall not be left unattended.

D. Contractor shall provide fuel for any required testing and retesting. If the fuel subsequently becomes contaminated, Contractor shall dispose of the fuel at no cost to the Owner and in accordance with all DEP regulations. Upon completion of the testing and prior final acceptance of the system, the Contractor shall fill the tanks to 90% of capacity.

END OF SECTION

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SECTION 15990
TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish the necessary labor, materials, instruments, transportation and devices required and test, adjust and balance the total heating-ventilating-cooling systems, both water and air systems. Each as specified and detailed herein, or as required to cause the systems to perform in accordance with the intent of the Drawings and this Section. Systems to be tested, adjusted and balanced include all systems installed by the HVAC Contractor.

B. Testing, balancing and operation of the systems shall be performed by competent and experienced personnel, having formerly done similar work and whose qualifications and performance shall be subject to the approval of the Engineer. Test and balance air and water system and submit testing and balancing reports to the Engineer for review and approval. Re-balance when required by the Engineer, incorporating all changes and certify the systems have been tested and balanced to meet specified requirements.

C. The tests shall demonstrate the specified capacities and operation of equipment and materials comprising the systems. Such tests other than as described herein, which are deemed necessary by the Engineer to indicate the fulfillment of the Contract, shall be made.

D. Data required by this Section shall receive complete approval before final payment is made.

E. If, in the opinion of the Engineer, the Construction Contractor has not, will not, or cannot comply with the testing, balancing and adjusting requirements of this Section, he may advise the Owner to employ a qualified firm to perform such work at Construction Contractor's sole expense.

F. Refer to Section 15500 for additional requirements.

G. Refer to the Drawings for additional requirements.

1.02 RELATED WORK

A. Refer to Section 15500.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, the following:

1. Qualifications and experience information and data as detailed under Paragraph 1.04 below.

2. Proposed testing schedules and procedures.

3. Preliminary draft "system" balancing reports as systems are completed and tested.

4. Final systems and Project balancing reports as final system adjustments are made as systems are accepted by the Owner.

5. All submittals shall contain a statement that Sections 15500, 15990 and all other referenced Sections have been read and complied with. The certification statement shall be made by all of the following that are applicable; the Construction Contractor, sub-contractor and the vendor. The statement shall be an individual statement for each party involved, and shall be included with every submittal and resubmittal.

B. In general, corrections or comments or lack thereof, made relative to submittals during review shall not relieve the Construction Contractor from compliance with the requirements of the drawings and specifications. Submittals are for review of general conformance with the design concepts of the project and general compliance with the contract documents. The Construction Contractor is responsible for the final design conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating the work of all trades, and performing the work in a safe and satisfactory manner.

1.04 QUALITY ASSURANCE

A. Qualifications standards for this work - Affiliation with manufacturers, installing contractors or engineering firms will not preclude acceptability. Submit qualifications within 60 days after Contract award. Membership in the AABC or NEBB for air and water testing is required. The testing balancing contractor shall not be affiliated with the on-site contractors.

B. To perform required professional services, the balancing agency shall have a minimum of two test-and-balance engineers certified by the AABC or NEBB.

C. This certified test-and-balance engineer shall be responsible for supervision and certification for the total work specified herein.

D. The balancing agency shall submit records of experience in the field of air and hydronic system balancing or any other data as requested by the Engineer. The supervisory personnel for the firm shall have at least 5 years' experience and all the employees used in this project shall be qualified technicians in this specific field.

E. The balancing agency shall furnish all necessary calibrated instrumentation to adequately perform the specified services. An inventory of all instruments and devices in possession of the balancing agency may be required by the Engineer to determine the balancing agency's performance capability.

1.05 ENGINEERING SERVICES

A. When engineering services are specified to be provided by the Construction Contractor, the Construction Contractor shall retain a licensed professional engineer to perform the services. The engineer shall be licensed at the time the work is done and in the State in which the project is located. If the State issues discipline specific licenses, the engineer shall be licensed in the applicable discipline. In addition, the engineer shall be experienced in the type of work being provided.

B. All work is to be done according to the applicable regulations for professional engineers, to include signing, sealing and dating documents. When submittals are required by a professional engineer, in addition to state required signing and sealing, a copy of the current wallet card or wall certificate indicating the date of expiration shall be included with the submittal.

1.06 SCHEDULE AND PROCEDURES

A. A complete schedule of balancing procedures for each of the buildings or systems shall be submitted in sufficient time in advance so that the Engineer might arrange to observe these procedures as they progress. Before commencing with the balancing of the systems submit the methods and instruments proposed to be used to adjust and balance the air and water systems.

B. Submit proposed testing programs at least 2 weeks prior to the scheduled test to assure agreement as to personnel and instrumentation required and scope of each testing program.

1.07 DRAWING REVIEW

A. The balancing organization shall thoroughly review the location of all fresh air dampers, return dampers, spill dampers, quadrant dampers, splitter dampers, bypass dampers, face dampers, fire dampers, registers, grilles, diffusers, VAV boxes, troffers, etc. The purpose of the review is to finalize the optimum locations for dampers, test ports and balancing valves shown on the Drawings.

1.08 EQUIPMENT CURVES

A. Fan Characteristics Charts: The HVAC and Construction Contractors shall provide to the Balancing Organization any required characteristic curve charts for all fans to include air conditioning units and air handling units. Characteristic curve charts shall be not less than 8-1/2-in by 11-in and shall show the static pressure, capacity horsepower and overall efficiency for operating conditions from no load to 130 percent of specified load. The minimum size of the actual fan curve shall be no less than 6-in by 8-in. The use of faxed copies of curves is not acceptable.

1.09 GUARANTEE

A. The balancing work shall be guaranteed to be accurate and factual data, based on readings in the field. All typewritten data shall be submitted within 14 working days of the performance of the test. Test data shall not be held until final completion, but shall be submitted on an interim basis as soon as the test or appropriate groups of tests are finished.

PART 2 PRODUCTS

2.01 MATERIALS

A. Furnish gaskets, lubricants and other expendable materials required to be replaced during the execution of this work.

B. Fixed-pitched pulleys required for fan adjustments shall be furnished on an exchange basis by the party responsible for the fan installation.

C. Where test results indicate that air quantities at any system fan are below or in excess of the specified amount, the HVAC and Construction Contractors, at their own expense, shall change driving pulley ratio or shall make approved changes to obtain the specified or scheduled air quantities.

D. Testing apparatus: Furnish plugs, caps, stops, valves, pumps, compressors, blowers and similar devices required to perform this work.

1. Furnish anemometers, thermometers, gauges, voltmeters, ammeters, lachometers and similar instruments, not part of the permanent installation, but required to record the performance of the equipment and systems.

2. Testing apparatus, not part of the permanent installation, shall remain the property of the Construction Contractor, but made available to the Engineer.

3. Instruments used for testing shall be certified accurate to within plus or minus 0.10 degrees F for temperature or plus or minus 0.10-in wc for pressure. Calibration of the instruments shall be done within 7 days of testing for this project and henceforth every 30 days thereafter for the duration of the testing period. Certification of calibration shall be submitted to the engineer prior to starting the work.

2.02 TESTING REPORTS

A. Forms: Furnish test report data on 8-1/2-in by 11-in bond AABC or NEBB form paper in accordance with Section 01300. Submit format for recording data and receive approval prior to use.

B. Reports shall be Excel spreadsheets format and shall be submitted in both hard copy and as a data file.

C. The report shall contain the following general data in a format selected by the balancing agency:

1. Project number

2. Contract number

3. Project title

4. Project location

5. Project architect

6. Project mechanical engineer

7. Test and balance agency

8. Test and balance engineer

9. Construction contractor

10. Mechanical subcontractor

11. Dates tests were performed

12. Certification

D. At a minimum, the report shall include:

1. Preface. A general discussion of the systems, any abnormalities and problems encountered.

2. Instrumentation list. The list of instruments including type, model, manufacturer, serial number and calibration dates.

3. System Identification. In each report, the VAV boxes, zones, supply, return and exhaust openings and traverse points shall be numbered and/or lettered to correspond to the numbers and letters used on the report data sheets and on the report diagrams.

E. Prepare 11-in by 17-in single line diagrams or 12-in by 18-in half size drawings showing all duct systems indicating all terminal air outlets including diffusers, grilles and registers, perforated plates, nozzles and other types of air supply, exhaust or return outlets. The minimum scale for diagrams showing the measurement points shall be 1/8-in=1-ft-0-in in the final form as submitted. The use of faxed copies of diagrams is not acceptable. Location of test points shown on the diagrams shall be clear and easy to locate on the diagram. The identification mark of the test points shall be the same as is shown on the test report showing the test data. The identification for test points shall include indication of the units served, and shall not have a duplicate in the project. All supply outlets shall be adjusted so that there are no drafts. Grille and register readings may be made by a vane anemometer, but diffuser readings shall be made by a flow hood or a velometer, using the tip recommended by the diffuser manufacturer. Each test sheet shall include the following data:

1. Job name and address.

2. Name of HVAC Contractor.

3. Name of balancing organization.

4. Instruments used to perform the test.

5. Name of test technician or test engineer.

6. Fan system and/or zone number.

7. Room number or area name.

8. Size of outlet.

9. Type outlet.

10. Manufacturer of outlet.

11. The cfm at each outlet on system and corresponding cfm at each outlet as noted on the plans.

12. Percent deviation of the measured flow versus the design flow.

13. Indication of the branch and terminal that are the open/low that are the basis for balancing the remainder of the system

PART 3 EXECUTION

3.01 START OF BALANCING

A. The Construction Contractor shall notify the Balancing Organization and Engineer when systems become operational and ready for preliminary and final testing, adjusting and balancing.

B. Final balancing shall not begin until system has been installed complete and is capable of normal operation. Provide personnel to assist in rough balance and calibration.

C. All grilles, dampers, fans, coils, pumps, valves and linkages shall be verified to be installed and operating.

D. System shall be capable of operating under control as specified on Drawings and/or contained herein.

E. Visually inspect all fire dampers on branch take-offs to each floor to ensure that they are fully open.

F. Verify with straight edge that fan/pump and motor shafts are parallel and that sheaves are in proper alignment.

G. Verify that belts are properly tensioned when unit is operating with no excessive squeal at startup. If not correct, adjust sheaves or motor base accordingly.

H. Start fans and verify that rotation is correct. If rotation is incorrect coordinate with electrical contractor to switch power leads such that the motor rotates correctly.

I. Check nameplate voltage on motor, compare to scheduled voltage. Notify the Engineer immediately of any discrepancies. Measure and record actual voltage across all power leads. Notify the Engineer of discrepancies immediately.

J. Check motor nameplates full load amps, measure and record amperage across all power leads. If there are marked discrepancies in amperage draws between legs, notify the Engineer immediately.

K. Measure and record fan/pump and motor rpm. Check that motor rpm agrees with nameplate and scheduled rpm.

L. If, upon commencing the work, the balancing contractor finds that the systems are not ready, or if a dispute occurs as to the readiness of the systems, the balancing agency shall request an inspection to be made by the Engineer. This inspection shall establish to the satisfaction of the represented parties whether or not the systems meet the basic requirements for testing and balancing. Should the inspection reveal the notification to have been premature, all costs for the inspection and work previously accomplished by the balancing agency shall be paid for by the Construction Contractor. Furthermore, such items that are not ready for testing and balancing shall be completed and placed in operational readiness before testing and balancing services shall be recommenced.

M. Leaks, damage and defects discovered or resulting from startup, testing and balancing shall be repaired or replaced to like-new condition with acceptable materials. Tests shall be continued until system operates without adjustments or repairs.

3.02 REQUIRED ACCURACY

A. Systems shall be balanced to be within the following limits of the capacity shown on the Drawings. Limits shall be applied to both individual components and to the system totals.

1. General Systems (plus/minus 10 percent)

3.03 TESTING

A. HVAC Air Systems

1. Balance the supply return and exhaust air systems in accordance with AABC or NEBB Standards by the use of direct reading instruments such as an "anemotherm" or velometer which has been properly calibrated.

2. Temporarily add static pressure to the system, to simulate the effect of dirty filters, by blanking off portions of the filter section, covering filter section with cheesecloth or other suitable means. Confirm static has been added with new static pressure reading across fan. Remove cheesecloth, etc., after traverses are complete.

3. If so instructed by the Engineer, further balancing of temperature shall be made either by thermometer or by temperature recorder.

4. The sequence of air balancing shall be as follows:
   a. First, establish air flow quantity at supply fan by main duct traverse.
   b. Next, establish air flow quantities in main ducts and branches.
   c. Finally, establish air flow quantities at outlets, using proportional balancing among branch outlets. All multiple opening systems shall be left with at least one "open low" inlet or outlet, to which all other system openings shall be proportionally balanced. The "open low(s)" on each system shall be indicated in the report.
   d. Grille and register readings may be made by a vane anemometer, but diffuser readings shall be made by a flow hood or a velometer using the tip recommended by the diffuser manufacturer. All supply outlets shall be adjusted so there are no drafts.
   e. After all outlets are adjusted to within the tolerances specified elsewhere in this Section, remeasure all system outlets, and retraverse all branch and main ducts to establish final "as balanced" flows.
   f. All main air ducts shall be traversed, using a Pitot tube and manometer. The manometer shall be calibrated to read two significant figures in all velocity pressure ranges. The static pressure reading at the traverse point shall be recorded for each successive traverse.
      1) A main duct is defined as either of the following:
         a) A duct serving five or more outlets.
         b) A duct serving two or more branch ducts.
         c) A duct emanating from a fan or plenum.
      2) All other ducts are branch ducts.

3) The intent of this operation is to measure by traverse, the total air quantity handled by the fan and to verify the distribution of air to zones and to adjust system pressure to minimum level required to satisfy the farthest air outlet.

g. Adjust fan speeds if results of system capacity tests are not within tolerances specified and repeat Paragraphs 3.03.A.4.c, d, and e above, as required.
h. Mark all final balancing damper positions with a permanent marker.

5. Furnish data in excel spread sheet format tabulating the following:
   a. Opening number, type, size and design flow rate.
   b. Quantity of air in cfm at each air outlet and inlet.
   c. Dry and wet bulb temperature in each room.
   d. Dry and wet bulb temperature of the supply air.
   e. Dry and wet bulb temperature of the return air.
   f. Outdoor dry and wet bulb temperature at the time the above tests are conducted.
   g. Total, sensible, and latent capacity in BTUH.

6. Adjust belts, sheaves and the alignment of air handling equipment.

7. Where various combinations of sheaves must be installed on fan systems to achieve the correct air delivery, change the sheaves and continue to take successive readings until the correct combinations are installed.

8. Furnish data in excel spread sheet format taken at each air moving device, to include fans, packaged units and air handling units, tabulating the following:
   a. Manufacturers, model number and serial number of units.
   b. All design and manufacturer's rated data.
   c. Total quantity of supply air in cfm.
   d. Total quantity of return air in cfm.
   e. Total quantity of exhaust or relief air in cfm.
   f. Total quantity of outside air in cfm.
   g. Outlet velocity - fpm.
   h. The rpm of each fan or blower.
   i. Maximum tip speed - fpm.
   j. The rpm of each motor.
   k. Voltage and ampere input of each motor (one reading for each phase leg on 3 phase motors).
   l. Pressure in inches w.g. at inlet of each fan or blower.
   m. Pressure in inches w.g. at discharge of each fan or blower.
   n. Pressure drops across system components such as louvers, filters, coils and mixing boxes.
   o. Submit the actual fan operating point on a copy of the fan shop drawing showing operating curve.
   p. List the following data from all fan motors installed.
      1) Manufacturer model and size.
      2) Motor horsepower, service factor and rpm.
      3) Volts, phases, cycles and full load amps.
      4) Equipment locations.
   q. Pressure in inches w.g. at inlet to unit cabinet.
   r. Pressure in inches w.g. at discharge from unit cabinet.
   s. Outdoor air and return air damper position.

t. List the following data for all coils installed in the unit:
   1) Airflow rate in cfm.
   2) Number of rows.
   3) Number of fins per inch.
   4) Face area in square feet.
   5) Tube size in inches.
   6) Tube and fin materials.
   7) Outdoor-air, wet- and dry-bulb temperatures in deg F.
   8) Return-air, wet- and dry-bulb temperatures in deg F.
   9) Entering-air, wet- and dry-bulb temperatures in deg F.
   10) Leaving-air, wet- and dry-bulb temperatures in deg F.
   11) Water flow rate in gpm.
   12) Water pressure differential in feet of head or psig.
   13) Entering-water temperature in deg F.
   14) Leaving-water temperature in deg F.
   15) Refrigerant expansion valve and refrigerant types.
   16) Refrigerant suction pressure in psig.
   17) Refrigerant suction temperature in deg F.
   18) Inlet steam pressure in psig.
   19) Input fuel type.
   20) Input fuel capacity in BTU/h.
   21) Number of stages.
   22) Actual operating current and voltage for all legs.

B. Condensing Units

1. Furnish typewritten data, tabulating as follows:
   a. Manufacturer, model number, size and serial number of all units.
   b. All design and manufacturer's rated data.
   c. Suction and condensing temperatures, and pressures.
   d. Temperatures of entering and leaving air.
   e. Voltage and ampere input of motors under full load (one for each phase leg).
   f. Capacity in BTUH.

3.04 FINAL ACCEPTANCE

A. At the time of final inspection, the balancing agency shall recheck, in the presence of the Engineer, specific and random selections of data recorded in the certified test-and-balance report.

B. Points and areas for recheck shall be selected by the Engineer.

C. Measurements and test procedures shall be the same as the original test and balance.

D. Selections for recheck, specific plus random, shall not normally exceed 15 percent of the total number tabulated in the report, except where special air systems require a complete recheck for safety reasons.

E. If the specific rechecks are more than 5 percent deviation from the report or specified flows, all of the systems, that require specific recheck, shall be rebalanced. If 5 percent or 5 of the random checks, whichever is less, exceeds a 10 percent deviation from the specified flows, the report shall be rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, a new certified test-and-balance report submitted, and a new inspection test made, all at no additional cost to the Owner.

END OF SECTION

SECTION 16000
ELECTRICAL – GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete and make operational, electrical and process instrumentation systems at the JEA Robena Road Pump Station as shown on the Drawings and as specified herein.

B. The work shall include furnishing, installing and testing the equipment and materials specified in other Sections of the Division 16 Specifications and shown on the Drawings.

C. The work shall include furnishing and installing the following:

1. Electrical service from the Power Company.

2. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions of these specifications.

3. Conduit, wiring and terminations for all field-mounted instruments furnished under other Divisions of these specifications, including process instrumentation primary elements, transmitters, local indicators and control panels. Lightning and surge protection equipment wiring at process instrumentation transmitters. Install vendor furnished cables specified under other Divisions of these specifications.

4. A complete raceway system for the Data Highway Cables and specialty cable systems. Install the Data Highway Cables and other specialty cable systems furnished under Division 13 in accordance with the system manufacturers' installation instructions. Review the raceway layout, prior to installation, with the computer system supplier and the cable manufacturer to ensure raceway compatibility with the systems and materials being furnished. Where redundant cables are furnished, install cables in separate raceways.

5. Conduit, wiring and terminations for variable frequency drives, harmonic filters, transformers and power factor correction capacitors furnished under other Divisions of these specifications.

6. Power wiring for all heating, ventilating, and air conditioning (HVAC) equipment furnished under other Divisions of these Specifications, including power wiring for 120V unit heater motors, thermostats, fan motors, dampers and other HVAC inline unit wiring shown on the Drawings.

7. Furnish and install precast manholes, precast handholes and light pole bases.

8. Furnish and install manhole and handhole frames and covers.

9. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this Section shall be furnished at no extra cost.

10. Provide Short Circuit, System Protective Device Coordination Analysis and Arc Fault Analysis in accordance with Section 16015.

11. Perform testing of the electrical equipment in accordance with the requirements of the individual specification sections and in accordance with Section 16950.

12. Set the electrical protective devices in accordance with NETA standards and in accordance with the protective coordination study.

D. The CONSTRUCTION CONTRACTOR shall prepare and furnish electrical and instrumentation conduit layout shop drawings for yard electrical, within and under all roads, buildings and structures to the ENGINEER for approval prior to commencing work. Layouts shall include but not be limited to equipment, pull boxes, manholes, conduit routing, dimensioning, methods and locations of supports, reinforcing, encasement, materials, conduit sizing, equipment access, potential conflicts, building and yard lighting, and all other pertinent technical specifications for all electrical and instrumentation conduits and equipment to be furnished. All layouts shall be drawn to scale on 24-in by 36-in sheets. Refer to the SUBMITTALS paragraph within this specification for additional requirements.

E. The work shall include complete testing of all equipment and wiring at the completion of work and making any minor correction changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; substandard work will be rejected.

F. A single manufacturer shall provide service entrance main circuit breaker, motor control centers, transformers, disconnect switches, panelboards, etc. This manufacturer shall also provide the power system study as specified herein.

G. CONSTRUCTION CONTRACTOR shall provide their own temporary power for miscellaneous power (drills, pumps, etc.). No facility circuits shall be used unless approved in writing by the ENGINEER. Any temporary added shall be removed at job completion.

H. Complete coordination with other contractors. CONSTRUCTION CONTRACTOR shall coordinate with all other contractors' equipment submittals and obtain all relevant submittals.

I. Mount control panels, transmitters, process instruments, operator stations, etc. furnished under other Divisions of these specifications.

J. Concrete electrical duct encasement, including but not limited to excavation, concrete, conduit, reinforcement, backfilling, grading and seeding is included in Division 16. All work shall be done in accordance with Divisions 2 and 3 of these specifications.

K. Excavation, bedding material, forms, concrete and backfill for underground raceways; forms and concrete for electrical equipment furnished herein is included in Division 16. All work shall be done in accordance with Divisions 2 and 3 of these specifications.

1.02 RELATED WORK

A. Excavation and backfilling, including gravel or sand bedding for underground electrical work is specified in Division 2.

B. Cast in place concrete work, including concrete encasements for electrical duct banks, equipment pads, light pole bases and reinforcing steel, is specified in Division 3.

1.03 SUBMITTALS

A. Submit to the ENGINEER, in accordance with Section 01300, shop drawings for equipment, materials and other items furnished under Division 16.

B. Shop drawings shall be submitted for the following equipment:

1. Raceways, Boxes, Fittings and Hangers
2. Wires and Cables
3. Low Voltage Cable Systems
4. Miscellaneous Equipment (as specified in Section 16191)
5. Panelboards
6. Motor Control Centers
7. Variable Frequency Drives
8. Lighting Fixtures and Lamps
9. Switches, Receptacles and Covers
10. Lightning Protection System
11. Precast Manholes and Handholes, Frames and Covers
12. Grounding Hardware and Connections
13. Service Entrance Rated Main Circuit Breaker
14. Diesel Engine Driven Generator
15. Automatic Transfer Switch

C. Submittals shall be required for the following items:

1. Concealed and Buried Conduit Layouts
2. Preliminary Short Circuit Study
3. Final Electrical Systems Analysis
4. Electrical System Testing and Settings Reports
5. Manufacturer’s Service Reports

D. The manufacturers name and product designation or catalog numbers shall be submitted for the following material utilized:

1. Testing Equipment

2. Ground System Resistance Test Equipment

E. Check shop drawings for accuracy and contract requirements prior to submittal. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform to the Specifications and the Drawings. This statement shall also list all exceptions to the Specifications and the Drawings. Shop drawings not so checked and noted shall be returned.

F. The ENGINEER's check shall be for conformance with the design concept of the project and compliance with the Specifications and the Drawings. Errors and omissions on approved shop drawings shall not relieve the CONSTRUCTION CONTRACTOR from the responsibility of providing materials and workmanship required by the Specifications and the Drawings.

G. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.

H. Material shall not be ordered or shipped until the shop drawings have been approved. No material shall be ordered or shop work started if shop drawings are marked "APPROVED AS NOTED - CONFIRM", "APPROVED AS NOTED - RESUBMIT" or "NOT APPROVED".

I. In addition to manufacturer's equipment shop drawings, submit electrical installation working drawings containing the following:

1. Concealed and buried conduit layouts, shown on floor plans drawn at not less than 1/4-in = 1-ft-0-in scale. The layouts shall include locations of process equipment, motor control centers, transformers, panelboards, control panels and equipment, motors, switches, motor starters, large junction or pull boxes, instruments and any other electrical devices connected to concealed or buried conduits.

2. Plans shall be drawn on high quality paper, size 36-in by 24-in and shall be presented in a neat, professional manner.

3. Concrete floors and/or walls containing concealed conduits shall not be poured until conduit layouts are approved.

J. Operation and Maintenance Data

1. Submit operations and maintenance data for equipment furnished under this Division, in accordance with Section 01730. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists, etc., to instruct operating and maintenance personnel unfamiliar with such equipment.

2. Manuals shall include the following as a minimum:
   a. A comprehensive index.
   b. A complete "As-Built" set of approved shop drawings.

c. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.
d. A table listing of the "as left" settings for all timing relays and alarm and trip setpoints.
e. System schematic drawings "As-Built", illustrating all components, piping and electric connections of the systems supplied under this Section.
f. Detailed service, maintenance and operation instructions for each item supplied.
g. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
h. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.
i. Complete parts list with stock numbers, including spare parts.

1.04 REFERENCE STANDARDS

A. Electric equipment, materials and installation shall comply with the latest edition of National Electrical Code (NEC) and with the latest edition of the following codes and standards:

1. National Electrical Safety Code (NESC)

2. Occupational Safety and Health Administration (OSHA)

3. National Fire Protection Association (NFPA)

4. National Electrical Manufacturers Association (NEMA)

5. American National Standards Institute (ANSI)

6. Insulated Cable Engineers Association (ICEA)

7. Instrument Society of America (ISA)

8. Underwriters Laboratories (UL)

9. Factory Mutual (FM)

10. International Electrical Testing Association (NETA)

11. Institute of Electrical and Electronic Engineers (IEEE)

12. Standard for Fire Protection in Wastewater Treatment and Collection Facilities (NFPA 820)

13. JEA Water and Wastewater Standards Manual

14. JEA Facilities Standards Manual

15. JEA Shared Services Standards

16. Florida Building Code Sixth Edition

B. All electrical equipment and materials shall be listed by Underwriter's Laboratories, Inc., and shall bear the appropriate UL listing mark or classification marking. Equipment, materials, etc. utilized not bearing a UL certification shall be field or factory UL certified prior to equipment acceptance and use.

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 PRIORITY OF THE CONTRACT DOCUMENTS

A. If, during the performance of the work, the CONSTRUCTION CONTRACTOR finds a conflict, error or discrepancy between or among one or more of the Sections or between or among one or more Sections and the Drawings, furnish the higher performance requirements. The higher performance requirement shall be considered the equipment, material, device or installation method which represents the most stringent option, the highest quality or the largest quantity.

B. In all cases, figured dimensions shall govern over scaled dimensions, but work not dimensioned shall be as directed by the ENGINEER and work not particularly shown, identified, sized, or located shall be the same as similar work that is shown or specified.

C. Detailed Drawings shall govern over general drawings, larger scale Drawings take precedence over smaller scale Drawings, Change Order Drawings shall govern over Contract Drawings and Contract Drawings shall govern over Shop Drawings.

D. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provisions of the Contract Documents will take precedence if they are more stringent or presumptively cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, or between Laws and Regulations, the higher performance requirement shall be binding on the CONSTRUCTION CONTRACTOR, unless otherwise directed by the ENGINEER.

E. In accordance with the intent of the Contract Documents, the CONSTRUCTION CONTRACTOR accepts the fact that compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, the CONSTRUCTION CONTRACTOR's responsibility to comply with all Laws and Regulations at all times.

1.06 ENCLOSURE TYPES

A. Unless otherwise specified herein or shown on the Drawings, electrical enclosures shall have the following ratings:

1. NEMA 1 for dry, non-process indoor locations.

2. NEMA 12 for "DUST" locations.

3. NEMA 4X for outdoor locations, rooms below grade (including basements and buried vaults), "DAMP" and "WET" and “PROCESS” locations.

4. NEMA 4X for "CORROSIVE" locations.

5. NEMA 7 (and listed for use in the area classifications shown) for "Class I Division 1 Group D", "Class I Division 2 Group D" and "Class II Division 1" hazardous locations shown on the Drawings.

1.07 SERVICE AND METERING

A. The power company serving this project is JEA. Service will be obtained at 480/277 Volts, 3 Phase, 4 Wire, wye-grounded, 60 Hz to the service entrance equipment as shown on the Drawings. Pay all fees and charges as required to obtain temporary and permanent service. Coordinate with JEA to provide and meet requirements for these services. The CONSTRUCTION CONTRACTOR shall pay for costs associated with obtaining the permanent service from Power Company via bid allowance. Upon activation of permanent service, the OWNER shall pay monthly power company charges for permanent service. Monthly power company charges for temporary power service shall not be payable via bid allowance. CONSTRUCTION CONTRACTOR will coordinate with Power Company for both temporary and permanent service. The service and installation shall be in accordance with JEA Rules and Regulations for Electric Service.

B. Furnish and install the primary conduits as required and secondary service conduit, wire, connectors, etc. to extend the service(s) to the service entrance location.

C. The power company will be responsible for the following work:

1. Furnishing and installing primary cables.

2. Furnishing and installing transformer.

3. Furnishing and installing transformer concrete pad.

4. Termination of underground primary cables within JEA primary distribution system.

5. Termination of underground primary cables at the transformer.

6. Termination of underground secondary cables at the transformer.

D. The CONSTRUCTION CONTRACTOR shall be responsible for the following work:

1. Make all arrangements with the power company for obtaining electrical service.

2. Furnishing and installing the primary conduits.

3. Furnishing and installing the grounding.

4. Furnishing secondary conduits and cables.

5. Meter socket enclosure and meter pedestal.

6. Steel bollards.

1.08 HAZARDOUS AREAS

A. Equipment, materials and installation in areas designated as hazardous on the Drawings shall comply with NEC Articles 500, 501, 502, 503, 504 and 510.

B. Equipment and materials installed in hazardous areas shall be UL listed for the appropriate hazardous area classification.

1.09 CODES, INSPECTION AND FEES

A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction.

B. Obtain all necessary permits and pay all fees required for permits and inspections.

1.10 ELECTRICAL SYSTEMS ANALYSIS

A. Provide the electrical system analyses in accordance with Section 16015.

1. Provide a preliminary short circuit and coordination analysis prior to the initial submittal of the electrical service switchgear submittal to confirm the equipment being provided new and the existing equipment are appropriately rated for the short circuit duty available and to ensure that the protective devices being provided properly coordinate among themselves and with the existing installed equipment.

2. Provide a final short circuit, protective devices coordination and arc flash analysis to be used for setting the protective devices and for providing the appropriate safety arc flash labeling on all equipment, existing and new. In addition, the final analysis report will be used by the OWNER as a bench mark for setting and testing protective devices in the future.

1.11 ELECTRICAL SYSTEM TESTING AND SETTINGS

A. Test and provide settings for systems and equipment furnished under Division 16 in accordance with Section 16950 "Electrical Testing and Settings" and the individual equipment sections for additional specific testing requirements. If the testing results are not within acceptable limits repair or replace all defective work and equipment at no additional cost to the OWNER.

B. Make adjustments to the systems furnished under Division 16 in accordance with the equipment manufacturers requirements/recommendations and the system coordination study specified in Section 16015.

1.12 INTERPRETATION OF DRAWINGS

A. The Drawings are not intended to show exact locations of conduit runs. Coordinate the conduit installation with other trades and the actual supplied equipment.

B. Install each 3-phase circuit in a separate conduit unless otherwise shown on the Drawings.

C. Unless otherwise approved by the ENGINEER, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.

D. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.

E. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation. Any adjustments required in the field shall be provided at no additional cost to the OWNER and coordinated and approved by the ENGINEER.

F. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the CONSTRUCTION CONTRACTOR and approved by the ENGINEER during construction. Obtain information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the ENGINEER and furnish all labor and materials necessary to complete the work in an approved manner.

G. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the approved equipment at no additional cost to the OWNER.

H. Redesign of electrical or mechanical work, which is required due to the CONSTRUCTION CONTRACTOR's use of an alternate item, arrangement of equipment and/or layout other than specified herein, shall be done by the CONSTRUCTION CONTRACTOR at his/her own expense. Redesign and detailed plans shall be submitted to the ENGINEER for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.

I. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by ½-inch spacers to provide a clearance between wall and equipment.

J. All floor mounted electrical equipment shall be placed on 4-inch thick (3/4-inch, 45-degree chamfer at all exposed edges) concrete pads, provide reinforcement, anchors, etc.

K. The CONSTRUCTION CONTRACTOR shall harmonize the work of the different trades so that interferences between conduits, piping, equipment, architectural and structural work will be avoided. All necessary offsets shall be furnished so as to take up a minimum space and all such offsets, fittings, etc., required to accomplish this shall be furnished and installed by the CONSTRUCTION CONTRACTOR without additional expense to the OWNER. In case interference develops, the ENGINEER is to decide which equipment, piping, etc., must be relocated, regardless of which was installed first.

L. Raceways and conductors for the fire alarm and lightning protection systems are not shown on the Drawings. Provide raceways and conductors as required by the system manufacturer for a complete and operating system. Raceways shall be installed concealed in all finished spaces and may be installed exposed or conducted in process spaces.

M. Raceways and conductors for lighting, switches, receptacles and other miscellaneous low voltage power and signal systems as specified are not shown on the Drawings. Raceways and conductors shall be provided as required for a complete and operating system. Homeruns, as shown on the Drawings, are to assist the CONSTRUCTION CONTRACTOR in identifying raceways to be run exposed and raceways to be run concealed. Raceways shall be installed concealed in all finished spaces and may be installed exposed or concealed in all process spaces. Raceways installed exposed shall be near the ceiling or along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes hoists, monorails, equipment hatches, doors, windows, etc. Raceways installed concealed shall be run in the center of concrete floor slabs, above suspended ceilings, or in partitions as required.

1.13 PHASE BALANCING

A. The Drawings do not attempt to balance the electrical loads across the phases. Circuits on motor control centers and panelboards shall be field connected to result in evenly balanced loads across all phases.

B. Field balancing of circuits shall not alter the conductor color coding requirements as specified in Section 16120.

1.14 SIZE OF EQUIPMENT

A. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.

B. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.

1.15 RECORD DRAWINGS

A. As the work progresses, legibly record all field changes on a set of Project Contract Drawings, hereinafter called the "Record Drawings".

B. Record Drawings shall accurately show the installed condition of the following items:

1. One-line Diagram(s).

2. Equipment elevations (front views).

3. Raceways and pullboxes.

4. Conductor sizes and conduit fills.

5. Panel Schedule(s).

6. Control Wiring Diagram(s).

7. Lighting Fixture Schedule(s).

8. Lighting fixture, receptacle and switch outlet locations.

9. Underground raceway and duct bank routing.

10. Plan view, sizes and locations of switchgear, distribution transformers, substations, motor control centers and panelboards.

C. Submit a schedule of control wiring raceways and wire numbers, including the following information:

1. Circuit origin, destination and wire numbers.

2. Field wiring terminal strip names and numbers.

D. In addition to the schedule, provide point-to-point connection diagrams showing the same information submitted in the schedule of control wiring raceways including all designations and wire numbers.

E. Submit the record drawings, schedule of control wiring raceways and wire numbers and the point-to-point connection diagrams to the ENGINEER. The schedule of control wiring raceways and wire numbers and the point-to-point connection diagrams shall be computer generated (i.e. no hand-written or drawn schedules, drawings, or diagrams will be accepted).

1.16 EQUIPMENT INTERCONNECTIONS

A. Review shop drawings of equipment furnished under other Divisions and prepare coordinated wiring interconnection diagrams or wiring tables. Submit copies of wiring diagrams or tables with the Record Drawings.

B. Furnish and install all equipment interconnections.

1.17 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be new, except where specifically identified on the Drawings to be re-used.

B. Material and equipment of the same type shall be the product of one manufacturer and shall be UL listed.

C. Warrant all equipment furnished under Division 16 in accordance with Section 01740. Refer to individual equipment sections for additional warranty items.

1.18 EQUIPMENT IDENTIFICATION

A. Identify equipment (disconnect switches, separately mounted motor starters, control stations, etc.) furnished under Division 16 with the name of the equipment it serves. Motor control centers, control panels, panelboards, transformers, switchboards, switchgear, junction or terminal boxes, transfer switches, etc., shall have nameplate designations as shown on the Drawings.

B. Nameplates shall be engraved, laminated plastic, not less than 1/16-in thick by 3/4-in by 2-1/2-in with 3/16-in high white letters on a black background.

C. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two-sided foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate, the nameplate shall be permanently fastened to the adjacent mounting surface. Cemented nameplates shall not be drilled.

D. All voltages (e.g. 208 volts, 480 volts, etc.) within pull boxes, junction boxes etc. shall be identified on the front exterior cover. Signs shall be red background with white engraved lettering, lettering shall be a minimum of 1" high.

E. All receptacles, wall switches, lighting fixtures, photo cells, emergency lights, exit lights, etc. shall be identified with the panel and circuit to which it is connected. Identification shall be with machine generated labels with ¼” high letters.

1.19 SAFETY REQUIREMENTS

A. The CONSTRUCTION CONTRACTOR shall make every effort to keep all employees and/or subcontractors aware of the danger inherent in working in dangerous proximity to the existing power lines. The minimum recommended precautionary measures are as follows:

1. Make sure that all persons responsible for operating cranes, draglines and other mobile equipment have a copy of, and are familiar with the State Department of Commerce Regulations for Use of Cranes, Draglines and Similar Equipment Near Power Lines, as well as the U.S. Department of Labor OSHA Regulations, before commencing operation of said equipment.

2. Make sure that all cranes, draglines and other mobile equipment have attached to them the black and yellow Department of Commerce warning signs required by the said Regulations of State Department of Commerce.

3. Warn all employees on the ground, new and old employees alike, of the danger of holding on to or touching a cable or other piece of equipment or machinery that is located or working close to any overhead power line.

4. If, during the course of construction, it becomes necessary for the CONSTRUCTION CONTRACTOR, or subcontractor, and their employees, to operate cranes, draglines, or their mobile equipment, in dangerous proximity of any overhead power lines, or in such a manner that such equipment might come close to any overhead power lines, the CONSTRUCTION CONTRACTOR shall give the Power Company or overhead power line owner prior notice of such proposed operation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SLEEVES AND FORMS FOR OPENINGS

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

B. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or other subcontractors and locate the concealed conduit before the floor slab is poured.

C. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the ENGINEER may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.

D. Seal all openings, sleeves, penetration and slots as specified in Section 16110.

3.02 CUTTING AND PATCHING

A. Cutting and patching shall be done in a thoroughly workmanlike manner and be in compliance with modifications and repair to concrete as specified in Section 01045. Sawcut concrete and masonry prior to breaking out sections.

B. Core drill holes in existing concrete floors and walls as required.

C. Install work at such time as to require the minimum amount of cutting and patching.

D. Do not cut joists, beams, girders, columns or any other structural members.

E. Cut opening only large enough to allow easy installation of the conduit.

F. Patching to be of the same kind and quality of material as was removed.

G. The completed patching work shall restore the surface to its original appearance or better.

H. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.

I. Remove rubble and excess patching materials from the premises.

J. When existing conduits are cut at the floor line or wall line, they shall be filled with grout of suitable patching material.

3.03 INSTALLATION

A. Any work not installed according to the Drawings and this Division or without approval by the ENGINEER shall be subject to change as directed by the ENGINEER. No extra compensation will be allowed for making these changes.

B. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors.

Electrical equipment shall be stored in dry permanent shelters. If an apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be replaced at no additional cost to the OWNER, the damaged unit(s) or systems shall remain on site and returned to the manufacturer after the replacement unit(s) or systems have been delivered to the site. Under no circumstances will electrical equipment damaged by water be rehabilitated or repaired, new equipment shall be supplied and all cost associated with replacement shall be borne by the CONSTRUCTION CONTRACTOR.

C. Equipment that has been damaged shall be replaced or repaired by the equipment manufacturer, at the ENGINEER's discretion.

D. Repaint any damage to factory applied paint finish using touch-up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted per the field painting requirements Section 09902, at no additional cost to the OWNER.

3.04 MANUFACTURERS SERVICE

A. Provide manufacturer's services for testing and start-up of the following equipment:

1. 480 Volt Motor Control Centers (__3__ days __2__ trips minimum)

2. Variable Frequency Drives (__3__ days __2__ trips minimum)

3. SE Rated Main Circuit Breaker (__3__ days __2__ trips minimum)

4. Automatic Transfer Switch (__3__ days __2__ trips minimum)

5. Diesel Engine Driven Generator (__4__ days __2__ trips minimum)

B. Testing and startup shall not be combined with training. Testing and start-up time shall not be used for manufacturers warranty repairs.

C. The manufacturers of the above listed equipment shall provide experienced Field Service Engineer to accomplish the following tasks:

1. The equipment shall be visually inspected upon completion of installation and prior to energization to assure that wiring is correct, interconnection complete and the installation is in compliance with the manufacturer's criteria. Documentation shall be reviewed to assure that all Drawings, operation and maintenance manuals, parts list and other data required to check out and sustain equipment operation is available on-site. Documentation shall be red-lined to reflect any changes or modifications made during the installation so that the "as-built" equipment configuration will be correctly defined. Spare parts shall be inventoried to assure correct type and quantity.

2. The Field Service Engineers shall provide engineering support during the energization and check-out of each major equipment assembly. They shall perform any calibration or adjustment required for the equipment to meet the manufacturer's performance specifications.

3. Upon satisfactory completion of equipment test, they shall provide engineering support of system tests to be performed in accordance with manufacturer's test specifications.

4. A final report shall be written and submitted to the CONSTRUCTION CONTRACTOR within fourteen days from completion of final system testing. The report shall document the inspection and test activity, define any open problems and recommend remedial action. The reports after review by the CONSTRUCTION CONTRACTOR shall be submitted to the ENGINEER.

3.05 TRAINING

A. Provide manufacturer's services for training of plant personnel in operation and maintenance of the equipment specified under Division 16.

1. 480 Volt Motor Control Centers (__1__ days __1__ trips minimum)

2. Variable Frequency Drives (__1__ days __1__ trips minimum)

3. SE Rated Main Circuit Breaker (__1__ days __1__ trips minimum)

4. Automatic Transfer Switch (__1__ days __1__ trips minimum)

5. Diesel Engine Driven Generator (__1__ days __1__ trips minimum)

B. The cost of training programs to be conducted with OWNER's personnel shall be included in the Contract Price. The training and instruction, insofar as practicable, shall be directly related to the system being supplied.

C. Provide detailed O&M manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.

D. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance including trouble-shooting of each system.

E. All training schedules shall be coordinated with and at the convenience of the OWNER. Shift training may be required to correspond to the OWNER's working schedule. The training shall be conducted with record "as-built" drawings sufficient for a class of eight personnel.

F. Within 120 days of contract award to the CONSTRUCTION CONTRACTOR, submit an overview of the proposed training plan. This overview shall include, for each course proposed:

1. An overview of the training plan.

2. Course title and objectives.

3. Prerequisite training and experience of attendees.

4. Recommended types of attendees.

5. Course Content - A topical outline.

6. Course Duration.

7. Course Location - Training center or jobsite.

8. Course Format - Lecture, laboratory demonstration, etc.

9. Schedule of training courses including dates, duration and locations of each class.

10. Resumes of the instructors who will actually implement the plan.

G. The ENGINEER will review the training plan submittal with the OWNER.

END OF SECTION

SECTION 16015
ELECTRICAL SYSTEMS ANALYSIS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide both a preliminary and a final short circuit, selective coordination and arc flash study of the complete electrical distribution system as specified herein and as shown on the Drawings. The study shall include motor starting/running calculations.

B. Provide both a preliminary and final harmonic study of the complete electrical distribution system as specified herein and as shown on the Drawings.

C. Obtain and pay for the services of the independent engineering specialty firm, subject to the approval of the Engineer, to provide a complete fault current, device evaluation, protective devices selective coordination, arc flash study, harmonic study and motor starting study. The selective coordination study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and including the largest feeder circuit breaker and motor starter in the all low voltage motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, Uninterruptible Power Supplies (UPS), power factor correction equipment, transformers and protective devices associated with emergency and standby generators, and the associated paralleling equipment and distribution switchgear. The arc flash study shall begin with the utility company's feeder protective device and include all of the electrical distribution equipment down to and including low voltage motor control centers and power distribution panelboards and lighting panels. All information required to perform the study shall be obtained by the entity performing the study.

D. Submit the preliminary short circuit, selective coordination and motor starting/running study prior to submittal of SE rated main circuit breaker, motor control centers, and 480 Volt panelboards shop drawings. The aforementioned shop drawings will not be reviewed until the preliminary power system study is approved by the Engineer. No exceptions will be allowed. The preliminary study shall include but not limited to:

1. Short circuit, and protective device coordination and motor starting studies shall be performed on nationally recognized computer software such as SKM System Analysis, EDSA, ETAP, or approved equal.

2. Obtain and verify with the utility company all information needed to conduct the study. Obtain and verify with the Owner ratings of existing electrical equipment that shall be included in the study.

3. Current transformers' ratio and burden calculations shall be based on a 10 percent maximum ratio error per ANSI C57.13. Identify current transformers that will not allow the protective devices to operate within acceptable ANSI error margins and recommend corrective action.

4. The preliminary study shall verify equipment is being applied within their design ratings and electrical protective devices will coordinate.

5. Recommend changes and/or additions to equipment as required providing adequate protection and coordination based on the actual equipment supplied and the results of the short circuit and protective device selective coordination studies. Submit any such changes and additions as a part of the study. Field settings of devices, adjustments, and minor modifications to equipment that are required to accomplish conformance with the approved short circuit and protective device selective coordination studies shall be carried out by the CONSTRUCTION CONTRACTOR at no additional cost to the Owner.

E. After release of electrical equipment by the manufacturer, but prior to energizing the electrical equipment, submit the final short circuit and selective coordination study including all calculations, tabulations, protective devices coordination graphs, etc. as specified herein.

1. Provide a complete short circuit study and protective device selective coordination study for both the utility power distribution system and the emergency/standby power distribution system under the scope of this study. The study shall include but shall not be limited to:
   a. Full compliance with applicable ANSI and IEEE Standards.
   b. Preformed on nationally recognized computer software such as EDSA, SKM System Analysis, ETAP, or equal.

2. Provide a report summarizing the selective coordination and motor starting/running study including: one-line diagram of the system, relay and breaker setting tabulation, coordination curves, relay curves, circuit breaker curves, motor starting/running curves, protective device coordination and short circuit calculation, all prepared by the specialty firm.

3. Recommend changes and/or additions to equipment as required providing adequate protection and coordination based on the actual equipment supplied and the results of the short circuit and protective device selective coordination studies. Submit any such changes and additions as a part of the study. Field settings of devices, adjustments and minor modifications to equipment that are required to accomplish conformance with the approved short circuit and protective device selective coordination studies shall be carried out by the CONSTRUCTION CONTRACTOR at no additional cost to the Owner.

1.02 RELATED WORK

A. Section 16950 "Electrical Systems Testing and Setting".

B. Motors are included under other Divisions and are specified in Section 16150.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, the following:

1. The number of years the specialty firm has been in the business of performing coordination studies.

2. Identification of each of the three qualifying projects for each of the past three years including:
   a. A brief description of each study.
   b. Name of owner of installation on which study was performed with address, telephone number, and contact person.
   c. Date of study.

d. Any other information indicating the firm's experiences and ability to perform the work and business status.

B. Preliminary Short Circuit and Coordination Study Report shall include but not limited to:

1. The coordination study report shall be bound in a standard 8-1/2-in by 11-in size report.

2. Electrical distribution system one-line diagram. One-line diagrams shall be legible on printed paper and shall not exceed 11-in x 17-in in size unless required to clearly illustrate the system and related data.

3. Provide detailed “Input Data” report that identifies all input parameters associated with the equipment depicted on the system one-line diagrams including but not limited to Utility data, conductor sizes and lengths, protective device sizes and rating, transformer sizes and ratings, motor types and sizes, etc.

4. Provide current transformers' ratio and burden calculations to confirm that the current transformers will not saturate prior to operation of the protective relays and confirming the current transformers used with differential protection will not saturate under any fault condition.

5. Tabulation of each protective device, its short circuit rating, the available fault current available at the device and an indication whether or not the device is adequately rated for the available fault current and voltage at which it is applied.

6. Preliminary graphic time-current curves showing how the protective devices proposed by the equipment suppliers will coordinate as being applied. TCC’s shall be produced and printed in color to assist the reviewing engineer in the graphical analysis of the protective device coordination. Each device on a TCC shall be a different color and where devices are shown on multiple TCCs the color for the device shall be constant on each TCC that the devices are shown on.

C. Final Short Circuit and Selective Coordination Study Report shall include but not limited to:

1. The coordination study report shall be bound in a standard 8-1/2-in by 11-in size report. The selection of all protective relays types, current transformers, fuse types and ratings shall be the responsibility of the manufacturer and shall be based on the preliminary coordination study, which shall be submitted prior to the equipment shop drawings in accordance with Section 01300. The complete study shall be approved by the Engineer before any equipment is shipped. The report shall include the following sections and information:

2. An executive summary outlining the distribution system, the information received from the power company, assumptions made to complete the report, statement of the adequacy of the distribution equipment to safely clear any fault currents, the adequacy of the distribution equipment to close in on a fault, identify any problem areas with recommendations for resolving the problem.

3. Electrical distribution system one-line diagram. One-line diagrams shall be legible on printed paper and shall not exceed 11-in x 17-in in size unless required to clearly illustrate the system and related data.

4. Provide detailed “Input Data” report that identifies all input parameters associated with the equipment depicted on the system one-line diagrams including but not limited to Utility data, conductor sizes and lengths, protective device sizes and rating, transformer sizes and ratings, motor types and sizes, etc.

5. Provide current transformers' ratio and burden calculations to confirm that the current transformers will not saturate prior to operation of the protective relays and to confirm the current transformers used with differential protection will not saturate under any fault condition.

6. Transformer differential protection calculations including current transformer mismatch relay setting and charts. Provide differential current transformer wiring schematics including polarity and wiring connections based on the winding configuration of the actual power transformers being supplied.

7. Tabulation of all protective devices, circuit breakers, fuses, current transformers, etc. The tabulation shall indicate the device, manufacturer, catalog number, recommended setting, etc.

8. Industry standard graphic time current, protective relay and protective device curves, showing equipment and material damage curves, relay, circuit breaker, fuse curves, available fault currents at the equipment, transformer inrush currents, etc., for each piece of equipment. TCC’s shall be produced and printed in color to assist the reviewing engineer in the graphical analysis of the protective device coordination. Each device on a TCC shall be a different color and where devices are shown on multiple TCCs the color for the device shall be constant on each TCC that the devices are shown on.

9. Tabulation of each protective device, its short circuit rating the available fault current available at the device and an indication whether or not the device is adequately rated for the available fault current and voltage at which it is applied.

10. Calculations and required documentation including copies of correspondence with involved entities such as utility fault contribution coordination.

D. Preliminary Arc Flash Study Report shall include but not limited to:

1. The Arc Flash study report shall be bound in a standard 8-1/2-in by 11-in size report.

2. An executive summary outlining the distribution system, the information received from the power company, assumptions made to complete the report and recommendations to reduce the arc flash values.

3. Recommendations to reduce the arc flash incident energy levels.

E. The Final Arc Flash Study report shall be bound in a standard 8-1/2-in by 11-in size report. The report shall include the following sections and information:

1. An executive summary outlining the distribution system, the information received from the power company, assumptions made to complete the report and recommendations to reduce the arc flash values.

2. Provide a detailed bus label for each fault location. Each label shall include a listing of the protective device settings and incident energy at several different working distances.

3. Provide A NFPA 70 E work permit form for each fault location.

4. Provide labels for each fault location.
   a. Labels shall be indoor/outdoor rated weather resistant vinyl or polyester with a UV resistant overlaminate. The label shall have a minimum thickness of 5 mil. Labels shall be backed with pressure sensitive permanent cold temperature adhesive rated for a minimum 5-year life in the environment in which they are installed.
   b. The label shall match any pre-existing facility or Owner specified formatting. The CONSTRUCTION CONTRACTOR shall be responsible for obtaining this formatting information prior to submitting label templates.
   c. A single label for equipment is acceptable where equipment is continuous. In the event of split busses or equipment not arranged in a continuous fashion, multiple labels shall be provided.
   d. Line side labels for equipment main breakers shall be included in addition to load side labels.
   e. Labels shall be DANGER/WARNING type conforming to the NFPA 70E and ANSI Z534.4 standards. Labels are required to have the minimum information specified by these standards printed on them. Labels shall be legible and standard throughout the plant.
   f. Labels templates shall be provided to the Engineer and Owner for final approval and shall be printed and affixed by the CONSTRUCTION CONTRACTOR. CONSTRUCTION CONTRACTOR shall be responsible for all work required to print and affix the labels to the equipment. Labels shall be affixed in accordance with the direction of the Owner.

5. PPE Table – Provide a PPE table that defines the Personnel Protective Equipment classes and clothing descriptions identified in the reports and labels.

F. Preliminary Harmonic Study Report shall include but not limited to:

1. The harmonic study report shall be bound in a standard 8-1/2-in by 11-in size report.

2. Electrical distribution system one-line diagram.

3. Provide the minimum available fault current available from the utility and show the calculations of plant load vs. available fault current to determine the appropriate THD threshold as defined in IEEE 519.

4. Provide the harmonic parameters assumed for use in the study for the harmonic generating equipment, i.e., VFD units, UPS units, static inverters, Ozone units, etc.

G. Final Harmonic Study Report shall include but not limited to:

1. The harmonic study report shall be bound in a standard 8-1/2-in by 11-in size report. The selection of the harmonic mitigation equipment shall be the responsibility of the manufacturer and shall be based on the preliminary harmonic study, which shall be submitted prior to the equipment shop drawings in accordance with Section 01300. The

complete study shall be approved by the Engineer before any equipment is shipped. The report shall include the following sections and information:

a. An executive summary outlining the distribution system, the information received from the power company, assumptions made to complete the report, document harmonic profile for all harmonic producing equipment.
b. Electrical distribution system one-line diagram.
c. Recommended parameters for harmonic mitigation equipment, if required. Recommendations shall detail the projected effects of the mitigation effects and shall prove them via a revised harmonic study.
d. Calculations and documentation indicated.

H. Submittal of Digital Data and System Model

1. Following final approval of any of the above-mentioned studies, the CONSTRUCTION CONTRACTOR shall provide a digital copy of all reports submitted as part of the project. Reports shall not be password protected and shall be free manipulated by the Engineer or Owner.

2. Following final approval of any of the above studies, the CONSTRUCTION Contractor shall provide the complete digital system model and system library used to build the model and complete the studies. All files needed to accurately recreate the study completed by the CONSTRUCTION CONTRACTOR must be furnished and a backup of the system library used to define all system components must be provided.

1.04 REFERENCED STANDARDS

A. Institute of Electrical and Electronic Engineers, Inc. (IEEE):

1. Plants

2. Standard 241, Recommended Practice for Electrical Power Systems in Commercial Buildings

3. Standard 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Systems

4. Standard 399, Recommended Practice for Industrial and Commercial Power System Analysis

5. IEEE Std. 519- Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems, 2014

6. IEEE Std. 1584- IEEE Guide for Arc Flash Hazard Calculations

7. NFPA 70E

8. IEEE Std. 242

B. American National Standards Institute (ANSI):

1. Standard C37.90, IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus

2. Standard C37.91, IEEE Guide for Protective Relay Applications to Power Transformers

3. Standard C37.95, IEEE Guide for Protective Relaying of Utility-Consumer Interconnections

4. Standard C37.96, IEEE Guide for AC Motor Protection

5. Standard C57.12.59, IEEE Guide for Dry-Type Transformer Through-Fault Current Duration

6. Standard C57.13, IEEE Standard Requirements for Instrumentation Transformers

7. Standard C57.109, IEEE Guide for Liquid-Immersed Transformer Through-Fault-Current Duration

1.05 QUALITY ASSURANCE

A. Independent Engineering Specialty Firm's Experience

1. Specialty firm shall have been in the business of the type of work specified, for at least the past five years.

2. The specialty firm shall have a minimum of three projects of equal or greater size, service, with the type of equipment specified for each of the past three years.

B. Specialty firm shall be incorporated in the State, Commonwealth or District, in which the equipment will finally reside and shall have a licensed, in the same jurisdiction, professional engineer as a full-time employee, to supervise and seal the report.

C. The specialty firm shall be an independent organization, which can function as an unbiased authority, professionally independent of the manufacturers, suppliers and installers of equipment or systems evaluated by the specialty firm.

D. All electrical studies shall be stamped and signed by a professional electrical engineer. The engineer shall be registered in the State, Commonwealth or District in which the equipment will finally reside.

1.06 SHORT CIRCUIT STUDY

A. Perform a short circuit study in accordance with ANSI Standards C37.010 and C37.13 to check the adequacy and to verify the correct application of circuit protective devices and other system components within the construction package. The study shall address the case when the system is being powered from the utility source as well as from the on-site generating facilities, normal and alternate (bus tie closed) modes of operation. Minimum and maximum possible fault conditions shall be covered in the study. It shall be the responsibility of the CONSTRUCTION

Contractor performing the study to determine the operating parameters of the system and to derive the worst-case fault conditions. Assumptions of plant operation shall not be allowed.

B. Consider the fault contribution of all motors operating during the maximum demand condition of the motors.

C. Calculate short-circuit momentary duties and interrupting duties on the basis of an assumed bolted 3 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. The short circuit tabulations shall include X/R ratios, asymmetry factors, KVA and symmetrical fault-current. 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.

D. The studies shall include representation of the site power system, the base quantities selected, impedance source data, calculation methods and tabulations, one-line diagrams, conclusions and recommendations.

E. Provide the following:

1. The available fault current at each bus within the limits of the study shall be identified and listed.

2. The momentary and interrupting rating of all elements of the distribution system shall be listed. The maximum available fault current available at each element shall be calculated.

3. Determine the adequacy of the electrical protective devices to withstand the maximum available fault at the terminals of the equipment. Provide an equipment list, the equipment rating (both momentary and withstand), the maximum available fault rating and the adequacy of the equipment to withstand the fault. The results shall be tabulated in the form of a PASS/FAIL device evaluation table Equipment that does not have adequate ratings shall be identified immediately and brought to the attention of the Engineer.

4. The short circuit portion of the report shall include:
   a. Executive summary describing the distribution system, the procedures used to develop the study, utility related information furnished by the utility company including the name and telephone number of the individual supplying the information, identify all assumptions made in the preparation of the study, identify any problem areas and provide a definitive statement concerning the adequacy of the distribution system to interrupt and withstand the maximum possible fault current.
   b. Computer printout of the input data.
   c. Computer printouts for the three phase and ground fault studies. Printouts shall indicate the fault current available at each major equipment, distribution bus within the high, medium and low voltage distribution systems.
   d. Table listing all the electrical distribution and utilization equipment (including VFDs), the equipment interrupting and withstand ratings, the available fault current at the terminals of the equipment and the ability of the equipment to interrupt and/or withstand the fault.
   e. The short circuit study shall be prepared using approved computer software and must include complete fault calculations as specified herein for each proposed and ultimate

source combination. Source combinations may include present and future Power Company supply circuits, large motors, or generators.

F. Automatic Load Transfer

1. Provide a detailed study demonstrating the interrupting capacity of automatic transfer bus ties and switches, as well as the fault withstand capabilities. The following shall be considered:
   a. X/R ratio fault-current of circuit at point of transfer.
   b. X/R ratio and fault-current rating of the transfer device.
   c. Length of time fault may persist prior to protective device opening.
   d. Magnetic stress withstand rating.
   e. I2t withstand rating.
   f. Transfer device maximum interrupting duty compared to load interrupting duty.

1.07 PROTECTIVE DEVICE COORDINATION

A. Provide a protective device time-current coordination study in accordance with ANSI/IEEE Std. 242, with coordination plots of protective devices plus tabulated data, including ratings and settings selected. In the study, balance shall be achieved between the competing objectives of protection and continuity of service for the system specified, taking into account the basic factors of sensitivity, selectivity and speed.

B. Provide separate plots for each mode of operation: (1) "double-ended mode" (double-ended substation with bus tie open); (2) "singled ended mode" (single incoming utility feeder energized all switchgears single ended with bus ties closed); (3) "stand-by mode" (on-site generation solely providing power to the system; (4) "peak shaving modes" (a.) (double-ended substation with bus tie open with on-site generation paralleled) and (b) (single-ended with bus ties closed with on-site generation paralleled). Show maximum and minimum fault values in each case. Multiple power sources shown in one plot is not acceptable.

C. Each primary protective device required for a delta-to-wye-connected transformer shall be selected so the characteristic or operating band is within the transformer parameters, which, where feasible, shall include a parameter equivalent to 58 percent of the ANSI C37.91 withstand curve to afford protection for secondary line-to-ground faults. 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. Separate the protective relays by a 0.3-second time margin for the maximum 3 phase fault conditions to assure proper selectivity. The protective device characteristics or operating bands shall be terminated to reflect the actual symmetrical and asymmetrical fault-currents sensed by the device. Provide the coordination plots for 3 phase and phase-to-ground faults on a system basis. 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.

D. Select relay types (i.e., inverse, very inverse, extremely inverse, over current with or without voltage restraint, timers, etc.), current transformer ratings and types, fuse, residually or zero sequence connected ground faults protection, etc., that will allow the system to be protected to within the equipment fault ratings and provide the maximum possible coordination between the protective devices.

E. Multifunction Solid State Relays

1. Where multifunction solid state relays are already installed, it shall be the responsibility of the CONSTRUCTION CONTRACTOR to obtain the current and complete list of software setpoints programmed into the device. These setpoints shall be evaluated for potential impacts on the protective device coordination.

2. Where multifunction solid state relays are being install, it shall be the responsibility of the CONSTRUCTION CONTRACTOR to provide all setpoints needed for the specified operation of the relay. These settings include but are not limited to:
   a. The complete pickup settings of all protective elements specified by the designer and shall not be limited to only the overcurrent pickup settings. Settings for protective elements such as reverse power, synchronization, frequency and voltage control, etc. shall be provided in full.
   b. Differential pickup and zone settings necessary for the relay to operate as specified and designed and to protect the zone it is intended for. Zone of protection calculations and balance equations shall be completed entirely by the CONSTRUCTION Contractor based on the equipment as furnished and designed.
   c. The complete protective relay logic map and logic equations. The relay logic is responsible for translating the pickups of the protective elements into relay output events and device trips. All logic necessary to create the specified output of the relay based on the specified protective elements shall be furnished with the protective device coordination report.
   d. Any and all miscellaneous settings necessary for the relay to communicate with the installation systems and the mirroring of data to other installation systems as specified or designed.

3. CONSTRUCTION CONTRACTOR shall be responsible for the programming of relays prior to the field testing and start up requirements of this contract. CONSTRUCTION CONTRACTOR shall be responsible for all time needed to complete the relay settings in order to furnish a completely functional system as specified and required by the approved protection device settings.

F. Arc Flash Mitigation and Reduction Modes

1. Where devices are furnished with alternative trip settings intended to mitigate arc flash hazards, the CONSTRUCTION CONTRACTOR shall coordinate these alternative pickup settings and provide representation of their tripping characteristics via TCC’s. The alternative pickup settings shall be coordinate with the associated load and shall be set to provide the fastest device response time while avoiding nuisance trips during normal plant operation.

G. Generator Protective Devices

1. The study shall address all of the protective devices provided for generator protection.

2. Protective relays requiring settings shall be included.

3. The Electrical Contractor shall obtain all necessary generator information to perform this study.

H. Motor Protection and Coordination

1. Provide a complete and independent set of current-time characteristic curves for all motors 50 HP and above indicating coordination between the protective relays and the thermal and starting characteristics of the motor.

2. The CONSTRUCTION CONTRACTOR shall obtain from the motor supplier the necessary information to perform the study. Certified curves for "Safe Time vs. Current at 100% Voltage" and "Accelerating Time vs. Current at 100% Voltage" are necessary and shall become part of the final report.

I. Call discrepancies to the attention of the Engineer in the conclusions and recommendations of the report.

J. The Time current Characteristic Curves shall include:

1. The coordination plots shall graphically indicate the coordination proposed for the several systems centered on full-scale log forms. The coordination plots shall include complete titles, representative one-line diagrams and legends, associated upstream power system relays, fuse or system characteristics, significant motor starting characteristics, significant generator characteristics, complete parameters for power, and substation transformers, complete operating bands for low voltage circuit breaker trip devices, fuses, and the associated system load protective devices. The coordination plots shall define the types of protective devices selected, together with the proposed coil taps, time-dial settings and pick-up settings required. The short-time region shall indicate the relay instantaneous elements, the magnetizing inrush, and ANSI transformer damage curves, the low voltage circuit breaker and instantaneous trip devices, fuse manufacturing tolerance bands, and significant symmetrical and asymmetrical fault-currents.

2. No more than six devices shall be shown on one coordination plot. Of these six curves, two (the largest upstream device and the smallest downstream device) shall repeat curves shown on other coordination plots in order to provide cross-reference. Give each curve in the study a study-unique number or letter identifier to permit cross-reference between plots.

3. The coordinating time interval between primary and back-up protective devices shall be as per Table 15-3, Section 15.6, IEEE Std. 242-2001.

4. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings. A tabulation shall include settings for every overcurrent protective device, timer, power system relays (e.g., ANSI 25, 27, 32, 67, 87, etc.), circuit breaker, recommended fuse and current transformer ratings, etc. Include C.T. ratio, burden and all other calculations required for the determination of settings. Provide recommended settings for all protective devices furnished under Division 16 and furnished with those furnished with Variable Frequency Drives and associated transformers, generators and associated paralleling and distribution switchgear.

1.08 ARC FLASH

A. Provide an arc flash study that utilizes the fault current values calculated in the short circuit study and the minimum clear times of the upstream protective device selected in the coordination study to calculate the incident energy at each fault location.

B. The Arc Flash study shall be in accordance with the procedure outlined in NFPA 70E.

C. Calculate the incident energy levels at each faulted bus for each mode of operation: (1) "double-ended mode" (double-ended substation with bus tie open); (2) "singled ended mode" (single incoming utility feeder energized all switchgears single ended with bus ties closed); (3) "stand-by mode" (on-site generation solely providing power to the system; (4) "peak shaving modes" (a.) (double-ended substation with bus tie open with on-site generation paralleled) and (b) (single-ended with bus ties closed with on-site generation paralleled). Determine arc flash incident energy values for both maximum and minimum fault values in each case.

D. Extent of Study

1. The arc flash study shall include analysis for all equipment that would normally be serviced while energized and cannot be easily shut down during maintenance periods. The CONSTRUCTION CONTRACTOR shall coordinate with the Owner to ensure that all equipment that is expected to be analyzed is included in the study. The extent of the analysis includes but is not limited to:
   a. Switchgear, MCC’s and distribution equipment
   b. Low voltage lighting panels, even those covered by certain calculation exceptions must be modeled and provided with a unique device label
   c. Low voltage control equipment such as 120-600V control panels.

E. Arc Flash Labels

1. The arc flash study shall produce a single set of label templates that shall not be printed until the final arc flash study has been approved.

2. A single set of labels shall be printed and affixed to the equipment analyzed if the equipment is continuous. Double ended equipment shall have individual labels for each side of the gear. Equipment that is not continuous shall have a single label placed on each piece of continuous gear.

3. Where applicable, LINE and LOAD labels shall be produced for equipment. Examples of equipment that require these labels include the main breakers of switchgear and MCC’s. In these cases, the LINE side breakers shall be affixed to indicate the hazard associated with the line side of the equipment and the LOAD label shall be affixed to indicate the hazard associated with the rest of the gear.

4. Labels shall be affixed where they are clearly identifiable with the equipment they depict. Labels shall not obscure any other signage on the equipment unless they are used to completely cover a previous arc flash label.

5. Labels shall meet the following requirements:
   a. Labels shall be indoor/outdoor rated weather resistant vinyl or polyester with a UV resistant overlaminate. The label shall have a minimum thickness of 5 mil. Labels

shall be backed with pressure sensitive permanent cold temperature adhesive rated for a minimum 5-year life in the environment in which they are installed.

b. All lettering shall be black and printed via thermal transfer. Backgrounds shall be orange for hazard risk categories 1-4 and red for “Dangerous” areas.
c. Where subjected to degrading or corrosive environments, the labels shall be provided with a tinted fiber glass cover.
d. The label shall match any pre-existing facility or Owner specified formatting. The CONSTRUCTION CONTRACTOR shall be responsible for obtaining this formatting information prior to submitting label templates.
e. A single label for equipment is acceptable where equipment is continuous. In the event of split busses or equipment not arranged in a continuous fashion, multiple labels shall be provided.
f. Line side labels for equipment main breakers shall be included in addition to load side labels.
g. Labels shall be DANGER/WARNING type conforming to the NFPA 70E and ANSI Z534.4 standards. Labels are required to have the minimum information specified by these standards printed on them. Labels shall be legible and standard throughout the plant.
h. Labels templates shall be provided to the Engineer and Owner for final approval and shall be printed and affixed by the CONSTRUCTION CONTRACTOR. CONSTRUCTION CONTRACTOR shall be responsible for all work required to print and affix the labels to the equipment. Labels shall be affixed in accordance with the direction of the Owner.

6. CONSTRUCTION CONTRACTOR shall produce all arc flash labels and coordinate affixing them onto all equipment.

F. Arc Flash Mitigation and Reduction Devices

1. Where devices are furnished with alternative trip settings intended to mitigate arc flash hazards, the CONSTRUCTION CONTRACTOR shall provide an alternative arc flash lookup table associated with these alternative settings.

2. Labels shall have only the worst case hazard risk category (without the arc flash reduction settings) depicted. Multiple labels for different device settings shall not be accepted.

3. Devices such as differential protection relays which limit incident energy by limiting the magnitude of the available fault and/or minimizing the fault clearing time may be used to calculate hazard risk categories. The use of these devices in the calculations shall only be permitted where permitted by the standards and code guidelines used to complete the arc flash analysis. If not explicitly stated by the standard as an acceptable method for calculating arc flash hazard, it shall not be permitted.

G. Arc Flash Hazard Mitigation

1. Acceptable hazard risk categories shall be coordinated by the CONSTRUCTION CONTRACTOR between the Owner and Engineer. Where there are no guidelines determining acceptable arc flash levels, the CONSTRUCTION CONTRACTOR shall actively attempt to reduce all hazard risk categories greater than 2. CONSTRUCTION CONTRACTOR shall list all areas greater that category 2 in the conclusion of the report and shall give reasons for the high incident energy.

2. The CONSTRUCTION CONTRACTOR shall be responsible for proposing and evaluating arc flash mitigation measure including but not limited to:
   a. Adjustment of protective devices in an attempt to better balance the system coordination and the incident energy available to an arcing fault.
   b. Equipment that could be used to physically remove the operator from the arc flash hazard boundary (mimic panels, remote switching/racking).
   c. Equipment that could be used to limit the amount of incident energy or reduce the protective device pickup time (maintenance mode bypass, differential relaying).

3. Proposing an evaluating these arc flash mitigation measures shall include evaluating the cost and implementation of the options as well as reevaluating and reporting the hazard risk category associated with their installation.

1.09 MOTOR STARTING/RUNNING

A. Provide a motor starting study for all electric motors rated above 100 HP to determine voltage dip or power inrush limitations at selected locations due to starting of motors. Include in the study problems created by reclosing of Power Company feeders in 20 cycles with a dead time of 15 cycles. Provide relay protection on breakers as the study recommends.

B. The motor starting/running study shall provide a voltage profile for the complete electrical distribution system. At a minimum, the voltage profile shall include voltage values at the utility service point, each switchgear/switchboard bus, each motor control center and at the terminals of each motor identified in Paragraph 1.08A.

C. A complete voltage profile shall be provided for each of the following operating conditions:

   1. All tie circuit breakers open with electrical distribution system operating double-ended.
      a. One profile for all equipment running (steady state condition)
      b. One profile for each motor starting scenario as identified in Paragraph 1.08A.

   2. All tie circuit breakers closed with the electrical distribution system operating single-ended.
      a. One profile for all equipment running (steady state condition)
      b. One profile for each motor starting scenario as identified in Paragraph 1.08A.

D. The CONSTRUCTION CONTRACTOR shall obtain from the motor supplier the necessary information to perform the study. Certified curves for "Safe Time vs. Current at 100% Voltage" and "Accelerating Time vs. Current at 100% Voltage" are absolutely necessary and shall become part of the final report.

E. Multifunction Solid State Motor Protection/Management Relays

   1. Following a starting study, the CONSTRUCTION CONTRACTOR shall produce all settings necessary for the programming of any and all motor protection and/or management relays. Generation of these settings shall take into account the motor starting parameters assessed during the motor starting study and shall incorporate all parameters coordinated with the motor manufacturer.

2. CONSTRUCTION CONTRACTOR shall develop all settings necessary to safely start and run any motor evaluated in the study and controlled by a motor protection/management relay. Settings generated shall include but shall not be limited to:
   a. Starting parameters including start and stall times, torque settings and transition timing where applicable.
   b. Motor protection settings coordinated with the motor manufacturer such as the number of starts per hour, safe stall times, overcurrent protection and mechanical jams.
   c. Logic required for the motor to start, transition and run as specified and designed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 QUALITY ASSURANCE

A. Adjust relay and protective device settings according to values established by coordination study. Setting shall be made in accordance with Section 16950.

B. Make minor modifications to equipment as required to accomplish conformance with the short circuit and protective device coordination studies.

C. Notify Consulting Engineer in writing of any required major equipment modifications.

END OF SECTION

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SECTION 16110
RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install complete raceway systems as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Refer to Section 16600 for additional requirements.

1.03 SUBMITTALS

A. Submit to the ENGINEER, in accordance with Section 01300, the manufacturers' names and product designation or catalog numbers with cut-sheets of all materials specified. Indicate in the submittal, the areas where specific materials are used.

PART 2 PRODUCTS

2.01 MATERIALS

A. Rigid Aluminum Conduit

1. Rigid aluminum conduit shall be 6063 alloy and shall be as manufactured by New Jersey Aluminum Corp.; Reynolds Aluminum International Services Inc.; Alumax Extrusions, Inc; VAW of America, Inc. or equal.

2. Rigid aluminum conduit shall be for use under the provisions of NEC Article 344.

B. Electrical Metallic Tubing

1. Electrical metallic tubing shall be hot-dipped galvanized steel as manufactured by the Allied Tube and Conduit Corp.; Triangle PWC Inc.; Wheatland Tube Co.; Bridgeport or equal.

2. Electrical metallic tubing shall be for use under the provisions of NEC Article 358.

C. Rigid Nonmetallic Conduit

1. PVC conduit shall be rigid polyvinyl chloride schedule 80 as manufactured by Carlon; An Indian Head Co.; Cantex; Queen City Plastics or equal.

2. PVC conduit used in underground concrete encased duct banks shall be rigid polyvinyl chloride schedule 40 as manufactured by Carlon; An Indian Head Co.; Cantex; Queen City Plastics or equal.

3. PVC conduit shall be for use under the provisions of NEC Article 352.

D. Liquidtight Flexible Metal Conduit, Couplings and Fittings

1. Liquidtight flexible metal conduit shall be Sealtite, Type UA, manufactured by the Anaconda Metal Hose Div.; Anaconda American Brass Co.; American Flexible Conduit Co., Inc.; Universal Metal Hose Co. or equal.

2. Fittings used with liquidtight flexible metal conduit shall be of the 3-piece screw-in type malleable iron as manufactured by the O.Z. Gedney Co. or equal.

3. Liquidtight flexible metal conduit shall be for use under the provisions of NEC Article 350.

E. Flexible Metallic Tubing

1. Flexible metallic tubing shall be for use under the provisions of NEC Article 360.

2. Flexible metallic tubing shall be hot-dipped galvanized steel strips shaped into interlocking convolutions firmly joined to one another assuring a complete lock similar to Tristeel as manufactured by Triangle - PWC, Inc. or equal.

3. Flexible metallic tubing shall be used only indoors for connection to lighting fixtures in NEMA 1 administration and office areas.

4. Furnish and install insulated bushings at terminations for conductor protection.

F. Flexible Couplings

1. Flexible couplings shall be type ECGJH as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Killark Electric Manufacturing Co. or equal.

G. Boxes and Fittings

1. Pressed steel switch and outlet boxes shall be hot-dipped galvanized with hot-dipped galvanized tile rings as manufactured by the Raco Manufacturing Co.; Adalet Co.; O.Z. Manufacturing Co. or equal.

2. NEMA 1 and NEMA 12, junction boxes, pull boxes etc., shall be sheet steel unless otherwise shown on the Drawings. Boxes shall be galvanized and have continuously welded seams. Welds shall be ground smooth and galvanized. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies and covers shall not be less than 14-gauge metal. Covers shall be gasketed and fastened with stainless steel screws. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets (refer to Section 16191 for additional requirements). Boxes shall be as manufactured by Hoffman Engineering Co.; Lee Products Co.; ASCO Electrical Products Co., Inc., or equal. All boxes shall be shop primed and painted by the box manufacturer.

3. NEMA 4X stainless steel, junction boxes and pull boxes shall be 316 stainless steel with 316 stainless steel hardware and gasketed covers. Boxes shall have continuously welded seams and welds shall be ground smooth. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies and covers shall not be less than 14-gauge metal. Covers shall be gasketed and fastened with stainless steel screws. Terminal boxes shall be

furnished with hinged doors, terminal mounting straps and brackets (refer to Section 16191 for additional requirements.) Boxes shall be as manufactured by Hoffman Engineering Co.; Lee Products Co.; ASCO Electrical Products Co., Inc., or equal.

4. Explosion-proof boxes shall be designed for Class 1, Group D, Division 1 hazardous locations. They shall be cast aluminum, with stainless steel hinged covers and stainless steel hardware and bolts; Type EJB-N4 as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Adalet-PLM or equal.

5. Cast aluminum boxes and fittings shall be copper free aluminum with cast aluminum covers and stainless steel screws as manufactured by the Killark Electric Co..; Crouse-Hinds Co.; Appleton Electric Co.; or equal.

6. Cast aluminum device boxes shall be Type FD. All cast aluminum boxes and fittings shall be copper-free aluminum with cast aluminum covers and stainless steel screws as manufactured by the Killark Electric Co.; Crouse-Hinds Co.; L. E. Mason Co. or equal.

7. Cast aluminum fittings (C's, T's, LB's, etc.) shall be of the mogul design (with rollers) as manufactured by Appleton Electric Co.

8. Multi-Outlet Assembly
   a. Multi-Outlet Assembly shall only be used where specifically indicated on the drawings. The assembly enclosures shall consist of two piece, all steel or anodized aluminum raceways which shall allow for field installation of wiring and standard receptacles.
   b. Multi outlet assemblies shall be UL Listed as a Multi-outlet assembly.
   c. Raceway bases and removable covers shall be .040-in steel, minimum of 2-1/8-in high by 1-5/8-in deep. Entrance fittings shall be sized for 3/4-in conduit.
   d. Raceways shall include all fittings, couplings, etc, for the complete installation of a finished system.
   e. Device covers shall be the 1702 Series by Walker, similar by Isoduct; Wiremold or equal.
   f. The multi-outlet assembly shall be the 1700 Series by Walker, similar by Isoduct; Wiremold or equal.

9. Pedestal boxes for laboratory bench receptacles shall be cast aluminum, polished finish, single face with 1/2-in NPT tapped inlet, single gang: J.A. Pink Catalog No. 800-A; double gang: J.A. Pink Catalog No. 801-A, similar by Hubbell or equal.

10. Floor boxes shall be of the adjustable single gang, concrete tight type for installation in concrete fill, Walker 800 Series, similar by Hubbell; Thomas & Betts Co. or equal.

11. Conduit hubs shall be of the grounding type as manufactured by Myers Electric Products, Inc. or equal.

12. Conduit wall seals for new concrete walls below grade shall be O.Z./Gedney Co., Type WSK; Spring City Electrical Manufacturing Co., Type WDP or equal.

13. Conduit wall seals for cored holes shall be Type CSML as manufactured by the O.Z./Gedney Co. or equal.

14. Conduit wall and floor seals for sleeved openings shall be Type CSMI as manufactured by the O.Z./Gedney Co. or equal.

15. Combination expansion-deflection fittings embedded in concrete shall be Type XD as manufactured by the Crouse-Hinds Co.; O.Z./Gedney Co.; Spring City Electrical Mfg. Co. or equal.

16. Combination expansion-deflection fittings installed exposed shall be Type XJ as manufactured by Crouse-Hinds Co.; O.Z. Gedney Co.; Spring City Electrical Mfg. Co. or equal.

17. Explosion proof fittings shall be as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; O.Z./Gedney Co. or equal.

18. Conduit sealing bushings shall be O.Z./Gedney, Type CSB or equal.

19. Elbows and couplings shall be aluminum.

20. Electrical metallic tubing fittings shall be of the steel, raintight, concrete-tight, insulated throat (connectors), compression type as manufactured by the Appleton Electric Co.; Crouse-Hinds Co. or equal.

H. Conduit Mounting Equipment

1. In dry indoor non-process areas, hangers, rods, backplates, beam clamps, channel, fasteners, anchors, nuts, washers, etc., shall be hot-dipped galvanized steel.

2. Type 316 Stainless steel channel with type 316 stainless steel hardware (hangers, rods, backplates, beam clamps, fasteners, anchors, nuts, washers, etc.) shall be used in process areas, as shown on the drawings, in areas designated "WET", "DAMP" and "CORROSIVE" on the Drawings and in outdoor locations. All channel and hardware shall be resistant to the chemicals present in the area in which it is used.

3. Expansion anchors (minimum 3/8" diameter) shall be equal to Kwik-Bolt as manufactured by the McCullock Industries, Minneapolis, MI; Wej-it by Wej-it Expansion Products, Inc., Bloomfield, CO; or Kwik-Bolt II as manufactured by the Hilti Fastening Systems, Inc, Tulsa, OK. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1-in behind the steel reinforcement. Apply anti-seize compound to all nuts and bolts. Supports installed without the approved compound shall be dismantled and correctly installed, at no cost to the OWNER.

I. Wall and Floor Slab Opening Seals

1. Wall and floor slab openings shall be sealed with "FLAME-SAFE" as manufactured by the Thomas & Betts Corp.; Pro Set Systems; Neer Mfg. Co.; Specified Technologies, Inc. or equal.

J. Cold Galvanizing Compound

1. Cold galvanizing compound shall be 95% zinc rich paint as manufactured by ZRC Products Company, a Division of Norfolk Corp. or equal.

PART 3 EXECUTION

3.01 RACEWAY APPLICATIONS

A. Except where otherwise shown on the Drawings, or specified, all wiring shall be in rigid aluminum conduit.

B. Schedule 80 PVC conduit shall be used where shown on the Drawings and in chemical rooms, chlorinator rooms and chlorine storage areas or areas designated "CORROSIVE" on the Drawings.

C. PVC conduit shall be used for underground work. Schedule 80 PVC shall be used underground where concrete encasement is not called for. Schedule 40 PVC shall be used when encased in concrete. All elbows associated with underground PVC conduit shall be rigid aluminum.

D. Electrical metallic tubing and fittings may be used only in NEMA 1 administration and office areas. Electrical metallic tubing and fittings shall not be embedded in concrete, installed outdoors, in process areas, shops, maintenance areas, electrical rooms, etc.

E. All conduit of a given type shall be the product of one manufacturer.

3.02 BOX APPLICATIONS

A. Unless otherwise specified herein or shown on the Drawings, all boxes shall be metal.

B. Exposed switch, receptacle and lighting outlet boxes and conduit fittings shall be cast aluminum.

C. Concealed switch, receptacle and lighting outlet boxes shall be pressed steel. Welded seamed boxes will not be permitted.

D. Terminal boxes, junction boxes and pull boxes shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16000.

3.03 FITTINGS APPLICATIONS

A. Combination expansion-deflection fittings shall be used where conduits cross structure expansion joints. Refer to Structural Drawings for expansion joint locations. Provide bonding jumpers around fittings.

B. Conduit wall seals shall be used where underground conduits penetrate walls or at other locations shown on the Drawings.

C. Conduit sealing bushings shall be used to seal conduit ends exposed to the weather and at other locations shown on the Drawings.

3.04 INSTALLATION

A. No conduit smaller than 3/4-inch electrical trade size shall be used, nor shall any have more than the equivalent of three 90-degree bends in any one run. Pull boxes shall be provided as required or directed.

B. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.

C. The ends of all conduits shall be tightly plugged to exclude dust and moisture during construction.

D. Conduit supports, other than for underground raceways, shall be spaced at intervals of 8-ft or less, as required to obtain rigid construction.

E. Single conduits shall be supported by means of aluminum one-hole pipe clamps in combination with aluminum one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-in diameter. Surface mounted panel boxes, junction boxes, conduit, etc, shall be supported by spacers to provide a minimum of 1/2-in clearance between wall and equipment.

F. Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete expansion anchors shall be provided.

G. All conduits on exposed work, within partitions and above suspended ceilings, shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduit shall be run perfectly straight and true.

H. Conduit terminating in pressed steel boxes shall have double locknuts (aluminum) and insulated grounding bushings.

I. Conduit terminating in gasketed enclosures shall be terminated with grounding type conduit hubs.

J. Conduits containing equipment grounding conductors and terminating in sheet steel boxes shall have insulated throat grounding bushings with lay-in type lugs.

K. Conduits shall be installed using threaded fittings unless otherwise specified herein.

L. Liquidtight flexible metal conduit shall be used for all motor terminations, the primary and secondary of transformers, generator terminations and other equipment where vibration is present.

M. Flexible couplings shall be used in hazardous locations for all motor terminations and other equipment where vibration is present.

N. Aluminum fittings and boxes shall be used with aluminum conduit. Aluminum conduit shall not be imbedded in concrete containing chlorides, unwashed beach sand, sea water, or coral bearing

aggregates. Aluminum conduit shall be isolated from other metals with heat shrink tubing (Raychem or equal) or plastic-coated hangers. Strap wrenches shall be used for tightening aluminum conduit. Pipe wrenches, channel locks, chain wrenches, pliers, etc. shall not be used.

O. All threads on aluminum conduit and fittings shall be cleaned and coated with “No-Oxide” compound before installing.

P. Aluminum conduit installed in concrete or below grade shall be completely covered with two (2) coats of bitumastic paint or with heat shrink tubing (Raychem or equal).

Q. Where conduits pass through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke.

R. PVC conduit to non-metallic and metallic box connections shall be made with sealing rings, with a stainless-steel retainer as manufactured by Thomas & Betts Co.

S. Conduit ends exposed to the weather shall be sealed with conduit sealing bushings.

T. Expansion fittings shall be used on exposed runs of PVC conduit where required for thermal expansion. Installation and number of fittings shall be as provided per the NEC and approved by the PVC conduit manufacturer.

U. All conduit entering or leaving a motor control center, switchboard or other multiple compartment enclosure shall be stubbed up into the bottom horizontal wireway or other manufacturer designated area, directly below the vertical section in which the conductors are to be terminated.

V. Conduit sealing and drain fittings shall be installed in areas designated as NEMA 7.

W. Spare conduits and conduit stubouts for future construction shall be provided with threaded PVC end caps at each end.

X. No unbroken run shall exceed 300 feet in length. This length shall be reduced by 75 feet for each 90-degree elbow.

Y. Aluminum conduit entering manholes and below grade pull boxes shall be terminated with grounding type bushings and connected to a 3/4" x 10' rod with a #6 bare copper wire.

Z. Underground circuits shall be installed directly to the respective motor control centers, lighting panels, etc., except stainless steel pull boxes shall be wall mounted on structures to eliminate excessive bends. With prior written approval, below grade pull boxes may be used. Splices shall not be made in above or below grade pull boxes unless otherwise indicated on the plans and approved in writing by the ENGINEER.

AA. All conduits shall have a 4-inch concrete housekeeping pad at all slab and grade penetrations. The housekeeping pad shall have 45-degree, 3/4-inch chamfer at all exposed edges.

BB. All risers from underground, concrete pads, floors, etc., shall be provided with heat shrink tubing (Raychem Co. or equal) from a point 1 foot-0-inch below bottom of slab or grade to a point not less than 6 inches above grade or surface of slab.

CC. Existing conduits are to be reused only where specifically noted on the drawings. Mandrels shall be pulled through all existing conduits which will be reused and through all new conduits 2-in in diameter and larger prior to installing conductors.

DD. 3/16-in polypropylene pull lines shall be installed in all new conduits noted as spares or designated for future equipment.

EE. Where no size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of NEC Article 314.

FF. Conduits shall not cross pipe shafts, access hatches or vent duct openings. They shall be routed to avoid such present or future openings in floor or ceiling construction.

GG. The use of running threads is prohibited. Where such threads are necessary, a 3-piece cast aluminum union shall be used.

HH. Conduits passing from heated to unheated spaces, at all exterior spaces, refrigerated spaces, and cold air plenums, etc, shall be sealed with "Duxseal" as manufactured by Manville or seal fitting to prevent the accumulation of condensation.

II. All field cut ends of hot dipped galvanized mounting channel shall be cleaned and painted with cold galvanizing compound before installation.

JJ. All underground control and instrumentation conduits shall be separated from power conduits by a minimum of 12 inches unless specifically noted otherwise. Crossing of control and instrumentation conduits with power conduits shall be kept to a minimum and where they must cross they shall cross at 90-degree angles.

END OF SECTION

SECTION 16120
WIRES AND CABLES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish, install and test all wire, cable and appurtenances as shown on the Drawings and as specified herein.

B. Install data highway, fiber optic, coaxial and I/O cables furnished under Division 13.

1.02 SUBMITTALS

A. Submit to the ENGINEER, in accordance with Section 01300, samples of proposed wire. Each sample shall have the size, type of insulation and voltage stenciled on the jacket.

B. Approved samples will be sent to the project location for comparison by the Resident Engineer with the wire actually installed.

C. Installed unapproved wire shall be removed and replaced at no additional cost to the OWNER.

1.03 DELIVERY, STORAGE AND HANDLING

A. Carefully handle all conductors to avoid kinks and damage to insulation.

PART 2 PRODUCTS

2.01 GENERAL

A. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper.

B. All conductors shall be stranded, except that lighting and receptacle wiring may be solid.

C. Except for control, signal and instrumentation circuits, wire smaller than No. 12 AWG shall not be used.

D. All wire of a given type shall be the product of a single manufacturer.

2.02 MATERIALS

A. 600 Volt or Less Wire and Cable

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

2. Wire for circuits over 150 volts to ground shall be NEC type XHHW for sizes 4/0 AWG and smaller, and shall be NEC type RHW for sizes 250 MCM (kcmil) and larger.

3. Wire for control circuits shall be #14 AWG minimum NEC type XHHW stranded.

4. Equipment grounding conductors shall be installed in all raceways. Equipment grounding conductors shall be the same NEC type as the phase conductor, green and sized per NEC Table 250.122. Ground grid conductors shall be uninsulated unless shown otherwise on the Drawings.

5. Types THHN, XHHW and RHW wire shall be as manufactured by the Southwire Co., Pirelli Cable Corp., Okonite Co., or equal.

6. Multi-conductor control cable shall be stranded, #14 AWG, 600 V, cross-linked polyethylene insulated w/PVC jacket. Type "XLP" as manufactured by the Southwire Co., American Insulated Wire Corp., or equal.

7. Telephone cable shall be #22 AWG, 4-pairs, solid copper PVC insulation and PVC jacket. UL rated Type CMR as manufactured by American Insulated Wire Corp., or equal.

2.03 INSTRUMENTATION WIRE

A. Process instrumentation wire shall be twisted pair, 600 V, cross linked polyethylene insulated, shielded with foil tape and braid, polyvinyl chloride jacketed type "XLP" as manufactured by the Rockbestos Co., or JEA approved equal.

B. Cable for 4-20 mA instrumentation, potentiometer, RTD and similar analog circuits shall be multi-conductor twisted and shielded with foil tape and braid.

1. Single pair cable:
   a. Conductors: 2 No. 16 AWG stranded and twisted
   b. Insulation: XLP
   c. Shield: 100 percent foil tape and braid
   d. Jacket: PVC with UL and manufacturers identification

2. Three conductor (triad) cable:
   a. Conductors: 3 No. 16 AWG stranded and twisted
   b. Insulation: XLP
   c. Shield: 100 percent foil tape and braid
   d. Jacket: PVC with UL and manufacturers identification

3. Multiple pair cables (where shown on the Drawings):
   a. Conductor: Multiple 2 No. 16 AWG stranded and twisted
   b. Insulation: XLP
   c. Shield: Individual pairs and overall shielded with 100 percent foil tape and braid
   d. Jacket: PVC with UL manufacturers identification

2.04 COMMUNICATION CABLE

A. Ethernet 10/100/1000 BASE-T/TX Cable: The unshielded twisted pair cable shall be designed for use with a high speed (10/100/1000 Mbps) Ethernet 10/100/1000 BASE-T/TX communications network. The twisted pair cable shall have a nominal impedance 100 ohms at one MHz, a maximum attenuation of 8 dB per 1000 feet at one MHz. The twisted pair cable must have frequency tested up to 250 MHz or more. The twisted pair cable shall be plenum rated and shall have a minimum of four 23 AWG solid copper conductor pairs. All 10/100/1000

BASE-T/TX (RJ-45) terminations on the twisted pair cable shall be done in a professional and workman like manner. Terminations shall provide for proper strain relief on the cable jacket. Strain relief on the wire and/or wire insulation shall not be acceptable. Cable shall be Siemens 6XV1840-2AH10 or approved equal. Connectors shall be industrial type, Siemens 6GK1901-1BB10-2AA0 or approved equal.

B. PROFIBUS DP Cable: Where required, provide shielded twisted pair cable designed for use with a PROFIBUS DP network. The twisted pair cable shall be non-plenum, with one 22AWG solid copper conductor pair, a tinned copper braid shield, and sunlight resistant PVC jacket. The cable shall have nominal impedance of 150±15 ohms at 3-20MHz, and maximum attenuation of 5.4dB per 100m at 16MHz. All RS485 bus connector terminations shall be done in a professional and workmanlike manner and shall provide for proper shield grounding and strain relief. Cable shall be Siemens Fast Connect type 6XV1830-0EH10 or approved equal. Connectors shall be Brad Harrison MA9D00-42 and MA9D01-42 type or approved equal.

2.05 TERMINATIONS AND SPLICES (POWER CONDUCTORS)

A. Unless otherwise indicated on the plans, no splices may be made in the cables without prior written approval of the ENGINEER. Where splicing is approved, then splicing material shall be approved by the ENGINEER and cable manufacturer. Splicing materials for all 600 volt splices shall be made with long barrel tin plated copper compression (hydraulically pressed) connectors and insulated with heavy wall heat shrinkable tubing. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.

B. 600-volt wire lugs shall be tin plated copper, long barrel compression type (hydraulically pressed) for wire sizes No. 8 AWG and larger. Lugs for No. 10 AWG and smaller wire shall be locking spade type with insulated sleeve. Lugs shall be as manufactured by the Thomas and Betts Co., or equal.

2.06 TERMINATION AND SPLICES (CONTROL CONDUCTORS)

A. Unless otherwise indicated on the plans, no splices may be made in the cables without prior written approval of the ENGINEER. Where splicing is approved, then splicing material shall be approved by the ENGINEER and cable manufacturer. Splicing materials and installation shall be as required by the ENGINEER. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.

B. Termination connectors shall be of the expanded vinyl insulated locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.

2.07 TERMINATIONS (INSTRUMENTATION CABLES)

A. Termination connectors shall be of the expanded vinyl insulated locking fork-end (upturned leg ends) type as manufactured by 3M Co.; Panduit Corp. or equal.

2.08 MOTOR CONNECTIONS

A. For wire sizes #8 AWG and larger, long barrel tin plated copper compression (hydraulically pressed) type connections (Burndy Co., or equal) shall be installed on the branch circuit wires and the motor leads. Bolted connections shall utilize products which are rated for vibration applications (bolt, nut and spring washer). All connections shall be insulated with heavy duty heat shrinkable material (Raychem Corp. or equal).

2.09 WIRE AND CABLE MARKERS

A. Wire and cable markers shall be type written, heat shrinkable type as manufactured by the W.H. Brady Co., Thomas & Betts Co., 3M Co., or equal.

B. Wire and cables with diameters exceeding the capacity of the heat shrinkable markers shall be marked with pre-printed, self-adhesive vinyl tapes as manufactured by the W.H. Brady Co., Panduit Corp., or equal.

2.10 WALL AND FLOOR SLAB OPENING SEALS

A. Wall and floor slab openings shall be sealed with "FLAME-SAFE" as manufactured by the Thomas & Betts Corp. or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Uniquely identify all wires, cables and each conductor of multi-conductor cables (except lighting and receptacle wiring) at each end with wire and cable markers.

B. Use lubrications to facilitate wire pulling. Pulling compound shall be nontoxic, nonflammable, noncombustible and noncorrosive. The material shall be UL listed and compatible with the cable insulation and jacket.

C. All wire and cable shall be continuous and without splices between points of connection to equipment terminals, except a splice will be permitted by the ENGINEER if the length required between the points of connection exceeds the greatest standard shipping length available from the manufacturer specified or approved by the ENGINEER as the manufacturer of the particular item or wire and cable.

D. Seal openings in slabs and walls through which wires and cables pass.

E. Steel fish tapes and/or steel pulling cables shall not be used in PVC conduit runs.

F. Pull cable from direction that requires the least tension.

G. Feed cable into raceway with zero tension and without cable crossover at raceway entrance.

H. Use a feed-in tube and sheave designed for cable installation. Use sheaves with radii that exceed the cable manufacturer's recommended minimum bending radius.

I. Use a dynamometer and constant velocity power pulling. Velocity should not be less than 15-ft./min or more than 50-ft/min. Do not exceed the cable manufacturer's maximum recommended tension.

J. If cable cannot be terminated immediately after installation install heat shrinkable end caps.

K. Fireproof exposed cables in manholes, vaults, pullboxes, switchgear and other areas not protected by conduit where medium voltage cables are present. Use fire-proofing tape and glass tape in accordance with the manufacturer's instructions. Fire-proofing tape shall be with one half-lapped layer of Scotch Brand 77 Electric Arc and Fireproofing Tape by 3M Corp. or equal. Tape shall be secured with a two-layer band of Scotch Brand 69 Glass Electrical Tape by 3M Corp. or equal over the last wrap.

L. Uniquely identify all cable at supply and receiving ends and in all manholes, handholes or pullboxes. Use embossed brass tags and tywrap fasteners.

M. Hydraulically or manually operated cable benders shall not be used unless approved in writing by the ENGINEER.

N. Instrumentation cables shall be installed in conduits as specified. All circuits shall be installed as twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required.

O. Install shielded instrumentation wire from terminal to terminal with no splicing at any intermediate point. Shielded instrumentation wire, coaxial, data highway, I/O and fiberoptic cables shall be run without splices between instruments, terminal boxes, or panels.

P. Terminal blocks shall be provided at all instrument cable junctions, and all circuits shall be identified at such junctions.

Q. Ground shielding on instrumentation wire at one end only as recommended by the instrument manufacturer and isolated at all other locations. Terminal blocks shall be provided for inter-connecting shield drain wires at all junction boxes. Where individual circuit shielding is required, each shield circuit shall be provided with its own terminal block.

R. Install shielded instrumentation wire in conduit and pull boxes that contain only shielded instrumentation wire. Instrumentation cables shall be separated from all other (i.e. power, control, etc.) cables in manholes.

S. All shielded cable terminations at each end shall be provided with heat shrinkable tubing placed over the exposed shield and conductors. The tubing shall extend 1" minimum over the jacket end and extend ½" minimum from the jacket end over the exposed conductors.

3.02 WIRE COLOR CODE

A. All wire shall be color coded or coded using electrical tape in sizes where colored insulation is not available. Where tape is used as the identification system, it shall be applied in all junction boxes, manholes and other accessible intermediate locations as well as at each termination.

B. The following coding shall be used:

System	Wire	Color
240/120 Volts	Neutral	White
Single-Phase, 3 Wire	Line 1	Black
	Line 2	Red
208Y/120, Volts	Neutral	White
3 Phase, 4 Wire	Phase A	Black
	Phase B	Red
	Phase C	Blue
240/120 Volts	Neutral	White
3 Phase, 4 Wire	Phase A	Black
delta, center tap	Phase B (High)	Orange
ground on phase	Phase C	Blue
coil A-C		
480Y/277 Volts	Neutral	Gray
3 Phase, 4 Wire	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
Control (Individual Conductors)	AC	Red
	24VDC	Blue
	0VDC	White/Blue Stripes

3.03 FIELD TESTING

A. Test all 600-volt wire insulation with a megohm meter after installation and prior to termination. Make tests at not less than 1000 volts DC. Submit a written test report of the results to the ENGINEER. Notify ENGINEER in writing 48 hours prior to testing.

B. Field testing and commissioning shall be done in accordance with the latest revision of the "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" published by the InterNational Electrical Testing Association unless otherwise modified by this Section. Minimum wire insulation resistance shall not be less than 250 Megohms.

C. All service conductors shall be tested as in paragraph A above with the ENGINEER present.

END OF SECTION

SECTION 16123
LOW VOLTAGE CABLE SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all low voltage cable systems and connecting hardware for the horizontal pathways for the safety and security systems, data networks, and communication systems.

B. Install data communications, coaxial and specialty I/O cables furnished under other Divisions.

C. Furnish and install wiring for fire alarm systems.

1.02 RELATED WORK

A. Power supply wiring up to 600V is included in Section 16120.

B. Fiber optic cable is included in Section 13321.

C. Underground ducts, manholes, and handholes are included in Section 16600.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 01300.

B. Shop drawings shall include the following information:

1. Detailed catalog information or drawings describing electrical and physical characteristics of the equipment specified in sufficient detail to show compliance with the Drawings and Specifications.

2. Cable schedules and conduit assignments.

3. Submit cable pulling calculations where required.

4. Test reports.

C. Project Record Documents:

1. Submit record document information in accordance with Section 16000.

2. Submit the following information for record purposes:
   a. Field wiring interconnection drawings illustrating all field components and electric connections to the systems supplied under this Section.

1.04 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1. EIA TIA/EIA-569-A; Commercial Building Standards for Telecommunications Pathways and Spaces and related bulletins.

2. EIA TIA/EIA-568-B; Commercial Building Telecommunications Cabling Standard and related bulletins.

3. ANSI/TIA/EIA-568-C.0 – Generic Communications Cabling for Customer Premises.

4. ANSI/TIA/EIA-568-C.1 – Commercial Building Communications Cabling Standard Part 1: General Requirements.

5. ANSI/TIA/EIA-568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards

6. ANSI/TIA/EIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces.

7. ANSI/TIA/EIA-606-A – Administration Standard for the Commercial Telecommunications Infrastructure.

8. ANSI/TIA-607-B – Commercial Building Bonding and Grounding (Earthing) Requirements for Telecommunications.

B. National Electrical Manufacturers Association (NEMA) for relevant equipment standards.

C. BICSI – TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM)

D. Underwriters' Laboratories (UL).

E. National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code.

F. National Electrical Contractors Association (NECA/BICSI)

1. NECA/BICSI 607, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings and related bulletins.

G. Where reference is made to one of the above standards, the revision in effect at the time of the bid shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. All category cabling manufacturers must be able to provide documentation from an independent third-party testing agency that verifies through random sampling that cable components perform at or above the levels contained on their product specifications, not simply at or above the standard.

B. Regulatory Requirements:

1. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 (NEC) unless more stringent requirements are specified or indicated.

C. Certifications:

1. The manufacturer shall maintain a documented ISO 9001 or 9002 quality assurance program implementing suitable procedures and controls to monitor all aspects of production and testing.

2. All cables and devices shall be UL listed and labeled where standards exist.

1.06 SYSTEM DESCRIPTION

A. Low voltage cable subsystems consist of copper twisted-pair cabling assemblies connecting various outlets and devices located at individual work areas using the following types of cables:

1. Ethernet cables

2. DeviceNet cables

3. Profibus cables

4. RS-485 cables

5. Shielded twisted pair cables

6. Unshielded twisted pair cables

B. Low voltage cabling systems: Includes cables, jacks, splice panels, connecting blocks, patch cords, connectors, jumpers, and necessary support systems, such as cable managers and faceplates.

1. Furnish and install all materials necessary for complete and working cabling systems.

C. System Responsibilities:

1. The CONSTRUCTION CONTRACTOR shall coordinate the work within the Communication Rooms with the OWNER or its designated Telecommunications Contractor concerning access and terminations at rack mounted equipment.

D. Performance Requirements:

1. Surge Withstand Capability: per ANSI/IEEE C62.41 without damage.

2. The equipment and components shall operate continuously at its rated current under the following environmental conditions without damage or degradation of operating characteristics or life:
   a. Operating Ambient Temperature: 40 degrees C maximum ambient temperature.

b. Storage Temperature: -40 degrees C to 65 degrees C.
c. Relative Humidity: 0 to 95%, non-condensing.
d. Altitude: Operating to 3300 ft, de-rate for higher elevations.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection:

1. Store and handle materials in accordance with manufacturer's instructions.
   a. Keep materials in manufacturer's original, unopened containers and packaging until installation.
   b. Store materials in clean, dry area indoors.
   c. Protect materials during storage, handling, and installation to prevent damage.

2. Refer to Section 16000.

1.08 WARRANTY

A. Refer to Section 16000.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. Products of the following manufacturers are acceptable.

1. Alpha Wire Company

2. Berk-Tek

3. Belden CDT

4. General Cable

5. or equal

C. Like items of materials/equipment shall be the end products of the same manufacturer in order to provide standardization for appearance, performance, and manufacturer's parts and service.

2.02 NETWORK CABLING

A. Provide Ethernet network cables of the cable types indicated on the Drawings and as specified. If no type is indicated, provide Category 6 UTP.

1. Augmented Category 6a Unshielded Twisted Pair.

2. Enhanced Category 6e Unshielded Twisted Pair.

3. Category 6 Unshielded Twisted Pair (UTP).

4. Category 6 Shielded Twisted Pair.

B. Cables shall meet TIA/EIA-568-C.2 standards and shall consist of four non-bonded twisted pair cables formed into a single PVC jacketed cable core.

1. Conductors:
   a. Solid copper conductors.
   b. Minimum No. 24 AWG.

2. Insulation:
   a. Polyolefin polyethylene (non-plenum) or FEP (plenum).
   b. 300-volt rated insulation.

3. Color code:
   a. Pair 1: White/blue stripe and blue.
   b. Pair 2: White/orange stripe and orange.
   c. Pair 3: White/green stripe and green.
   d. Pair 4: White/brown stripe and brown.

4. Outer jacket:
   a. Sunlight resistant, flame retardant polyvinyl chloride outer jacket.
   b. White sheath for Voice.
   c. Blue sheath for Data.
   d. Low Smoke, CMP-50, FEP, clear jacket where required by fire code.

5. Electrical characteristics:
   a. Frequency range: 0.772-100 MHz.
   b. Attenuation: 32.1 dB/100 m.
   c. Near-end crosstalk (NEXT): 39.3 dB.
   d. Power sum NEXT: 37.3 dB.
   e. Attenuation to crosstalk ratio (ACR): 7.2 dB.
   f. Power sum attenuation to crosstalk ratio (PSACR): 5.3 dB/100 m.
   g. Equal level far-end crosstalk (ELFEXT): 22.8 dB.
   h. Power sum ELFEXT: 19.8 dB/100 m.
   i. Return loss: 17.3 dB.
   j. Propagation delay: 537 ns/100 m.
   k. Delay skew: 45 ns/100 m.
   l. Propagation delay (skew), max: 2.5 ns/100 m.

2.03 DEVICENET CABLE

A. Provide DeviceNet cables of the cable types as indicated on the Drawings and as specified.

1. Cables shall meet NEC/UL specification for wet locations.

2. Compliant with the device manufacturer’s and ODVA specifications, and shall pass the ODVA established conformance test.

3. Approved to bear the ODVA Conformance Tested Service Mark.

B. Thick cable types shall consist of two shielded pairs for data and power within an overall jacket:

1. Shielded data pair:
   a. Tinned, copper conductors, minimum No. 18 AWG.
   b. Flame retardant polypropylene insulated.
   c. Aluminum foil-polyester tape shield, 100 percent coverage.
   d. Color: Blue and white.

2. Shielded DC power pair:
   a. Tinned, copper conductors, minimum No. 16 AWG.
   b. Polyvinyl chloride insulated.
   c. Aluminum foil-polyester tape shield, 100 percent coverage.
   d. Color: Black and red.

3. Outer jacket:
   a. Sunlight/oil resistant polyvinyl chloride outer jacket.
   b. 600-volt rated insulation.
   c. Overall 65 percent tinned copper braid shield.
   d. Outer shield tinned copper drain wire.

C. Thin cable types shall consist of two shielded pairs for data and power within an overall jacket:

1. Shielded data pair:
   a. Tinned, copper conductors, minimum No. 20 AWG.
   b. Foam polyethylene (FPE) insulated.
   c. Aluminum foil-polyester tape shield, 100 percent coverage.
   d. Color: Blue and white.

2. Shielded DC power pair:
   a. Tinned, copper conductors, minimum No. 18 AWG.
   b. Polyvinyl chloride insulated.
   c. Aluminum-foil polyester tape shield, 100 percent coverage.
   d. Color: Black and red.

3. Outer jacket:
   a. Sunlight/oil resistant polyvinyl chloride outer jacket.
   b. 300-volt rated insulation.
   c. Overall 65 percent tinned copper braid shield.
   d. Outer shield tinned copper drain wire.

2.04 PROFIBUS CABLE

A. Provide Profibus cables of the cable types as indicated on the Drawings and as specified. Cables shall meet Profibus specifications and be certified when applicable.

1. Profibus PA, single pair:
   a. Conductors: Tinned copper, minimum No. 18 AWG.
   b. Insulation: Polyolefin, 300-volt rated.
   c. Aluminum foil-polyester shield with 100 percent coverage.
   d. Tinned copper drain wire.

e. Outer jacket: Orange colored chlorinated polyethylene (CPE) meeting NEC/UL specifications for direct burial or wet locations.

2. Profibus DP, single pair:
   a. Conductors: Tinned copper, minimum No. 22 AWG.
   b. Insulation: Polyolefin, 300-volt rated.
   c. Aluminum foil-polyester shield with 100 percent coverage.
   d. Tinned copper drain wire.
   e. Outer jacket: Purple colored chlorinated polyethylene (CPE) meeting NEC/UL specifications for direct burial or wet locations.

2.05 RS-485 CABLE

A. Two pair shielded twisted cable:

1. Conductors:
   a. Tinned copper, minimum No. 22 AWG.

2. Insulation:
   a. FHDPE: Foam high-density polyethylene.
   b. 300-volt rated.

3. Outer shield:
   a. 100 percent coverage.
   b. Aluminum foil-polyester tape.
   c. Tinned copper braid.

4. Outer shield drain wire:
   a. Tinned, copper conductor.
   b. Minimum No. 22 AWG.

5. Outer jacket:
   a. Sunlight resistant PVC.
   b. UL/CSA flame tested.

6. Minimum bending radius 2.5 inches.

7. Increase conductor sizes for voltage drop. Observe the manufacturers recommendations and distance limitations.

2.06 SECURITY AND SURVEILLANCE SYSTEMS

A. Cable applications for card access control, video surveillance, and intrusion detection systems shall be coordinated with the specific requirements of the equipment vendor by the CONSTRUCTION CONTRACTOR. Cables shall meet or exceed the following:

1. Peer-to-peer network communication cable (ACU Panel to ACU Panel):
   a. Two pair, twisted, No. 22 AWG,
   b. Solid tinned copper conductors.
   c. Drain wire: solid tinned copper.
   d. Overall 100 percent shield.

2. Strike power (DC power):
   a. One pair, twisted, No. 18 AWG.
   b. Stranded copper conductors.
   c. Shielded.

3. Detection device inputs such as glass break sensors, motion sensors, etc. (Signal and power):
   a. Two pair, twisted, No. 22 AWG.
   b. Stranded copper conductors.
   c. Shielded.

4. Contact device inputs such as door switches, tamper switches, etc. (Signal):
   a. One pair, twisted, No. 18 AWG.
   b. Stranded copper conductors.
   c. Shielded.

5. Card reader communication cable: (ACU Panel to reader):
   a. Eight conductors, twisted, No. 22 AWG.
   b. Stranded copper conductors.
   c. Overall 100 percent shield.

6. Miscellaneous I/O (per point)
   a. One pair, twisted, No. 18 AWG.
   b. Stranded copper conductors.
   c. Shielded.

7. Ethernet cable for IP based systems: Cat 6

8. Security cable outer jacket shall be yellow.

9. Increase conductor sizes for voltage drop. Observe the manufacturers recommendations and distance limitations.

10. Cable and wire installed between access control components and intelligent field panels and power supplies at indoor locations shall be installed in conduit. Cable and wire installed in underground raceways shall be rated for wet locations.

2.07 TERMINATIONS

A. Provide modular jacks, patch panels, connecting blocks, patch cords, connectors, enclosures, jumpers, and necessary support systems, such as cable managers and faceplates for terminating low voltage cable systems.

1. Modular Jacks.
   a. 8-position modular RJ-45 jack, IDC terminals, T568A/B wiring scheme.
   b. Identification: Stamped or have icons for identification.
   c. Voice color: fog white
   d. Data color: orange

2. Work Area Outlets
   a. Flush-Mounted Faceplates: Coordinate with Architect to match finish. Part numbers shown are for standard color fog white.
   b. 1-port faceplate with mounting lugs for wall phone, stainless steel, mounts within single-gang wall box, Legrand/Ortronics OR-403STJ1WP, or equal.
   c. 2-port faceplate, high-impact thermo-plastic, with recessed label fields, mounts within single-gang wall box, Legrand/Ortronics OR-40300548, or equal.
   d. 4-port faceplate, high-impact thermo-plastic, with recessed label fields, mounts within single-gang wall box, Legrand/Ortronics OR-40300546, or equal.
   e. Modular Furniture Faceplates: 4-port modular furniture bezel to fit furniture knockout, with recessed label field.
   f. Each WAO shall have individually cabled voice and data jacks.
   g. A Fiber to the Desktop (FTTD) Work Area Outlet (WAO) shall consist of an 8-port faceplate with an expanded electrical device box inside the wall that allows for proper fiber bend radius, two LC type fiber optic connectors, voice and data jacks, and one 4-strand indoor single mode fiber optic cable.

3. Termination Blocks
   a. Category 6, 96 pair, 110-style, with mounting legs, wall mount.
   b. Block Labels: Clear plastic holder for 110 blocks with paper inserts.
   c. Wiring Troughs: Horizontal trough for routing of patch cords and cross-connect wire, with mounting legs.
   d. Mounting Brackets: 19-inch, rack-mount brackets for 200 pair, 110 termination blocks and wiring troughs.

4. Patch Panels
   a. Voice/Data Patch Panels: 24 or 48-port, 8-position modular jack panel, high-density, 8-port modules, Category 6, IDC terminals, T568A/B wiring scheme.
   b. FTTD Patch Panels: Refer to Section 26 05 20.
   c. Modular Patch Cords: Factory-terminated, double-ended, 8-position to 8-position, modular, stranded conductors, Category 6, 4 pair.
   d. 110/110 Patch Cords: Factory-terminated, double-ended, 110-connector to 110-connector, modular, stranded conductors, Category 6, 4 pair.
   e. 110/Modular 8-Position Patch Cords: Factory-terminated, double-ended, 110-connector to 8-position, modular, stranded conductors, Category 6, 4 pair.
   f. Patch cords shall be manufactured by the same manufacturer as the data patch panels and modules to ensure compatibility, performance and warranty, and shall meet or exceed Category 6 performance requirements.
   g. Cable management panel: Ortronics OR-808044855, or equal.

PART 3 EXECUTION

3.01 GENERAL

A. Install low voltage cable systems in accordance with Section 16120 and this Section. Install cables in conduit, cable trays, spaces below raised floors, open ceiling areas, non-ventilated spaces above ceiling tile, and through plenum air-handling spaces above ceiling tile.

B. Install communications horizontal cabling in accordance with manufacturer's instructions, ANSI/TIA/EIA-568-C.0, ANSI/TIA/EIA-568-C.1, ANSI/TIA/EIA-569-B, BICSI TDMM, and NFPA 70.

C. Inspect installed conduit, wireway, cable trays, and inner duct to ensure cable pathways are completely and thoroughly clean before installing cabling. Clean raceway and inner duct systems as necessary.

D. Protect exposed cables where subject to damage.

1. Provide abrasion protection for cable or wire bundles which pass through holes or across edges of sheet metal.

2. Use protective bushings to protect cables.

3. Protect installed cabling from damage during construction.

E. Install a 1/8-inch minimum nylon pull cord with cables in each conduit and in each empty conduit.

F. Do not fill greater than TIA/EIA-569-B and the NEC maximum fill for particular raceway type.

G. Replace any damaged cables or cables that fail the specified tests.

H. Install cables in continuous lengths from origin to destination, without splices, except for designated transition or consolidation points. Where transition or consolidation points are allowed, they shall be located in accessible locations and housed in enclosure suitable for the intended purpose.

I. Each voice jack and each data jack shall be connected to a dedicated 4-pair Unshielded Twisted Pair (UTP) Category 6 cable.

J. Provide pulling calculations for cables installed using mechanical pulling equipment to verify that the maximum cable tension and sidewall pressure will not exceed manufacturer's recommended values. Submit the calculations to the Engineer a minimum of two weeks before cable installation.

3.02 INSTALLATION

A. All of the systems cabling shall be installed in conduit except where shown otherwise on the Drawings. For retrofitting existing spaces, surface raceway systems such as Wiremold may be used subject to approval of the Engineer.

B. Install a minimum of a 1-inch conduit from each WAO box to the telephone equipment room. Looping of multiple work area outlets or floor boxes with a single conduit is not allowed. Dedicated cable baskets or trays specifically designed for communications service may be used above false ceilings or other locations indicated on the Drawings. Maintain adequate separation between telephone and electrical power facilities to prevent induced voltages and EMI.

C. Bundle cables in groups of no more than amount of cables designed for by cable support manufacturer based on cable OD and weight. Support bundles at a maximum of 48-inch intervals if J-hook or trapeze system is used.

D. Install appropriate carriers to support cabling, where support for cables are required. Do not allow cables to rest on acoustic ceiling grids, plumbing pipes, or electrical conduits. Do not attach cables to ceiling grid or lighting fixture wires.

E. Install cable supports above fire-sprinkler system. Do not attach cables to fire-sprinkler system or ancillary equipment or hardware. Install cable system and support hardware so that it does not obscure valves, fire alarm conduit, boxes, or other control devices.

F. Provide following minimum separation distances between low voltage copper cables and power wiring of 480 volts or less:

1. Open or Nonmetal Communications Pathways:
   a. Electric motors, fluorescent light fixtures, and unshielded power lines carrying up to 3 kVA: 12 inches.
   b. Electrical equipment and unshielded power lines carrying more than 5 kVA: 36 inches.
   c. Large electrical motors or transformers: 48 inches.

2. Grounded Metal Conduit Communications Pathways:
   a. Electrical equipment and unshielded power lines carrying up to 2 kVA: 2-1/2 inches.
   b. Electrical equipment and unshielded power lines carrying from 2 kVA to 5 kVA: 6 inches.
   c. Electrical equipment and unshielded power lines carrying more than 5 kVA: 12 inches.
   d. Power lines enclosed in grounded metal conduit (or equivalent shielding) carrying from 2 kVA to 5 kVA: 3 inches.
   e. Power lines enclosed in grounded metal conduit (or equivalent shielding) carrying more than 5 kVA: 6 inches.

3.03 TERMINATIONS

A. Horizontal cables shall not be connected directly to telecommunications or network equipment. Suitable termination hardware including patch panels, 110-type punch-down blocks, and factory-manufactured patch cords shall be used to make this connection.

1. Cross-connect jumpers shall be used for analog voice circuits only.

2. VoIP and data cabling shall be terminated on separate patch panels in the telephone room. Patch panels shall be mounted on a wall-mounted bracket, in a free standing welded steel equipment rack, or in an enclosed data cabinet as shown on the Drawings.

3. One cable management panel shall be installed for each data patch panel in all wall, rack and cabinet installations.

B. Coil cables to house cable coil without exceeding manufacturers bend radius.

1. In hollow wall installations where box eliminators are used, store excess wire in wall.

2. Store no more than 12 inches of UTP and 36 inches of fiber slack.

3. Loosely coil excess slack and store in ceiling above each drop location, when there is not enough space present in outlet box to store slack cables.

4. Do not exceed a 1-in minimum bending radius for 4-pair twisted cables.

C. Dress and terminate cables in accordance with ANSI/TIA/EIA-568-C.0, ANSI/TIA/EIA-C.1, BICSI TDMM, and manufacturer's instructions.

1. Terminate 4-pair cables on jack and patch panels using T568-B or T568-A wiring scheme.

2. Pair Untwist at Termination: Do not exceed 12 mm (1/2 inch).

3. Bend Radius of Horizontal Cables: Not less than 4 times cable OD.

4. Maintain cable jacket to within 25 mm (1 inch) of termination point.

5. Neatly bundle cables and dress to their respective panels or blocks.
   a. Feed each panel or block by individual bundle separated and dressed back to point of cable entrance into rack or frame.

D. Terminate shielded cable foil shields and drain wires to maintain shield continuity and shielding effectiveness from the cable to the connector. The connector manufacturer's installation instructions should be followed for shielded cable termination.

E. Provide network data outlets (RJ-45) at locations shown on the Drawings and at the following locations:

1. Install a minimum of two data outlets at the Fire Alarm Control Panel (FACP) location in the electrical or mechanical room.

2. Install a minimum of one data outlet at each HVAC control panel.

3. Install a minimum of two data outlets in each electrical room.

4. Install a minimum of one data outlet at the security system control panel.

5. Provide a 120VAC duplex power receptacle within three feet of each data outlet location.

6. Data outlets located in hose or wash-down areas shall be installed above the anticipated damp area, and shall include a UL listed, NEMA rated water resistant cover.

3.04 FIELD QUALITY CONTROL

A. Test all cables in accordance with this specification section, ANSI/TIA/EIA-568-C.0, ANSI/TIA/EIA-568-C.1, and ANSI/TIA/EIA-568-C.2 standards, and manufacturer’s instructions.

B. Test cables and termination hardware 100 percent for defects in installation and verify cabling system performance under installed conditions in accordance with ANSI/TIA/EIA-568-C.0.

1. Verify all pairs of each installed cable before system acceptance.

2. Defects in cabling system installation, including but not limited to cables, connectors, patch panels, and connector blocks shall be repaired or replaced to ensure 100 percent useable conductors in all cables installed.

C. Testing

1. Test twisted-pair copper cable links for continuity, pair reversals, shorts, opens, and performance as specified.
   a. Additional testing is required to verify Category performance.
   b. Test horizontal cabling using manufacturers approved certification tester (Fluke or Agilent) for Category 6a, Category 6, and Category 5e performance compliance in accordance with ANSI/TIA/EIA-568-C.2.
   c. Category 6a shall conform to ANSI/TIA/EIA-568-C-2 for augmented Category 6 to 500 MHz.

2. Follow ANSI/TIA/EIA-568-C.2.

3. Basic Tests Required:
   a. Wire map.
   b. Length (feet).
   c. Insertion loss (dB), formerly attenuation.
   d. NEXT (Near end crosstalk) (dB).
   e. Return loss (dB).
   f. ELFEXT (dB).
   g. Propagation delay (ns).
   h. Delay skew (ns).
   i. PSNEXT (Power sum near-end crosstalk loss) (dB).
   j. PSELFEXT (Power sum equal level far-end crosstalk loss) (dB).

4. Category 6a: auto test to 500 MHz.

5. Category 6: auto test to 250 MHz.

6. Category 5e: auto test to 100 MHz.

7. Provide test results in approved certification testers original software format on CD, with the following minimum information per cable:
   a. Circuit ID.
   b. Information from specified basic tests required.
   c. Test Result: “Pass” or “Fail”.
   d. Date and time of test.
   e. Project name.
   f. NVP.
   g. Software version.

8. No failed test will be accepted. Retest these results and submit after a “Pass” is received.

9. Submit software copy of test results, in original tester software format, to the Owner and the Engineer.

10. Submit fully functional version of tester software for use by the Engineer in reviewing test results.

11. Report in writing to the Engineer immediately, along with copy of test results, failed test results that cannot be remedied through re-termination (as in the case of reversed or split pairs).

D. Verify networking performance with all interfacing systems by other manufacturers.

3.05 LABELING

A. Label horizontal cables using machine-printed label at each end of cable at approximately 12 inches from termination point and again at approximately 48 inches from termination point. Labeling shall be in accordance with ANSI/TIA/EIA-606-A and manufacturer's instructions.

1. Handwritten labels are not acceptable.

2. Label patch panel ports and work area outlet ports with cable identifier.

3. Coordinate with the Owner's specific labeling requirements.

4. Note labeling information on as-built drawings.

3.06 CLEANING

A. Remove all rubbish and debris from the work area. Remove dirt, dust, and concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags.

END OF SECTION

SECTION 16150
MOTORS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. All motors shall be furnished as called for in other Sections of these Specifications and shall be in conformance with the requirements of this section.

1.02 QUALIFICATIONS

A. Routine tests shall be performed on representative motors, and shall include the information described on NEMA MG1-12.54 "Report of Test Form for Routine Tests on Induction Motors". Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors.

1.03 SUBMITTALS

A. Submittal of motor data for acceptance shall include complete nameplate data and test characteristics in accordance with NEMA Standard MG1-12.54 "Report of Test Form for Routine Tests on Induction Motors" and, in addition, the following for motors typical of the units furnished:

1. Efficiency at ½, ¾ and full load
2. Power factor at ½, ¾ and full load
3. Motor outline, dimensions and weight
4. Descriptive bulletins, including full description of insulation system
5. Bearing design data
6. Special features (i.e., space heaters, temperature detectors, etc.)

B. The motor manufacturer shall submit to the ENGINEER as provided in Section 01300, certified dimension prints showing nameplate data and outline dimensions within three weeks of the date they receive the order.

C. Guarantee: All equipment furnished and installed under this Section shall be guaranteed against defects of workmanship, materials and proper installation for a period of one (1) year from date of acceptance. All such equipment or parts proven defective, due to the above noted causes, shall be replaced in the machines by the CONSTRUCTION CONTRACTOR at no expense to the OWNER.

D. Provide equipment warranty in accordance with Section 01740.

1.04 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

B. National Electrical Manufacturers Association (NEMA)

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.01 GENERAL

A. Unless otherwise noted, all motors ½ through 100 horsepower shall be rated 230/460 volt, 3 phase, 60 Hertz A.C.; motors 125 horsepower and above shall be rated 460 volt, 3-phase, 60 Hertz, and motors below ½ horsepower shall be rated 115/230 volt, 1 phase, 60 Hertz A.C.

B. All motors used with variable frequency drives shall be rated for inverter duty and shall be in accordance with the latest NEMA MG1, Section IV, Part 31.

C. All motors shall be built in accordance with current NEMA, IEEE, ANSI and AFBMA standards. Motors shall be of the type and quality described by this Section and other Divisions of the Specifications, and/or as shown on the Drawings, fully capable of performing in accordance with Manufacturer's nameplate rating, and free from defective material and workmanship.

2.02 RATINGS

A. All motors shall be sufficient size for the duty to be performed and shall not exceed their full-rated load when the driven equipment is operating at specified capacity and over the operational range. Unless otherwise noted, motors driving pumps, blowers, etc. shall not be overloaded at any head or discharge condition. The motor shall not be required to deliver more than its rated nameplate horsepower, at the 1.0 service factor, under any condition of mechanical or hydraulic loading (i.e. although a 1.15 service factor is required, it may not be used under any condition).

B. Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage 10 percent below nameplate rating. Where shown on the Electrical Drawings to be operated on a reduced voltage starter, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method.

C. All motors shall be continuous time rated suitable for operation in a 40 degrees C ambient unless noted otherwise.

D. Specific motor data such as Hp, rpm, etc., is specified under the detailed specification for the equipment with which the motor is supplied.

2.03 NAMEPLATES

A. The motor manufacturer's nameplates shall be engraved or embossed on stainless steel and fastened to the motor frame with stainless steel screws or drive pins. Nameplates shall indicate clearly all of the items of information enumerated in NEMA Standard MG1-10.38 or MG1-20.60, as applicable.

2.04 CONDENSATION HEATERS

A. Condensation heaters, where specified herein or under the detailed mechanical specifications shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 Volt, single phase with wattage as required. The heater wattage and voltage shall be embossed on the motor nameplate.

2.05 WINDING TEMPERATURE DETECTORS

A. Winding temperature detectors, unless specified otherwise herein shall be a factory installed, embedded, bi-metallic switch type with leads terminating in the main conduit box. This device shall protect the motor against damage from overheating caused by single phasing, overload, high ambient temperature, abnormal voltage, locked rotor, frequent starts or ventilation failure. The switch shall have normally open contacts. Not less than three detectors shall be furnished with each motor.

B. All motors operating with variable frequency drives shall be equipped with winding temperature detectors.

2.06 THREE PHASE INDUCTION MOTORS

A. Motors ~~50~~ 30 horsepower and larger shall have a 120-volt space heater for moisture control.

B. Unless specifically noted in other Sections of these Specifications, all motors shall have minimum efficiencies as listed below:

Horsepower	NEMA Nominal Efficiency, %
1-2	84.0
3-5	88.5
7-1/2	89.5
10	90.2
15	91.0
20	92.0
25	92.2
30	92.4
40-50	94.0
60-100	94.5
Over 100	95.0

2.07 CONSTRUCTION

A. General:

1. All drip-proof and weather protected Type I and Type II motors shall have epoxy encapsulated windings. Totally enclosed motors shall be provided with an upgraded insulation by additional dips and bakes to increase moisture resistance and shall not be encapsulated. Motors for outdoor service shall have vacuum pressure impregnated (VPI) epoxy insulation for moisture resistance. Two speed motors shall be of the two-winding type.

2. Squirrel-cage rotors shall be made from high-grade steel laminations adequately fastened together and to the shaft, or shall be cast aluminum or bar-type construction with brazed end rings.

3. All motors shall be of the premium efficiency and high-power factor type. All motors shall be the corrosion resistant type conforming to motors designated as “Corro-Duty” by U.S. Motors or equal.

4. Vertical motors shall be hollow or solid shaft as required by the equipment furnished under other Sections of these Specifications.

5. Totally enclosed non-ventilated (TENV) motors shall include the same ratings and accessories as specified for TEFC motors. Explosion-proof motors shall be UL listed and FM approved for Class 1, Division 1 hazardous areas.

B. Low Voltage, Three Phase Motors:

1. Motors shall be of the squirrel-cage induction type. Horizontal, vertical solid shaft, vertical hollow shaft, normal thrust and high thrust types shall be furnished as called for on the Drawings and as specified in other Sections of these specifications. Motors shall be of the type and quality described by these Specifications, and/or as shown on the schedule on the Drawings, fully capable of performing in accordance with Manufacturer's nameplate rating, and free from defective material and workmanship.

2. Motors shall have normal or high starting torque (as required), low starting current (not to exceed 650 percent full load current), and low slip.

3. Unless otherwise specified, motors shall be totally enclosed fan-cooled construction with a 1.15 service factor at the Class B Temperature-Rise.

4. The output shaft shall be suitable for direct connection or belt drive as required.

5. Motors shall have a Class F non-hygroscopic insulation system but shall be limited to Class B Temperature-Rise, at 1.15 service factor.

6. All motors shall have a final coating of chemical resistant corrosion and fungus protective epoxy fortified enamel finish sprayed over red primer over all interior and exterior surfaces. Stator bore and rotor of all motors shall be epoxy coated.

7. All fittings, bolts, nuts, and screws shall be plated to resist corrosion. Bolts and nuts shall have hex heads.

8. All machine surfaces shall be coated with rust inhibiter for easy disassembly.

9. Conduit box shall be split from top to bottom and shall be capable of being rotated to four 90 degree positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and sealed with a non-wicking, non-hygroscopic insulating material. A frame mounted pad with drilled and tapped hole, not less than 1/4-inch diameter, shall be provided inside the conduit box for motor frame grounding. All motor conduit boxes shall be provided with the correct number of conduit openings sized as indicated on the drawings. Boxes shall be suitably sized for conductor bending and terminations.

10. Totally enclosed motors shall be provided with condensate drain hole and epoxy coated motor windings to protect against moisture.

11. Nameplates shall be stainless steel. Lifting lugs or "O" type bolts shall be supplied on all frames 254T and larger. Enclosures shall have stainless steel screens. Motors shall be protected for corrosion, fungus and insects.

12. Low voltage, three phase motors shall be manufactured by U.S. Motors, TECO, Marathon, Siemens, General Electric, Toshiba or Reliance Electric.

13. Fractional Horsepower:
    a. Fractional horsepower motors shall be rigid, welded-steel, designed to maintain accurate alignment of motor components and provide adequate protection. End shields shall be cast iron or heavy fabricated steel. Windings shall be of varnish-insulated wire with slot insulation of polyester film, baked-on bonding treatment to make the stator winding strongly resistant to heat, aging, moisture, electrical stresses and other hazards.
    b. Motor shaft shall be made from high-grade, cold-rolled shaft steel with drive-shaft extensions carefully machined to standard NEMA dimensions for the particular drive connection.
    c. For light to moderate loading, bearings shall be quiet all-angle sleeve type with large oil reservoir that prevents leakage and permits motor operation in any position.
    d. For heavy loading, bearings shall be carefully selected precision ball bearings with extra quality, long-life grease, and large reservoir providing 10 years' normal operation without re-lubrication.

14. Integral Horsepower:
    a. Motor frames and end shields shall be cast iron or heavy fabricated steel of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure employed.
    b. Windings shall be adequately insulated and securely braced to resist failure due to electrical stresses and vibrations.
    c. The shaft shall be made of high-grade machine steel or steel forging of size and design adequate to withstand the load stresses normally encountered in motors of the particular rating. Bearing journals shall be ground and polished.
    d. Rotors shall be made from high-grade steel laminations adequately fastened together, and to the shaft. Rotor squirrel-cage windings may be cast-aluminum or bar-type construction with brazed end rings.
    e. Motors shall be equipped with vacuum-degassed anti-friction bearings made to AFBMA Standards, and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent lubrication, but facilities shall be provided for adding new lubricant and draining out old lubricant without motor disassembly. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings, or leakage of lubricant out of the bearing cavity.
    f. Bearings of high thrust motors will be locked for momentary upthrust of 30 percent downthrust. All bearings shall have a minimum B10 life rating of 5 years in accordance with AFBMA life and thrust values.
    g. Vertical hollow-shaft motors will have non-reverse ratchets to prevent backspin. Non-reverse ratchets shall be suitable for duty with variable frequency drives.

C. Low Voltage, Single Phase Motors:

1. Single phase motors shall be split-phase and capacitor-start induction types rated for continuous horsepower at the rpm indicated on the drawings or as required by the specifications. Motors shall be rated 115/230 volts, 60 Hertz, single phase, open drip-proof, or totally enclosed fan cooled as indicated on the drawings or as required by the specifications, with temperature rise in accordance with NEMA Standards for Class B insulation.

2. Totally enclosed fan cooled motors shall be designed for severe-duty.

3. Motors shall have corrosion and fungus protective finish on internal and external surfaces. All fittings shall have a corrosion protective plating.

4. Mechanical characteristics shall be the same as specified for polyphase fractional horsepower motors.

PART 3 EXECUTION

3.01 INSTALLATION

A. Motor Connections: All motors shall be connected to the conduit system by means of a short section 18-inch minimum of liquid tight conduit unless otherwise indicated. For all motor connections of No. 4 AWG or larger wire size, the CONSTRUCTION CONTRACTOR shall install a grounding conductor in the conduit and terminate at main conduit box and at the motor control center or variable frequency drive with approved ground lugs and clamps.

B. Low Voltage: For wire sizes #8 AWG and larger, long barrel tin-plated copper compression (hydraulically pressed) type connections (Burndy Co., or equal) shall be installed on the branch circuit wires and the motor leads. Bolted connections shall utilize products which are rated for vibration applications (bolt, nut and spring washer). All connections shall be insulated with heavy duty heat shrinkable material (Raychem Corp. or equal).

3.02 TESTS AND CHECKS

A. The following tests shall be performed on all motors after installation but before putting motors into service.

1. The CONSTRUCTION CONTRACTOR shall megger (1000 volts DC) each motor winding before energizing the motor, and, if insulation resistance is found to be low, shall notify the ENGINEER and shall not energize the motor. The following table gives minimum acceptable insulation resistance in megohms at various temperatures and for various voltages with readings being taken after one (1) minute of megger test run.

Degrees Winding Temperature		Voltage		
F	C	115 V.	230 V.	460V.
37	3.9	60	108	210
50	10	32	60	120
68	20	13	26	50
86	30	5.6	11	21
104	45	2.4	4.5	8.8
122	50	1	2	3.7
140	60	0.50	0.85	1.6

2. The CONSTRUCTION CONTRACTOR shall check all motors for correct clearances and alignment and for correct lubrication, and shall lubricate if required in accordance with Manufacturer's instructions. The CONSTRUCTION CONTRACTOR shall check direction of rotation of all motors and reverse connections if necessary. The correction for wrong rotational direction shall be made at the motor.

3. All tests shall meet the requirements of, but not be limited to, IEEE 43, 85 and 112. Efficiency tests for IEEE 112 shall include Method B.

4. The CONSTRUCTION CONTRACTOR shall provide to the ENGINEER a typed list of all motors 1 HP and larger listing the no load motor current and voltage and the full load current and voltage. Any phase current imbalance greater than 10% shall be reported to the ENGINEER.

B. Field testing and commissioning shall be done in accordance with the latest revision of the "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" published by the InterNational Electrical Testing Association (NETA Standard ATS).

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SECTION 16191
MISCELLANEOUS EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all miscellaneous equipment as shown on the Drawings and as specified herein.

B. This Section provides the requirements for miscellaneous equipment typically employed in a facility, however, not all components specified in this Section are necessarily utilized on this project.

1.02 SUBMITTALS

A. Submit to the ENGINEER, in accordance with Section 01300, detailed catalog information or drawings with sufficient detail to determine compliance with the specifications including describing electrical and physical characteristics of all equipment specified.

1.03 REFERENCE STANDARDS

A. Equipment enclosures shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16000.

PART 2 PRODUCTS

2.01 MATERIALS

A. Disconnect Switches

1. Disconnect switches shall be NEMA 4X heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle unless otherwise noted. All current carrying parts shall be copper.

2. NEMA 4X enclosures shall be stainless steel.

3. NEMA 7 enclosures shall be cast aluminum.

4. Lugs shall be copper.

5. All exterior hardware shall be stainless steel.

6. Switches shall be as manufactured by Eaton/Cutler Hammer or Schneider Electric/Square D Company.

B. Fused Disconnect Switches

1. Fused disconnect switches shall be NEMA 4X heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange

mounted operating handle unless otherwise noted. All current carrying parts shall be copper.

2. Fuses shall be rejection type, 600 Volts, 200,000 A.I.C., dual element, time delay, Bussman Fusetron, Class RK-5 or equal.

3. NEMA 4X enclosures shall be stainless steel.

4. NEMA 7 enclosures shall be cast aluminum.

5. Lugs shall be copper.

6. All exterior hardware shall be stainless steel.

7. Switches shall be as manufactured by Eaton/Cutler Hammer or Schneider Electric/ Square D Company.

C. Manual Motor Starters

1. Manual starters shall be furnished and installed for all typed of single-phase motors. Manual starters shall be non-reversing, reversing or two speed type as required. NEMA sizes shall be as required for the actual horsepower of the motor furnished. Manual starters shall have motor overload protection in each phase. Built-in control stations shall be furnished as required or as shown on the Drawings.

2. NEMA 4X enclosures shall be stainless steel.

3. NEMA 7 enclosures shall be cast aluminum.

4. Manual motor starters shall be as manufactured by Eaton/Cutler Hammer or Schneider Electric/Square D Company.

D. Magnetic Motor Starters

1. Motor starters shall be 2 or 3 Pole, single or 3 Phase as required, 60 Hz, 600 Volt, magnetically operated, full voltage non-reversing unless otherwise shown on the Drawings. NEMA sizes shall be as required for the horsepowers shown on the Drawings.

2. Two speed starters shall be for single or two winding motors as required by the actual motor furnished or as shown on the Drawings.

3. Each motor starter shall have a 120 Volt operating coil, and control power transformer. Starters shall have motor overload protection in each phase. Auxiliary contacts shall be provided as required or as shown on the Drawings. A minimum of one N.O. and one N.C. auxiliary contacts shall be provided in addition to the contacts shown on the Drawings.

4. Overload relays shall be non-adjustable, ambient compensated and manually reset.

5. Control power transformers shall be sized for additional load where required. Transformer secondaries shall be equipped with time-delay fuses.

6. Built-in control stations and indicating lights shall be furnished as specified herein where shown on the Drawings.

7. NEMA 4X enclosures shall be stainless steel.

8. NEMA Type 7 enclosures shall be cast aluminum.

9. Magnetic motor starters shall be as manufactured by Eaton/Cutler Hammer or Schneider Electric/ Square D Company.

E. Combination Magnetic Motor Starters

1. Motor starters shall be a combination motor circuit protector and contactor, 2 or 3 Pole, single or 3 Phase as required, 60 Hz, 600 Volt, magnetically operated, full voltage non-reversing unless otherwise shown on the Drawings. NEMA sizes shall be as required for the horsepowers shown on the Drawings. Motor circuit protectors shall be molded case with adjustable magnetic trip only. They shall be specifically designed for use with magnetic motor starters. Motor circuit protectors shall be current limiting type, with additional current limiters if required. Combination motor starters shall be fully rated for 65,000 Amps RMS symmetrical.

2. Two speed starters shall be for single or two winding motors as required by the actual motor furnished or as shown on the Drawings.

3. Each motor starter shall have a 120 Volt operating coil, and control power transformer. Starters shall have motor overload protection in each phase. Auxiliary contacts shall be provided as required or as shown on the Drawings. A minimum of one N.O. and one N.C. auxiliary contacts shall be provided in addition to the contacts shown on the Drawings.

4. Overload relays shall be non-adjustable, ambient compensated and manually reset.

5. Control power transformers shall be sized for additional load where required. Transformer secondaries shall be equipped with time-delay fuses.

6. Built-in control stations and indicating lights shall be furnished as specified herein where shown on the Drawings.

7. NEMA 4X enclosures shall be stainless steel.

8. NEMA Type 7 enclosures shall be cast aluminum.

9. Combination magnetic motor starters shall be as manufactured by Eaton/Cutler Hammer or Schneider Electric/ Square D Company.

F. Control Stations and Indicators

1. Control stations shall be heavy-duty type, with full size (30.5mm) NEMA 4X or 7 operators, indicators, etc.

2. Indicators shall be full voltage and push-to-test type. Indicators located indoors shall be LED type and indicators located outdoors shall be incandescent lamp type.

3. NEMA 4X enclosures shall be stainless steel.

4. NEMA 7 enclosures shall be cast aluminum.

5. Control stations shall be Square D Company Class 9001, similar by Cutler Hammer or General Electric Company.

G. General Purpose Dry Type Transformers

1. Transformers shall be dry type, two-winding with kVA and voltage ratings as shown on the Drawings.

2. Four full capacity taps shall be furnished, two 2-1/2 percent above and four 2-1/2 percent below rated primary voltage.

3. Maximum temperature rise shall be 80 degrees C. Windings shall be copper.

4. Transformers shall be built in accordance with ANSI C89.2 and NEMA ST-20.

5. Transformers shall be provided in NEMA 1 enclosures unless otherwise noted on the Drawings or as required by Section 16000. Where a NEMA 4X and/or stainless steel enclosure is required, the transformer shall be of the TENV type.

6. Transformers shall be furnished with hot dipped galvanized mounting hardware. Where a NEMA 4X and/or stainless steel enclosure is required, the hardware shall be 316 stainless steel.

7. Transformers shall be manufactured by Eaton/Cutler Hammer or Schneider Electric/ Square D Company.

H. Mini-Power Zone

1. Each Mini-Power Zone (MPZ) shall include a main primary breaker, a dry type transformer and a secondary panelboard with main breaker.

2. Enclosures shall be type NEMA 1 enclosures unless otherwise noted on the Drawings or as required by Section 16000. Main primary, secondary, and feeder breakers shall be enclosed with a padlockable hinged door. Where NEMA 3R stainless steel enclosure is required, the hardware shall be 316 stainless steel.

3. Transformers shall be dry type, two-winding with kVA and voltage ratings as shown on the Drawings.

4. Transformer windings shall be copper, 115-degree C rise, epoxy-resin encapsulated with two full capacity taps rated 5 percent below rated primary voltage.

5. Interconnecting wiring between the primary breaker and transformer, transformer and secondary main breaker, and secondary main breaker and distribution section shall be factory installed.

6. Panelboard bus shall be copper.

7. MPZ main primary breaker shall have a minimum interrupting rating of 65 kA at 480 volts and shall be sized per manufacturer's standard for the kVA size.

8. MPZ secondary main breaker shall have a minimum interrupting rating of 10 kA at 240 volts and shall be sized per manufacturer's standard for the kVA size.

9. MPZ feeder breakers shall be bolt-on type with a minimum interrupting rating of 10 kA.

10. Panelboard section shall include copper equipment ground bar.

11. MPZ shall be Mini Power-Zone as manufactured by Schneider Electric/Square D or Mini-Power Center as manufactured by Eaton/Cutler-Hammer.

I. Surge Protective Devices

1. Surge protective devices (SPD) shall be provided as indicated on the Drawings.

2. SPDs shall be tested and labeled in accordance with the latest edition of the following standards: ANSI/IEEE C62.41, ANSI/IEEE C62.45, NEMA LS-1, UL 1449, UL 1283 and NEC Article 285.

3. The SPD shall be UL listed at or above the available fault current level at the point of SPD application by UL, per UL 1449 latest edition.

4. The SPD shall be of a parallel design using fast-acting energy protection that will divert and dissipate the surge energy.

5. Each SPD shall incorporate 200kAIC fusing and shall monitor all modes of protection and provide LED indicator lights to provide positive operational status of each protected phase.

6. Minimum surge current ratings shall be as follows:
   a. Service entrance equipment, switchgear, and switchboards – 150 kA per mode (300 kA per phase).
   b. Distribution Panels and Motor control centers (480 volts) – 100 kA per mode (200 kA per phase).
   c. Branch panels or control panels (480 volts) – 100 kA per mode (200 kA per phase).
   d. Branch panels (single phase 120/240 volts or three phase 120/208 volts) – 50 kA per mode (100 kA per phase).

7. Manufacturers: Innovative Technologies or approved equal.

J. Wireway

1. NEMA 1 wireway shall be gasketed painted steel with stainless steel screw covers.

2. NEMA 4X wireway shall be 316 stainless steel with gasketed clamped covers.

3. NEMA 1 wireway shall be Square-Duct as manufactured by the Square D Co.; NEMA 4X shall be Bulletin F-22 as manufactured by the Hoffman Engineering Co. or equal.

K. Control Relays

1. Control relays shall be heavy duty machine tool type, with 10 Amp, 300 Volt convertible contacts. Number of contacts and coil voltage shall be as shown on the Drawings. General use relays shall be Square D Company, Class 8501 Type X, similar by; Cutler-Hammer, Allen-Bradley Company or General Electric Company. Latching relays shall be Square D Company, Class 8501 Type X, similar by; Cutler-Hammer, Allen-Bradley Company or General Electric Company.

2. Time delay relays shall be pneumatic, 600 Volt, 20 Amp contacts, with calibrated knob operated adjustment and numerical time dial. On delay and off delay types and timing ranges shall be as shown on the Drawings or as required for proper operation of the actual equipment furnished. Relays shall be Agastat Model 7012 or 7022 or equal.

L. Polyethylene Warning Tape

1. Warning tape shall be 5 mil red polyethylene film, 6-in minimum width. Tape shall be capable of being detected or located by either conductive or inductive location techniques.

2. Warning tape shall be Mutual Industries Part No. 17774 or equal.

M. Terminal Blocks

1. Terminal blocks shall be 600 Volt, channel mounted, with tubular screw and pressure plate.

2. Terminal blocks shall be Bulletin 1492-CA1 as manufactured by the Allen-Bradley Co. or equal.

N. JIC Boxes for GF Receptacles

1. JIC boxes shall be 6-inches x 6-inches x 4-inches aluminum continuous hinge clamp cover boxes, Hoffman Catalog Number A-606 CHAL with Type L23 stainless steel fast operating JIC clamp, or equal.

2. Install 1-1/2-inch bushings in bottom of box for cord and plug to pass through.

O. Corrosion Inhibitors

1. All equipment enclosures, terminal boxes, etc, located in a NEMA 4X rated area (where shown on the Drawings) that contains electrical or electronic equipment or terminal strips shall be furnished with an internally mounted, chemically treated corrosion inhibitor pad.

2. The corrosion inhibitor pads shall be as manufactured by Hoffman Engineering Co.; 3M or equal.

P. Equipment Mounting Stands

1. Equipment mounting stands shall be custom fabricated from 1/4-in 316 stainless steel plate and 3-in 316 stainless steel channel, unless otherwise shown on the Drawings.

2. All hardware shall be 316 stainless steel.

Q. Terminal Cabinets:

1. Interiors shall be so designed that control relays and terminal blocks can be replaced or added without disturbing adjacent units. Each cabinet shall be furnished with a minimum of 50 spare terminals.

2. All interiors shall be completely factory assembled with control relays, terminal blocks, insulating barriers, etc. All 120-volt AC and DC terminal blocks shall be isolated from each other by insulating barriers or separate enclosures.

3. All wiring within the cabinets shall be grouped together in harnesses and secured to the structure.

4. All shielded cables shall terminate in separate cabinets. A third terminal shall be provided for each twisted shielded pair and the shield for each connected thereto, unless otherwise noted on manufacturer's shop drawings.

5. Terminal blocks shall be tubular screw type with pressure plates and shall be rated 600 volts. Terminal blocks shall be Allen Bradley Catalog Number 1492-CA1 or equal.

6. Boxes shall be made from 14-gauge galvanized steel and shall be of sufficient size to provide a minimum of 4 inches of wiring space on all sides and between adjacent terminal blocks. A minimum 2-inch spare shall be provided between control relays. A minimum of four mounting studs shall be provided on each cabinet. Cabinets shall be furnished without knockouts. Holes for raceways shall be drilled on the job.

7. A single or double hinged door shall cover the front of each terminal cabinet. Doors shall have a neoprene gasket, vault type handle, three-point catch and lock. Two keys shall be supplied for each lock. All locks shall be keyed alike. A terminal block schedule shall be provided with each terminal point numbered and identified (typewritten) as to function.

8. All exterior and interior steel surfaces of the cabinets shall be properly cleaned and finished with ANSI 61 grey over a rust-inhibiting phosphatized coating conforming to ANSI A55.1. The finish paint shall be of a type to which field applied paint will adhere.

9. Cabinets in wet, damp, corrosive and all outdoor locations shall be NEMA 4X 316 stainless steel.

10. Cabinets shall be Schaefer with latch kit hardware or pre-approved equal.

R. Break-Glass Emergency Station

1. Break-Glass Emergency Station shall be of the break glass design with a weatherproof cast metal outer case finished in fire red and have an attached chain hung "Hammer". A glass panel shall be mounted in front of the push button operator. Switch contacts shall be 1-open, 1-closed, rated 10 Amp, 600 Volts.

2. A black phenolic nameplate with engraved white lettering to read: GENERATOR EMERGENCY STOP (28 characters maximum) shall be fastened to the outer case front.

Station shall be equal to Key Systems, Inc., Catalog No. 561-S (Surface mounting), 561 (Semi-flush mounting), similar by Crouse-Hinds; Killark or equal.

S. Power Monitors

1. Microprocessor based metering: At each circuit location shown on the Drawings, furnish a digital microprocessor based metering device capable of monitoring and displaying the functions listed below. The device shall provide the status input functions indicated and the capability to communicate data to a centralized monitoring system via a data highway network. The device shall be UL listed. The device shall be Siemens PAC4200 with Profibus DP expansion card.

2. Metering Functions
   a. The Digital AC Instrumentation Package shall be capable of measuring, calculating and directly displaying on the front panel display the following information:
      1) Volts on each phase plus average of all three phases
      2) Current on each phase plus average of all three phases
      3) Neutral or ground current
      4) Frequency
      5) Power Factor
      6) KVA
      7) KVAR
      8) KW
      9) Total KWH as an accumulating total, providing bi-directional (import/export) indication
      10) Total KVARH as an accumulating total, providing bi-directional (import/ export) indication
      11) Amps Demand

3. Monitoring and Control Functions
   a. Provide eight self-powered digital status inputs to monitor the following points:
      1) Circuit breaker OPEN status
      2) Circuit breaker CLOSED status
      3) Circuit breaker TRIPPED status
      4) Circuit breaker OUT OF SERVICE (withdrawn) status.
   b. Provide one auxiliary analog input rated 1.0 VAC/VDC nominal full scale input which can be used to measure an external variable such as transformer temperature, air temperature, or battery voltage.
   c. Provide one auxiliary analog output (selectable 0-20ma or 4-20ma) proportional to any measure parameter.
   d. Provide three Form C dry contact control relay outputs rated 277 VAC or 30 VDC at 10 Amp maximum load current, that can each function as:
      1) Setpoint relays that operate as a function of any measured parameter for demand, power factor, or load control. Seventeen programmable setpoints shall each have programmable operate and release limits and time delays on operate and release. Relays shall provide selectable pulse mode or tach mode operation.
      2) Remote control relays operated by commands via the communications port.
      3) Breaker trip relay (over/under volt, volt unbalance, phase reversal, current unbalance, over/under frequency).
      4) KWH or KVARH pulse output relay.
      5) Alarm relays.

4. Operational Features
   a. Provide the following operating features:
      1) True RMS measurements.
      2) Connect directly to PT's and CT's for systems over 600 volts.
      3) Provision for a fourth current input for measurement of ground or neutral current.
      4) 300 amp, one second surge protection on all four current inputs.
      5) 3-field, 20 character, high visibility 0.4-in character height vacuum-fluorescent display with a programmable time out feature.
   b. Store in non-volatile memory the following:
      1) A time-stamped alarm and event log of up to 50 events which records event date, time (to 1 second), event type and value for all over/under limit conditions, all status input activity and all relay operations. Log shall be read via the communications port.
      2) A time-stamped minimum/maximum log, which records the value of any parameter exceeding the previous highest or lowest value recorded. Log shall be read from the front panel display or via communication port.
      3) A time-stamped snapshot (historical) log, with a 100-snapshot capacity and user-definable snapshot interval from 1 second to 400 days which records snapshot values for Average Volts, Average Amps, KW, KVAR, KW Demand, Power Factor, Frequency, KWH, KWH Reverse, KVARH and Auxiliary Volts Input. Log shall be read via the communications port.
      4) All setup data.

5. The device shall be field programmable as follows:
   a. Volts scale, volts mode (wye, delta, single phase), amps scale, Vaux scale, baud rate and the relay operation shall be programmable from the front panel.
   b. All parameters above, plus additional alarm/event parameters shall be programmable via the communications port using a portable terminal or a computer.
      1) The programming shall be password protected.

6. Waveform Capture
   a. Provide waveform capture capability allowing any of the eight voltage and current input channels to be digitally sampled at 256 samples/60 Hz cycle. Waveform capture shall be initiated using commands made via the communications port. Waveform capture data shall be mad accessible via the communications port.

7. Data Communications
   a. Provide a communication cards for Profibus DP.
   b. Provide all communication cables to interconnect monitors within the electrical equipment.
   c. All necessary cables, connectors, software, hardware, etc. shall be provided as required to interface with a computer system and/or related PLCs as specified herein or in other Sections and Divisions of the specifications.

T. Main Circuit Breaker Enclosure (Service Entrance Rated)

1. Service: 1200AF/1000AT, 480 volt, 3-phase, 3-wire, 60 Hertz, service entrance rated. Provide lugging for service neutral conductors.

2. The overall short circuit withstand rating of the equipment and devices shall be 65,000 Amperes R.M.S. symmetrical at 480 volts. Main circuit protective devices shall be fully

rated for the specified short circuit duty. Systems employing series connected ratings for main and feeder devices shall not be used. Bus shall be tin plated copper.

3. Circuit Breakers
   a. Power circuit breakers: 100 percent equipment rated, 600 volt, insulated case circuit breakers with integral fully adjustable solid state trip device. Trip device shall be temperature insensitive and have the following characteristics and functions:
      1) Independently adjustable long time pick-up and delay.
      2) Independently adjustable short time pick-up and delay.
      3) Adjustable instantaneous.
      4) Independently adjustable ground fault pick-up and delay.
      5) Trip mode targets for over load, short circuit, and ground fault.

4. Main breakers shall be housed in a free-standing floor mounted, NEMA 1 gasketed enclosures 90" high as shown on the drawings. Enclosures shall be painted ANSI-61 light grey. Each main breaker shall be labeled as main service disconnecting means, signage shall also be provided which reads as follows "DANGER 480 VOLTS - KEEP OUT".

5. Manufacturer shall provide ground fault CT's, metering, lightning arresters, etc. as shown on the drawings.

6. Surge protection device (SPD) with a minimum surge current rating of 300 kA per phase. Refer to Section 16191 for additional requirements.

7. Main circuit breakers, enclosures, etc., shall be as manufactured by Eaton/Cutler Hammer or Schneider Electric/ Square D Company.

2.02 CONTROL SYSTEM

A. The Manufacturer shall provide a complete and fully functional control system to manually or automatically operate the control system as specified herein and in other applicable sections of these specifications. All Manufacturers recommended safety devices shall be furnished to protect operators. All control devices, unless specified otherwise, shall be mounted in the Control Panel.

B. Control Panel Construction

1. The control panel shall consist of a main circuit breaker, a motor circuit protector (MCP) and magnetic starter for each motor, and a 120-volt control power transformer (fused on primary and secondary). All control components shall be mounted in one common enclosure. Control switches shall provide means to operate each motor manually or automatically.

2. Unless specifically noted otherwise, the electrical control equipment shall be mounted within a NEMA 4X enclosure, constructed of not less than 14 gauge 316 stainless steel. Latches shall be quarter turn quick release type and all hardware shall be 316 stainless steel. Where NEMA 3R or 12 enclosures are specifically required, the door shall be 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.

3. 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.

4. A thermal-magnetic air circuit breaker, Type FH (65KAIC) as manufactured by the Square D Company, or equal, shall be furnished for the main breaker. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering. Each circuit breaker shall be adequately sized to meet the equipment operating conditions. Motor Circuit Protectors (MCP) shall be molded case with adjustable magnetic trip only, "Mag-Gard" as manufactured by the Square D or equal.

5. An open frame, across-the-line, NEMA-rated magnetic motor/starter, Class 8536 as manufactured by the Square D Company, or equal, shall be furnished for each motor. All motor starters shall be provided with motor circuit protectors and equipped to provide under-voltage release and overload protection on all three phases. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position. Overloads shall be of the melting alloy or bi-metallic type, adjustable overloads are not acceptable, Class 10 quick trip overloads shall be provided for all submersible motors. Overload reset push-buttons shall be located on the exterior of the door. Normally open and normally closed auxiliary motor overload contacts wired to terminal blocks shall be provided for each motor starter within the control panel

6. 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 13, 16 and as shown on the drawings.

7. 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.

8. Mode selector switches shall be Hand-Off-Auto type to permit override of automatic control and manual actuation of shutdown. Switches shall be NEMA 4X (800H) as manufactured by Allen-Bradley, or equal, providing three (3) switch positions, each of which shall be clearly labeled according to function.

9. Indicator lamps shall be LED (indoors) or Incandescent (outdoors) full voltage type and mounted in NEMA 4X (800H) modules, as manufactured by Allen-Bradley. Lamp modules shall be equipped to operate at 120-volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position. Indicators shall be provided for individual motor run and an indicator for each failure condition.

10. A six (6) digit, non-reset elapsed time meter shall be connected to each motor starter to indicate the total running time of each motor in "hours" and "tenth of hours". The elapsed time meters shall be Series T50 as manufactured by the ENM Company or equal.

11. A failure alarm with horn and beacon light shall be provided. Silence and reset pushbuttons shall also be furnished. A common failure reset pushbutton shall be provided to reset the alarm conditions (reset shall occur only if fault condition has been cleared). The alarm horn shall be weatherproof rated with gasket (Federal Signal Corporation, Cat. #350 or equal).

The alarm beacon shall be NEMA 4X rated, red lens and solid-state flasher (Ingam Products Inc. LRX-40).

12. The control panel shall operate on a power supply of 480 volts, 3-phase, 60 Hertz unless otherwise noted.

13. The control diagrams and overload tables shall be laminated to the inside of the door except where door space is limited the laminated documents shall be in the print storage pocket.

14. 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. A set of reduced drawings shall be provided for each panel, fixed to fit in the storage pocket.

15. 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.

16. The control panel shall include an adjustable time delay relay to prevent any two motors from starting simultaneously. All timing relays shall be solid state, with pin (octal) and bases, relays shall be T-series as manufactured by Diversified Electronics Inc. or equal.

17. Alternators shall be provided to sequence motors, alternators shall be 008-120-13SP or 009-120-23AP as manufactured by Sta-con, or equal.

18. 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.

19. All exterior mounted equipment shall be rated NEMA 4X. Hinged NEMA 4X 316 stainless steel viewing windows will be permitted where such equipment is not available with a NEMA 4X rating.

20. The control panel shall be provided with surge protection device (SPD). The SPD shall be mounted within the control panel enclosure. Lead lengths shall not be longer than 12 inches from the main circuit breaker and as straight as possible. The SPD shall have a minimum surge current rating of 200kA per phase. Refer to Section 16191 for additional requirements.

21. All control panel wiring shall be numbered at both ends with type written heat shrinkable wire markers.

22. 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.

23. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed using an epoxy process (inner door nameplates shall be fastened with stainless steel screws). Nameplates shall be laminated plastic, engraved white letters with a black background.

24. All control panels shall be provided with a master nameplate located on the exterior door.

25. 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.

26. Corrosion Inhibitor Emitter: Inclusion of an industrial corrosion inhibitor emitter that shall protect internal components of control panel from corrosion for up to one year. One spare emitter shall be provided for each control panel.

27. All control relays shall have 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.

28. Terminal blocks shall be 600 volt heavy duty rated, tubular clamp type. Terminal strips shall be Allen Bradley catalog #1492-CA-1 or equal. Each terminal shall be individually labeled.

29. The completed control panel assembly shall be U.L. certified. The minimum overall short-circuit withstand rating of the control panel and devices shall be 65,000 Amperes RMS symmetrical at 480 volts.

30. Intrinsically safe relays shall be solid state type with 5 amp output contacts, suitable for use on 120 volt, 60 hertz power supply and shall be Factory Mutual approved for devices in Class 1, Division 1 hazardous atmospheres. Intrinsically safe relays shall be Gems Solid State Safe-Pak as manufactured by Gems Sensors, Division of Transamerica Delaval, Inc. or equal.

31. All electronic control equipment (i.e. controllers, isolators, signal boosters, transmitters, PLC's, etc.) shall be as specified in Division 13.

32. A copper ground bar with sufficient terminals for all field and panel ground connections shall be provided.

33. All signal wiring entering and exiting the control panel shall be provided with surge protection. Surge protection shall be as specified in Division 13.

34. 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, the space shall be provided for field conduit and wiring access only.

35. 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)	White

Less than line voltage (individual conductors)	AC	Red
	24VDC	Blue
	0VDC	White/Blue Stripes
	Foreign	Yellow

C. Spare Parts

1. The following number of spare parts shall be furnished for each control panel.
   a. 1 Indicator light assembly
   b. 2 control relays for each type furnished
   c. 5 fuses for each type/size furnished
   d. 1 set thermal overloads for each size furnished
   e. 1 selector switch for each type furnished
   f. 1 starter coil for each size furnished

PART 3 EXECUTION

3.01 INSTALLATION

A. Mounting Stands

1. Field mounted disconnects, pushbutton control stations, etc, shall be mounted on 316 stainless steel stands as specified herein or as shown on the Drawings. Where clearance requirements for stands may not be maintained, the ENGINEER may direct equipment to be wall-mounted adjacent to the motor or device, but in no case shall the distance from the motor or device to the control station exceed 3 ft.

B. Miscellaneous Equipment

1. Perform tests and adjust as required per Section 16000.

2. Provide and install identification as required per Section 16000.

3. All wiring shall be done in a neat and workmanlike manner.

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

END OF SECTION

SECTION 16216
DIESEL ENGINE DRIVEN GENERATOR
(SELF-CONTAINED WITH WEATHERPROOF SOUND ATTENUATED ENCLOSURE)

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The CONSTRUCTION CONTRACTOR shall furnish all labor, materials, equipment, tools and services, and shall install, place in operation, and field test one new skid mounted diesel engine driven generator unit with weatherproof sound attenuated enclosure and sub-base fuel storage tank, and required supporting systems as shown on the Drawings and specified herein.

B. The unit shall have a continuous standby power rating (site rated) of not less than 375 KVA/ 300 KW at 80 percent lagging power factor with 3 phase, 60 Hertz, 480 volt, 4 wire, alternating current generator, complete with excitation system, controls, steel sub-base and all essential and desirable appurtenances. The unit shall be certified to meet the appropriate EPA Tier emission standards based upon the size and function of the generator set.

C. The unit shall be arranged for automatic starting and stopping and load electrical transfer upon failure of the normal source of utility power. Parallel operation with Power Company is not required.

D. Units shall also be capable of remote monitoring from the plant control system. See Instrumentation Drawings and Specifications for monitoring interface requirements to the plant control system.

E. All equipment and controls specified in this Section shall be new and be considered part of the engine generator package. The engine generator Manufacturer or his licensee shall be responsible for furnishing the package in its entirety as specified herein. Various components of the package, including interface wiring and interconnection piping shall be furnished and installed by others. However, the engine generator package shall be complete in all respects and shall include all equipment and controls necessary for a fully operational alternative electrical power supply.

F. The diesel engine driven generator with a weather protective sound attenuated enclosure shall also be in accordance with the JEA Water and Wastewater Standards Manual, JEA Facilities Standards Manual, and the JEA Shared Services Standards.

G. The equipment to be furnished under this Section includes; but shall not be limited to the following for each unit:

1. Generator set with unit mounted radiator.

2. Main line circuit breaker, 100% rated.

3. All required ductwork for an engine driven radiator cooled unit.

4. Entire engine exhaust system.

5. Fuel system piping, tank, and appurtenances.

6. 72-hour capacity at 100% load UL 2085 double wall sub-base fuel storage tank, with fuel transfer pumping and control system, and level and leak monitoring system.

7. Fuel cooler factory mounted on engine radiator.

8. Flexible connectors and/or expansion joints for field piping.

9. Engine generator control and instrumentation cabinet, gauges and alarms.

10. Engine mounted DC electric starting system with battery and battery charger.

11. Spring type vibration isolators.

12. Weather-proof sound attenuated enclosure.

13. Automatic Transfer Switch with Bypass-Isolation Switch.

14. Spare parts and special tools.

15. Services of a Manufacturer's representative.

1.02 RELATED WORK

A. The concrete foundation is included in Division 3.

B. All electrical equipment and work furnished under this section shall meet the requirements of Division 16.

C. Conduit and wire within generator enclosure shall comply with Sections 16110 and 16120.

D. Power monitoring is included in Section 16191.

E. Regulatory provisions regarding fuel tanks are included in Section 01170.

1.03 SUBMITTALS

A. Submit shop drawings and product data, in accordance with Section 01300, which shall include the following:

1. Copy of this specification confirming compliance with each paragraph.

2. Shop drawings, catalog cuts, internal wiring schematics and other materials required to completely describe the systems and equipment being furnished.

3. Identification, description and dimensions for each separately installed sub-assembly or piece of equipment and associated piping and electrical connection details and schematics.

4. Foundation drawings, indicating size and location of anchor bolts.

5. Performance specifications of all items of equipment.

6. Detailed description of jacket water treatment materials and procedures.

7. Control panel layout drawings showing interior and exterior views, dimensions, paint finish specifications and component bill of materials, and schematics.

8. Complete electrical, instrumentation, control and wiring diagrams in sufficient detail to allow installation of instrumentation and controls and electrical components. Specifically, the following is required:
   a. Complete instrumentation and control schematics, presented in conformance with Instrument Society of America Bulletin S5.1, latest edition and NFPA 79, latest edition.
   b. Complete electrical circuit schematics, including all generator control, alarms, and power to motors, accessories, instruments, etc. Schematics shall include all termination points in each control panel. All wiring shall be identified by numbers and every termination point shall be assigned a number. Termination point number (including wire number) shall appear on the schematics for each wiring termination shown.
   c. Complete external electrical interconnection diagrams for wiring between control panels, switchgear and engine terminal boxes.

9. Complete Operations and Maintenance Manuals, as specified in Section 01730, covering all equipment furnished, annotated to reference only the specific model numbers supplied. Include parts lists and parts prices current to the date of submittal; include information relevant to parts supply and ordering. It is essential that this information be received prior to the startup and testing of the engine/generator unit.

B. Design Data

1. Submit design data for engine, generator, and accessories in format indicated in Paragraphs B2 through B12 (For rated KW capacity).

2. Engine Data
   a. Manufacturer
   b. Model
   c. Number and arrangement of cylinders
   d. RPM
   e. Bore x stroke
   f. Maximum power at rated RPM
   g. BMEP at rated KW (including any parasitic loads and generator efficiency)
   h. Piston speed, feet per minute
   i. Make and model of governor

3. Generator Data
   a. Manufacturer
   b. Model
   c. Rated KVA
   d. Rated KW
   e. Voltage
   f. Temperature rise above 40 degrees C ambient
      1) Stator by thermometer ___ degrees C
      2) Field by resistance ___ degrees C
      3) Class of insulation ___ degrees C

4. Generator efficiency including excitation losses and at 80 percent PF
   a. Full load ___ percent
   b. Three-quarters load ___ percent
   c. Half load ___ percent

5. Guaranteed fuel consumption rate (at generator terminals/138,000 BTU/gallon)
   a. Full load, gal/hr _____
   b. Three-quarters load, gal/hr _____
   c. Half load, gal/hr _____

6. Generator unit and accessories
   a. Weight of skid mounted unit _____ lbs.
   b. Overall length _____ inches
   c. Overall width _____ inches
   d. Overall height _____ inches
   e. Exhaust pipe size _____ inches

7. Exhaust gas emissions data, maximum values at loads varying from full to 1/4 load:
   a. Temperature_____ degrees F
   b. Flow _____ ACFM (mass and volume)
   c. Carbon Monoxide (CO) _____ grams/BHP-hr
   d. Nitrogen Oxides (NOx) _____ grams/BHP-hr
   e. Hydrocarbons (HC)_____ grams/BHP-hr
   f. *Sulfur Dioxide (SO2) _____ grams/BHP-hr
   g. *Based on ___ percent sulfur content by weight in the fuel

8. CFM of air required for combustion and ventilation based upon inlet air temperature of 40 degrees C: ___ CFM

9. Heat radiated to room by engine and generator: ____ BTU/min

10. Heat rejected to jacket water including lubricating oil and intercooler (if required) ___ BTU/min

11. Height from bottom of skid required for removing piston with connecting rod; (also for removing cylinder liner): ___-ft

12. The unit guaranteed to be adequate for motor starting as required by Paragraph 1.06C of this Specification.

13. Radiator (engine driven) fan cooling air volume and required BHP: _____ BHP

C. Test Reports

1. Furnish four copies of the Manufacturer's certified shop test record of the complete engine driven generator unit. The final test record shall confirm the generator set performance required in Paragraph 1.06.

1.04 REFERENCE STANDARDS

A. Design, manufacturing and assembly, testing and installation of elements of the equipment herein specified shall be in accordance with but not limited to published standards of the following, as applicable:

1. American Gear Manufacturers Association (AGMA)
2. American Institute of Steel Construction (AISC)
3. American Iron and Steel Institute (AISI)
4. American Society of Mechanical Engineers (ASME)
5. American National Standards Institute (ANSI)
6. American Society for Testing Materials (ASTM)
7. American Welding Society (AWS)
8. Anti-Friction Bearing Manufacturers Association (AFBMA)
9. Diesel Engine Manufacturers Association (DEMA)
10. Institute of Electrical and Electronics Engineers (IEEE)
11. Instrument Society of America (ISA)
12. International Standards Organization (ISO)
13. National Electrical Code (NEC)
14. National Electrical Manufacturers Association (NEMA)
15. National Fire Protection Association (NFPA)
16. Occupational Safety and Health Administration (OSHA)
17. Steel Structures Painting Council (SSPC)
18. Underwriters Laboratories, Inc. (UL)
19. US Environmental Protection Agency (EPA) – New Source Performance Standard for Stationary Reciprocating Compression Ignition Engines (NSPS)
20. Florida Building Code (FBC) Sixth Edition
21. Florida Administrative Code 62-762
22. JEA Water and Wastewater Standards
23. JEA Facilities Standards
24. JEA Shared Services Standards

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. The engine-generator set shall be the standard product, as modified by these specifications, of a Manufacturer regularly engaged in the production of this type of equipment and which maintains a permanent service organization and supply of spare parts in place at the time of the bid within 150 miles of the project site. The unit to be furnished shall be built from components which have proven compatibility, reliability and are coordinated to operate as a unit. To qualify as a Manufacturer, the engine must be the principal item manufactured and the completed engine generator set shall be supplied by that Manufacturer's authorized dealer only. The dealer shall have a minimum of ten (10) years experience in the field of power generation. The manufacturing facility shall be ISO 9001 certified. The three pre-approved vendors are Ring Power (Caterpillar), Cummins, Generac, and Zabatt Power Systems (AKSA).

B. The unit shall be of such physical dimensions to fit into the space provided as indicated on the Drawings. Maximum overall footprint (including intake hood and discharge hood) shall be 218” long by 78” wide. These dimensions do not include the stairs required on each side of generator set enclosure.

C. The CONSTRUCTION CONTRACTOR shall require that the standby generator Manufacturer coordinate his design with the supplier of the variable frequency drives, specified in Section 16370, to assure that sufficient generator reactance is provided to limit the line harmonics to acceptable levels as specified in IEEE Standard 519-2014 and to assure that the generator voltage control system will provide stable operation in the presence of such harmonics.

D. All mechanical equipment shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation without overheating or excessive vibration or strain, and require only that degree of maintenance generally accepted as peculiar to the specific type of equipment required. All parts and components of all units shall be designed and built for interchangeability so that replacement parts may be installed without any additional fitting or machining.

E. Components of mechanical and electrical equipment shall be the products of Manufacturers who can produce evidence of their ability to promptly furnish any and all interchangeable replacement parts as may be needed at any time within the expected life of the equipment.

F. The CONSTRUCTION CONTRACTOR shall submit information on torsional forces analysis on the engine generator package and upon request, any other additional information that the ENGINEER may deem necessary to verify that the specified generator set shall be free of harmful torsional stresses during any range of normal operation. Provide torsional test results and report to the ENGINEER.

G. The Manufacturer shall have suitable testing facilities adequate for performing the shop tests and inspections specified herein. The CONSTRUCTION CONTRACTOR shall submit a description of the Manufacturer's testing facilities. The descriptive matter shall contain illustrative photographs, drawings and such other matter as may be requested.

H. Services of Manufacturer's Representative

1. Provide services of factory-trained service technician, specifically trained on type of equipment specified. Submit qualifications of service technician for approval. Man-day requirements listed are exclusive of travel time and do not relieve CONSTRUCTION CONTRACTOR of obligation to provide sufficient service to place equipment in satisfactory operation.

2. Installation: to assist in location of anchor bolts; setting, leveling and field erection; coordination of piping, electrical, miscellaneous utility connections: 4 man-days.

3. Start-up, testing and calibration: 4 man-days.

4. Operation and maintenance instruction: 1 man-day.

5. Service inspections during first year of actual operation, for use at OWNER's request, and exclusive of repair, malfunction, or other troubleshooting service calls: 3 man-days (not anticipated as consecutive).

1.06 UNIT PERFORMANCE

A. The automatic voltage regulation at steady state operations shall be within plus or minus 0.25 percent from zero load to full-rated load for any load variation. Upon application or removal of full-rated load in one step, the transient voltage, and recovery to steady state operation shall be within nine seconds.

B. Stable or steady state operation is defined as operation with the frequency variation not exceeding plus or minus 0.25 percent (0.15 Hertz) and voltage variation plus or minus 0.25 percent of their mean value for constant load from zero load to full rated load. A rheostat shall provide a minimum of plus or minus five percent voltage adjustment from rated voltage.

C. The generator shall be capable of accepting a block load equal to the unit’s full KW rating.

D. The maximum voltage dip (including any instantaneous voltage dip) during starting shall be 20%.

E. The generator shall be designed and manufactured with sufficient reactance so as to be capable of supplying electrical power to both new and existing solid state switching devices such as variable frequency drives, reduced voltage solid-state starters and other non linear electrical loads to limit the associated harmonics to acceptable and non damaging levels, and to assure that the generator voltage control system will provide stable and proper electrical operation in the presence of such harmonics.

F. The unit shall be compliant to UL2200 labeled.

G. The unit shall be in compliant to NFPA 110.

1.07 DELIVERY, STORAGE AND HANDLING

A. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

B. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

C. All mechanical and electrical equipment shall be coated, wrapped and otherwise protected from rain, drippings of any sort, dust, dirt, mud, flood and condensed water vapor during shipment and while installed in place during construction. The protective coverings shall remain in place until the work areas are substantially free of all construction dust and debris. Full details of proposed protective measures shall be submitted for approval to the ENGINEER prior to shipment. Generator space heater shall be energized at all times during storage.

D. All units shall be properly packaged for truck shipment and especially treated for long periods of storage before use in a hot humid climate.

1.08 PROJECT/SITE REQUIREMENTS

A. The engine generator shall be installed as an outdoor unit, within an acoustically-treated weatherproof enclosure. Automatic temperature controls will operate to limit the maximum summertime temperature in the area of the generator, considering full-load engine generator heat radiation to 43 degrees C (110 degrees F). All equipment furnished to install under this Section shall be designed for an ambient temperature of 43 degrees C.

1.09 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two (2) year standard standby generator warranty and an additional three (3) year comprehensive (parts and labor) standby generator warranty from date of Substantial Completion. Labor, materials, and travel for the warranty period repair will be paid by manufacturer during normal business hours. Comprehensive warranty includes the following:

a. Cooling System
b. Thermostat Housing
c. Water Manifold Housing
d. Jacket Water Precooler
e. Jacket Water Pump
f. Thermostat
g. Radiator & Fan
h. Fuel System
i. Steel Fuel Lines
j. Fuel Shutoff Solenoid
k. Fuel Injectors
l. Fuel Transfer Pump & Housing
m. Fuel Priming Pump
n. Fuel Transfer Pump
o. Lubrication System
p. Pan, Pump Cooler
q. Crankcase Breather
r. Engine Oil Pump Drive

s. Pre-lubrication Pump
t. Electric System
u. Battery Charger
v. Control Module (ECM)
w. Sensors: All Engine Sensors
x. Wiring Harness and Connectors
y. Starter
z. Engine Alternator
aa. Alternator End
bb. Alternator, including Rotor, Stator, and Exciter
cc. Generator Controls
dd. Power Center
ee. Air Induction & Exhaust
ff. Exhaust Manifolds, Studs & Gaskets
gg. Inlet Air Heater Relay
hh. Intake Manifold
ii. Turbochargers
jj. Air-to-Air Aftercooler Cores
kk. Muffler/Exhaust System
ll. Exhaust Guards
mm. Diesel Oxidation Catalyst
nn. Short Block
oo. Cylinder Block Casting
pp. Crankshaft
qq. Connecting Rod Assembly
rr. Piston, Wrist Pin, Retainer Clip & Piston Rings
ss. Idler and Timing Gears
tt. Accessory Drive
uu. Cylinder Head
vv. Intake & Exhaust Valves
ww. Valve Mechanism
xx. Camshaft, Camshaft Bearings, Key, Gear
yy. Front & Rear Covers
zz. Front Cover / Plate / Housing / Gears & Gaskets
aaa. Vibration Damper
bbb. Flywheel Housing & Gasket
ccc. Crankshaft Front & Rear Seal
ddd. Optional After Treatment Coverage
eee. Diesel Particulate Filter
fff. Selective Catalytic Reduction
ggg. Any additional manufactured components, having a manufacturer's part number, installed by an authorized dealer.
hhh. 5-year warranty coverage also covers all authorized dealer overtime for warranty repairs and all rental equipment for equipment down longer than 48 hours.
iii. Tank manufacturer shall provide its standard 30-year warranty.

PART 2 PRODUCTS

2.01 GENERAL

A. The engine-generator sets shall be a factory assembled unit, specifically designed and equipped for operation on No. 2 diesel fuel oil, and shall be Caterpillar C9, or equal as manufactured by Cummins, or equal as manufactured by Generac, or equal as manufactured by AKSA. The engine and generator shall be directly connected with a semi-flexible steel coupling, shall be free from injurious torsional or other vibration and shall be vibro-mounted with a heavy steel sub-base. The diesel engine shall be vertical in-line, or V-type not over twelve cylinders, four stroke cycle, turbo-charged with intercooler using engine jacket water, full diesel, electronic fuel injection, arranged for direct connection to an alternating current generator. The unit shall operate at a rotative speed of not more than 1800 rpm and shall develop its full KW rating including radiator fan power, if so equipped at a BMEP not to exceed the following:

1. Four stroke cycle naturally aspirated 190 PSI

2. Four stroke cycle turbocharged 307 PSI

3. Four stroke cycle turbocharged with aftercooler 385 PSI using engine jacket water for aftercooler.

4. The piston speed shall not exceed 2250 FPM

5. Units offered at ratings in excess of their published ratings are not acceptable and will not be approved.

B. The engines shall be rigid, neat in appearance and shall allow easy access to the various parts for maintenance purposes. The bed plate and frame shall be of heavy construction. All parts shall be properly enclosed to prevent the throwing or dripping of oil.

C. The engine-generator sets shall be pre-piped and pre-wired as a package unit insofar as possible. Separate pre-wired terminal boxes shall be provided on the engine-generator skid for low voltage A.C. and D.C. interface wiring.

2.02 ENGINES

A. General

1. The engines shall be capable of withstanding a 5 percent overload for two hours out of every 24 hours without harmful detonation, overheating or other evidence of distress.

2. The complete engine-generator unit shall be free from harmful torsional or other vibration throughout the entire operation range of speed and load.

2.03 EQUIPMENT

A. Governor

1. The engine governor shall be an electronic isochronous speed controller. Speed droop shall be externally adjustable from 0 to 10% from no load to full rated load and shall

automatically adjust generator frequency from within a maximum of 0.25% of rated frequency under steady state operating no load and loaded conditions. Speed shall be sensed by a magnetic pickup off the engine flywheel ring gear. A provision for remote speed adjustment shall be included. The governor shall incorporate provisions for limiting fuel during start-up, and included capability for compensation adjustment. The use of generator set manufacturer's factory installed electronic engine control system to perform the governor functions of controlling fuel and speed is acceptable.

2. Furnish also a separate overspeed shutdown device which shall, in case of predetermined overspeed or the operation of various protective devices as later specified, instantly stop the engine without the fuel injection system losing its prime.

B. Supporting Structure

1. The diesel engine-generator shall be directly bolted, doweled, and aligned on a rigid, fabricated steel base, suitably sized to maintain the correct alignment, supported by Korfund or equal heavy-duty spring type vibro-isolators, anchored to the outdoor enclosure.

2.04 SYSTEMS

A. Fuel Oil Systems

1. Sub-base Fuel Storage Tank - The unit shall be equipped with a UL 2085 listed double wall sub-base fuel storage tank, All necessary fuel and vent lines for proper engine performance will be provided as well as a means to readily detect the fuel level in the tank without the use of a measuring stick.

2. The sub-base fuel storage tank shall a minimum capacity to provide 72 hours continuous operation of the engine-generator at 100 percent load. The sub-base fuel storage tank shall be sized to fit into a 218-inches by 78-inches footprint. Maximum height of fuel tank shall be 36-inches.

3. One engine driven fuel pump, taking its suction from the base tank shall deliver the fuel oil to the engine injection system through a duplex oil filter of the replaceable element type. The excess fuel supplied to the engine shall be returned to the tanks. Provide all equipment and controls required to coordinate fuel system operation.

4. Provide a fuel filter/water separator system installed on the engine and flexibly connected to the engine fuel supply. The filter shall be of the replaceable filter type, with clear water/sediment trap bowls for each. A 2-inch diameter differential pressure gauge with 0-15 psig scale and adjustable alarm switch shall be installed across the filters. Fuel shall be piped with flexible connections from the filter/water separator system to the intake of the engine fuel pump and then from the engine's fuel return to the fuel storage tank fuel return. The fuel/water separator shall be as manufactured by Racor.

5. The fuel storage tank shall be provided with the following items:
   a. Vent cap
   b. Primary Vent shall not exceed height of enclosure per sub-base tanks.
   c. Emergency vents
   d. EFG-8000l Greenleaf fuel level gauge
   e. EFC-420.1 4-20mA data converter

f. Manual fuel stick with gallons to inch laminated conversion chart.

6. The fuel storage tank shall be provided with the following connections:
   a. Fuel supply
   b. Fuel return
   c. Fill with camlock fitting and cap with aluminum or stainless steel fittings and 5 GL minimum overall spill containment box
   d. Back up mechanical Kruger fuel level gauge
   e. Vent
   f. Primary tank emergency vent
   g. Low level switch
   h. Leak detection
   i. Secondary tank emergency vent
   j. Secondary tank mechanical Kruger leak gauge
   k. Placard set stating size, fuel fill, vent, emergency vent, combustible, No Smoking, and Diesel on two sides and near fuel fill.

7. The fuel storage tank shall have controls that include but not limited to the following:
   a. Greenleaf Solar Gauge EFG-8000-I with EFC -420.1 4-20 mA data converter. The gauge shall monitor fuel level in gallons, interstitial leak, hi, and low fuel level.
      1) The EFC-420.1 4-20 mA data converter shall be mounted inside the generator control panel and shall be wired to the EFG-800I gauge and output feeds to SCADA shall include two sets of twisted pairs wires (TSP#18 Belden 3072F Twinax).
      2) All electrical runs shall be in either rigid or non-metallic liquid tight conduit.
      3) The EFG-8000-I gauge shall be mounted on the outside of the enclosure if on a base tank less than 500 gallons and at fuel fill end. All penetrations through enclosure shall be weather tight. For no or low light conditions EFG-12V is required for the EFG-8000-1I gauge.
      4) All conduits going from the EFG- 8000-I gauge to the EFC-420.1 data converter in the generator control panel shall be aluminum grade with aluminum or stainless unistrute with clamps securely attached to the concrete slab. No penetrations shall be made in to the above ground fuel storage tank.
   b. Level gauge, capable of measuring the fuel level without the engine running.

8. All parts of the fuel system shall meet the approval of, and be installed in complete compliance with, all applicable local, state and federal codes, laws and regulations.

B. Electric (Battery) Starting Systems

1. Starting shall be accomplished by an engine mounted, solenoid shift electric starter, capable of withstanding five consecutive continuous cranking periods of 10-second duration each separated by 15-second rest periods before shutting down completely and sounding the alarm.

2. The starting battery(ies) shall be low maintenance, long life, lead acid type, especially designed for diesel engine cranking service, and of a capacity as recommended by the battery Manufacturer for cranking the engine being furnished, for the necessary break-away current as required and the spinning current for four consecutive starts of 15 seconds of cranking on each start, without being recharged, with a battery temperature of 45 degrees F and with the SAE 30 oil in the engine maintained at 60 degrees F. The

battery(ies) shall be manufactured by CTD Power Systems, Chloride, or equal. An insulated protective covering, battery rack and suitable cables shall be provided.

3. Cell containers shall be sealed, translucent, shock absorbing, heat resistant plastic with electrolyte level marks and spray proof, flame arresting type vents. Battery shall be furnished with all connectors and hardware, lifting device, electrolyte terminal plates, cables, grease, hydrometer and brushes for cleaning posts and connectors.

4. Floor mounted structural steel battery racks shall be furnished specifically designed for battery service. The racks shall be finished with an acid and fire-resistant epoxy coating and non-metallic rain covers.

5. Battery chargers shall be a UL listed, fully automatic, filtered, float-type, charger suitable for wall or rack mounting. Input voltage shall be 120 volts A.C., single phase, 60 Hz. The D.C. output shall be regulated to within one percent with plus or minus ten percent fluctuations of the input voltage and shall be current limited at 120 percent of rated output. Accessories shall include D.C. ammeter and voltmeter (panel type; 2 percent accuracy), adjustable float and equalize controls and toggle switch, A.C. and D.C. circuit breakers, A.C. power failure alarm relay, low D.C. voltage alarm relay and D.C. ground fault relay. The charger shall be Chloride Model SCR-F; LaMarche Model A12B or equal.

C. Air Intake Systems

1. The engines shall be equipped with suitably sized dry type air intake filter(s) to protect working parts of the engine from dirt and grit with replaceable type filter element. In-line air inlet silencers shall be provided between the turbocharger and the air inlet filter. A crankcase breather shall be included and hose extended to the radiator discharge air location on the unit.

D. Lubrication System

1. The engines shall be provided with a full pressure lubricating oil system arranged to cool the pistons and to distribute oil to all moving parts of the engine including the turbocharger bearings and including full flow filter of the replaceable element type and a suitably sized shell and tube type oil cooler and an AMOT or equal automatic temperature regulator. An engine driven lubricating oil circulating pump shall be provided for the engine. This pump shall be of the positive displacement type, and shall have ample capacity to circulate the amount of lubricating oil and cooling oil required by the engine and turbocharger. The engines shall be provided with a sump type crankcase arrangement of sufficient capacity to suit the requirements of the engine.

2. The engines shall be furnished with a Kenco or equal float operated oil level controller with engine mounted integral oil storage tank. It shall be installed in such a position that it will maintain a constant crankcase oil level as recommended by the engine manufacturer and visually indicate the oil level.

E. Engine Cooling Systems

1. The units shall be radiator cooled with a blower or pusher type fan mechanically driven by the engine. The radiator shall be Bronze Glow 100% dipped. Fan and belts shall be completely guarded in accordance with OSHA regulations. The cooling system shall be

adequate for cooling the units at full rated load and, for installation in a climate (Northeast Florida Region) where freezing temperatures are encountered, shall be adequate for proper cooling in summer with a 50 percent ethylene glycol anti-freeze solution with rust inhibitor in the radiator, and with an ambient air temperature of 110 degrees F. A pressurized radiator cap, if used, shall be rated for not more than 6 PSI on the cooling systems. Furnish and install a suitable air discharge duct from the face of the radiator to the wall and incorporate in the wall automatic discharge dampers which shall automatically open when the unit starts and automatically close when the unit stops. The automatic dampers shall be furnished and installed as specified herein. The cooling system shall be adequate for properly cooling the unit at full rated KW capacity and with an ambient temperature of 110 degrees F. Louvers or openings shall be properly screened to prevent the entry of rodents, insects or birds.

a. Attached engine driven, centrifugal jacket water pump equipped with a mechanical seal and capable of circulating the required amount of jacket water through the radiator and required additional piping, to be suitably sized and furnished by engine manufacturer. Hose shall be silicone and have shut-off valves in accordance with JEA specifications.
b. Suitably sized full flow lubricating oil cooler.
c. Provide AMOT or equal automatic temperature regulators for the engine jacket water and lubricating oil which shall maintain pre-set temperature without restricting the rates of flow through the engine.
d. The engine thermostat shall be "AMOT" or equal which shall automatically maintain jacket water temperature at predetermined values without restricting the rate of flow through the engine.
e. The temperature regulators, and other cooling system components shall, as far as practical, be mounted on the engine or unit sub-base and factory piped. All external connections to the engine shall be made with flexible metal hose suitable for the pressure and temperatures involved. All pipe sizes shall be as recommended by the engine manufacturer.
f. As required by the manufacturer, the expansion tank shall be roof mounted adjacent to the silencer. Manufacturer shall provide all piping, supports, building modifications, etc. as required for a complete installation.

2. Provide suitable jacket water treatment for the prevention of both scale formation and corrosion in the engine water jackets and cooling system components which are in contact with the engine jacket water. This treatment shall be added to the cooling system prior to running the field acceptance test. The treatment shall be NALCOOL 2000 as supplied by and applied in strict accordance with the recommendations of the NALCO Chemical Company, 6233 West 65th Street, Chicago, IL 60638, or equal.

3. Before adding the recommended treatment, the engine jacket water system shall be thoroughly cleaned and conditioned, using NALCO 2015 Twin Pac, two step engine cooling system cleaning treatment, or equal, strictly in accordance with the manufacturer's instructions and using particular care to thoroughly flush and remove the soda ash immediately after 15 minutes of idling engine operation.

F. Exhaust System

1. High degree exhaust silencer, Maxim, Model M51, or equal, for critical grade silencing, shall be installed. The exhaust silencer noise attenuation shall be 28 to 32 dBA and be stainless steel construction. The exhaust silencer and exhaust piping shall be Type 304L

stainless steel, stainless steel with flanged fittings and of the size recommended by the engine Manufacturer. Suitable stainless steel bellows expansion joints shall be provided and installed where required to provide for expansion of the pipe caused by a 1200-degree F temperature change. The exhaust system shall be connected to the engine by a suitable section of flexible stainless steel bellows construction, exhaust flex as recommended by the engine Manufacturer as suitable for the maximum temperature condition which may be encountered. All exhaust line elbows shall be long radius.

2. The silencer shall be supported by a welded stainless angle iron cradle; silencer shall be bolted or strapped to cradle and then bolted to the roof support members mounted inside the roof of the enclosure for a horizontal mounting on top of the enclosure.

3. All exhaust piping shall be Type 304L, Schedule 10S stainless steel, and the exhaust shall discharge horizontally at the silencer outlet, with 45-degree bevel cut with a stainless expanded metal bird screen.

4. The intake of the silencer shall connect to the flexible exhaust connection by stainless steel pipe. Size as required by the engine manufacturer. A flexible stainless steel exhaust adapter, 18-inch minimum length, shall be furnished for mounting between the engine and silencer. The flexible exhaust connection as specified shall mount directly on exhaust manifold and shall be mounted so that no weight is exerted on the manifold at any time.

5. It is the intent of this specification to provide complete compliance with all applicable local, State and Federal codes, laws and regulations.

G. Miscellaneous Equipment and Requirements

1. Heaters
   a. Two automatic thermostatically controlled heaters shall be provided to maintain not less than 90 degrees F temperature with an ambient temperature of 30 degrees F (-1.11 degrees C) for the engine jacket water (sized for Northeast Florida climate) and engine lubricating oil system(s).
   b. Each heater shall be powered by MPZ-GEN, specified under Paragraph 2.07.
   c. All heaters shall be automatically deactivated when the engine generator unit is in operation.
   d. All jacket water heater hoses shall be silicone type.

2. Hearing Protection
   a. Two (2) circumaural hearing protection devices MSA Noisefoe Mark IV ear muffs or equal shall be furnished for the hearing protection of operating personnel. Provide with high impact plastic window type cabinet, suitable for wall mounting.

3. Remote Emergency Stop Push Button Stations
   a. Two emergency stop push button stations to be located at each exterior entrance of the enclosure per NFPA 110. A remote emergency stop push button to shut the engine down regardless of the switch position shall be placed by the pump control panel. Emergency Stop shall be in a stainless steel NEMA 4 enclosure, mushroom handle with clear cover. No “Break Glass” E-stops will be permitted.

2.05 GENERATOR CONTROL PANEL

A. An engine mounted steel control panel shall be furnished and mounted on the generator skid unit. The panel shall be EMCP 4.2, or approved equal by Owner and shall contain, but not be limited to, the following equipment / function:

1. Frequency Meter, dial type.
2. Voltmeter, 2 percent accuracy.
3. Ammeter, 2 percent accuracy.
4. Ammeter phase selector switch.
5. Voltmeter selector switch (4 position) line-to-line.
6. Automatic starting controls as specified.
7. Voltage level adjustment rheostat.
8. Dry contacts for remote alarms wired to terminal strips.
9. Main line circuit breaker, 100% rated.
10. Individual fault indicator lights for low oil pressure, high water temperature, overspeed, and overcrank with pre-alarm and remote alarm contacts.
11. Four position function switch marked “auto”, “manual”, “off/reset”, and “stop”.
12. Running time meter, oil pressure and water temperature gauges.
13. Panel lights, transformers, fuses, etc., as required.
14. Panel mounted kilowatt meter.
15. Unit mounted annunciator with audio/visual alarms and individual fault indicator lights. Provide additional dry contact alarm for each condition.
16. Emergency stop pushbutton.
17. Remote Annunciator NFPA 110.
18. All engine-generator units shall be capable of interfacing with JEA SCADA equipment.
19. Two normally-open dry contacts that will close when engine is running and open when engine is stopped.
20. Programmable cycle timer (PCT) for automatic exercising.

B. The 100% rated main line, molded case circuit breaker shall be installed on the generator unit and sized to the output of the generator. The location of the breaker (left or right hand will be confirmed during the shop drawing review process). The trip unit for each pole shall have

elements providing inverse time delay during overload conditions, instantaneous magnetic tripping for short circuit protection and ground fault tripping. The main line circuit breaker shall be installed in an oversized box.

C. Engine-Generator Interface to OWNER SCADA System

1. The following Inputs for each engine-generator set shall be set up for the interface to a Siemens ET200S Distributed I/O Module. The ET200S module will feed the generator status information to the SCADA equipment over Profibus. Contacts from the generator shall be prewired and labeled to the ET200S. Connect Greenleaf EFC-420.1 data converter and Transfer Switch contacts.

2. Digital Inputs to ET200S (Are to be connected in this order)
   a. Generator Run (From Generator)
   b. Generator Fault (From Generator)
   c. Fuel Leak (From Greenleaf data converter)
   d. Normal Power Available (From Transfer Switch)
   e. Transfer Switch Normal (From Transfer Switch)
   f. Transfer Switch Emergency (From Transfer Switch)

3. Analog Input to ET200S
   a. Fuel Level (From Greenleaf data converter)

4. Engine-Generator to Owner's SCADA system with PLC S7-1200 or S7-300:

   jjj. The following inputs for each engine-generator set shall be set up for the interface to a Siemens S7-1200 or S7-300 Distributed I/O Module in SCADA via Ethernet cable. The modules will feed the generator status information from the ST 200SP distributed I/O in the Generator to the SCADA equipment over Profibus. Contacts from the generator landed in the ET200SP per Drawings. The ET 200SP distributed I/O will communicate with SCADA via a shielded ethernet cable. Connect Greenleaf EFC-420.1 data converter and transfer switch contacts.
   kkk. Digital inputs to ET200SP are to be connected per Drawings.
   lll. Analog inputs to ET200SP:
      1) Fuel Level (from Greenleaf Data Converter).

5. The Bill of Material below is the list of the devices to be provided and installed with each engine-generator.

Manufacturer	P/N	Description	Qty
Attabox	AH12106C	Enclosure, NEMA 4X, Polycarbonate, Clear cover	1
Attabox	BP1210A	Backpanel, 12 ga, Aluminum, Unpainted	1
Phoenix Contact	2907562	Circuit Breaker, UL 489 branch rated, C-Curve, 1-pole, 5A	1

Manufacturer	P/N	Description	Qty
Siemens	6AG1 155-6AA01-7BN0	Interface Module, SIPLUS ET200SP IM155-6PN Standard	1
Siemens	6AG1 131-6BF01-7BA0	Digital Input Module, SIPLUS ET200SP DI 8x24VDC ST	3
Siemens	6AG1 134-6GD00-7BA01	Analog Input Module, SIPLUS ET200SP AI 4xI 2-/4-Wire ST	1
Siemens	6AG1 193-6BP00-7DA0	Base Module, White	4
Citel	DS220S-24DC	Surge Protector, 24VDC	1
Phoenix Contact	2313931	Profinet Network Isolator	1
WAGO	2002-1406	Terminal, Push-In, 1-Circuit, Yellow	2
WAGO	2002-1404	Terminal, Push-In, 1 Circuit, Blue	2
WAGO	2002-1407	Terminal, Push-In, 1 Circuit, Green/Yellow, Grounding	1
WAGO	2002-1492	Terminal End Plate, Orange	3
WAGO	2002-400	Adjacent Jumper, 2-Way Continuous	2
WAGO	249-116	End Anchor, 6mm, Gray	2
WAGO	210-112	Din Rail, Galvanized, Slotted, 2m	1
Square D	PK5GTA	Equipment Ground Bar Kit	1
Siemens	6XV1 840-2AH10	Profinet Cable, Fast Connect	1
Siemens	6AG1 901-1BB10-7AA0	Profinet Connector, SIPLUS	2

6. The PLC will be powered from the 24VDC supply from SCADA to the ET200SP in a separate 1/2" conduit from the generator to the RTU cabinet.

7. Fourteen (14) #18 tinned MTW Blue SCADA digital input wires shall be provided for each unit and ran back to SCADA RTU cabinet.

8. Two (2) Profinet Cables from the I/O Panel to RTU shall be in 3/4" conduit from the generator to the RTU. Cable shall be Siemens 6XV 840-2AH10 with connector Siemens 6AG1 901-1BB10-7AA0 on each end of cable.

9. All field wiring shall connect directly to I/O base terminals using ferrules with end sleeves.

10. All mounding screws shall be drilled and tapped (no self-tapping screws are allowed).

11. All mounting screws shall be stainless steel.

12. Din rail shall be model 1492-DR9 or equivalent.

13. Two (2) TSP #18 shielded pair of analog inputs shall be provided for each and ran back to SCADA RTU cabinet. TSP wire shall be Belden 3072 Twinax.

14. Communication wire from the Generator to ATS and the RTU shall be 18ga tin-coated MTW copper wire.

2.06 GENERATORS AND EXCITATION SYSTEMS

A. The generator shall be of the drip-proof, guarded, bracket type, especially designed for connection to the specified engine and shall be for 3-phase, 60-Hertz, 4-wire, 480-volt operation and shall be "Y" connected. The generator shall be mechanically and torsionally matched to the engine driver and shall be designed to withstand inherent pulsating torques of the engine.

B. Generator windings shall be braced for full line-to-ground and phase-to-phase fault with both generators operating.

C. The generators shall have a forged or cast alloy steel flanged shaft for direct connection through a suitable flywheel type coupling to the engine, or with suitable adapter and disc coupling; and shall be of the single bearing type with anti-friction bearing. Full load efficiency of the combined generator, exciter and regulator shall be not less than 93 percent.

D. The generator windings, insulation and excitation system shall be braced to withstand any possible short-circuit stresses and shall be designed to withstand any overheating or stresses caused by harmonics generated by the variable frequency drives. The excitation and voltage control system shall sustain at least 300 percent rated generated current for ten seconds when a 3-phase symmetrical short-circuit is applied at the generator terminals. The unit shall be "Radio Interference Proof" (RIP) and the "Telephone Influence Factor" (TIF) shall be within the limits of Section 9, ANSI C50.12.

E. The generator shall utilize a brushless, rotating field, Permanent Magnetic Generator (PMG) type excitation system with an electronic closed loop voltage regulator. The exciter rotor and field windings shall have Class H insulation, rated for Class B (80 degrees C) temperature rise at generator full load prime power rating.

F. The generator stator core shall be built up of low carbon steel laminating precision punched, deburred and individually insulated. Stator coils shall be all copper, random or form wound and inserted in insulated core slots. Wound core shall be repeatedly treated a minimum of three times with thermosetting synthetic varnish and backed for maximum moisture resistance, high dielectric strength and high bonding qualities. Armature lamination followers and frame ribs shall be welded integral with frame. The average dielectric strength for the form wound coils of the ground and end turn insulation shall not be less than 400 volts per mil. A vacuum pressure impregnation (VPI) process shall be utilized on form wound stator windings.

G. The generator shall be furnished with 120-volt anti-condensation space heaters, designed to hold a minimum temperature of 90 degrees F.

H. Generator rotor poles shall be built up of individually insulated steel punchings. Poles shall be wound and bonded with high strength varnish, then baked. Cage connections shall be brazed for strong construction and permanent electrical characteristics. Each pole shall be dovetailed and keyed to rotor shaft. The rotor shall be dynamically balanced for all speeds up to 125 percent of rated speed per NEMA specifications. The entire rotor assembly shall be 100 percent epoxy resin vacuum pressure impregnated, then baked.

I. A cooling fan shall be mounted on the rotor to draw air from exciter end, over rotor poles and through louvered openings in drive end.

J. The generator shall have an oil lubricated anti-friction bearing. The designed bearing life, based on B-10 curve of the Anti-Friction Bearing Manufacturers' Association, shall not be less than 40,000 hours.

K. Voltage regulator shall be hermetically sealed, silicon controlled rectifier type and shall employ a zener reference and three phase sensing. The voltage regulator shall provide automatic protection of the entire unit on 3-phase short-circuits. The voltage regulator shall include automatic over-excitation and under-frequency protection. Input isolation transformers and filters shall be provided to minimize disturbances caused by line harmonics. Exciter shall be fast response type with a rotating rectifier and surge suppresser, 3 phase, full-wave bridge. They shall feature low time constant design to minimize voltage transients under severe load changes.

L. Voltage regulation shall be within plus or minus 1 percent of rated voltage from no load to full load. Steady-state modulation shall not exceed plus or minus 1/2 percent. Instantaneous voltage dip shall not exceed 20 percent of rated voltage when full load at rated power factor is applied. Upon single step application of full load, recovery of stable operation shall occur within nine seconds.

M. The voltage regulator and associated equipment shall be mounted in the generator terminal boxes.

N. Generator stator leads shall be connected to copper bus bars in an oversize terminal box with differential and ground fault protection current transformers.

O. Accessories and Attachments:

1. Terminal Box: The unit shall contain a terminal box and any extension necessary and shall be sized and provided with space for four (4) - CT's for differential and ground fault protection. Suitable lugs shall be provided for terminating 480 volt cables with stress cones.

2. Low Voltage Terminal Boxes: The generator shall have a separate low voltage AC and DC terminal boxes with suitably marked terminal strip for high bearing temperature (each bearing), high stator temperature, and space heater connections.

3. Space Heaters: Space heaters shall be installed on the generator frame to maintain temperature of the entire generator above the dew phase. Heaters shall be automatically disconnected when the engine starts, all required controls shall be provided at the generator control panels.

2.07 WEATHERPROOF SOUND ATTENUATED ALUMINUM ENCLOSURE

A. The complete engine-generator set, main line circuit breaker, battery charger etc. shall be enclosed within a weatherproof, sound attenuated aluminum enclosure. The enclosure shall be of the walk-in type and shall be of the drop over configuration, suitable for pad mounting. The minimum distance from engine-generator and generator to end wall shall not be less than 3’-0” for walk-in type enclosures. The complete engine-generator set shall be enclosed in a modular, walk-in type weatherproof enclosure. The enclosure shall provide 6 feet minimum head clearance and 24-inch minimum walk around clearance on the sides not including radiator. The enclosure shall consist of two sidewalls, two end walls, louvers, and roof. The enclosure shall be designed to provide a sound level of mechanical noise of 85 dB(A) at 15 feet from any point

of the enclosure. The enclosure shall be manufactured by Phoenix Products, or approved equal by OWNER.

B. The engine generator supplier shall be responsible for coordinating the location of all equipment to be housed in the enclosures and on the enclosure roofs. The intent of these specifications is to call attention to certain features of the enclosures construction. The engine supplier shall furnish complete shop drawings for the enclosures in accordance with the requirements of Division 1. Shop drawings shall include but not be limited to the following specific items:

1. Complete dimensional drawings for the enclosure showing the location of all equipment installed within the enclosure or on the enclosure roof.

2. Installation details showing the location and special installation requirements of all foundation anchor bolts and other non-factory installed enclosure components such as silencer supports, engine exhaust piping, miscellaneous electrical components and other miscellaneous appurtenances such as wall and roof penetrations.

3. Detailed power distribution drawings, conduit and wire schedules, and details of all miscellaneous electrical components including mini-power zone, receptacles, junction boxes, lighting fixtures, transformers and switches. Electrical drawings shall indicate all required field connectors and connections resulting from the assembly of the enclosure sections.

4. The generator enclosure manufacturer shall provide calculations and written stamped certification by a Professional Engineer (P. E.), licensed in the state of Florida indicating that the furnished generator set enclosure is designed and constructed to meet the applicable wind resistance requirements of ASCE 7-10 and the Florida Building Code (FBC) Sixth Edition including the 2012 FBC supplement, including for missile impact resistance. Submit copies of the Florida P. E. stamped certified wind load calculations and report, and enclosure drawings indicating compliance for the specific designed generator outdoor enclosure to be furnished for this Project prior to site delivery of the equipment. Copies of the P.E. calculations report and certification and P.E. stamped drawings are to be included in the Manufacturer’s enclosure, operation and maintenance manuals to be furnished for the generator system.

5. The entire generator set outdoor enclosure, installed generator set, and mounting base assembly design and construction shall be in compliance with the National Electrical Code (NEC), the National Fire Protection Association (NFPA), and Occupational Safety and Health Administration (OSHA) including physical space clearances and protection around all electrical and mechanical equipment. The enclosure assembly shall conform to the equipment design criteria as specified herein and as shown on the Drawings. In addition, the enclosure manufacturer shall be listed as an approved vendor by the Florida Department of Community Affairs (DCA). The project furnished generator equipment enclosure shall meet the design, construction, and provision requirements of the Florida Department of Business and Regulation (DBPR), including verification of meeting the wind and windblown missile impact resistance requirements of the Florida Building Code (FBC) Sixth Edition . The Manufacturer’s enclosure design to be furnished shall have been physically tested to demonstrate compliance by a State of Florida approved independent third-party testing laboratory. The enclosure manufacturer shall provide Florida DBPR approval; documentation for the furnished enclosure; proof of the enclosure manufacturer’s

approved listing and enclosure construction design compliance with these requirements shall be included in the Shop Drawing Submittals, no exceptions.

C. Exact enclosure height shall be determined by the generator and enclosure manufacturer and shall be suitable to accommodate the engine cooling radiators, shroud, etc.

D. Each enclosure section shall consist of a roof, two end walls and side walls, of anodized marine grade aluminum and painted Padmount Green.

1. Design wind resistance in accordance with the Florida Building Code Sixth Edition:
   a. Ultimate design wind speed, V_{ult}: 194 mph
   b. Normal design wind speed, V_{asd}: 150 mph
   c. Exposure Category: C

2. Roof Live Load: 20 psf uniform

3. Enclosure shall be certified to meet the following latest codes:
   a. Florida Building Code Sixth Edition and ASCE 7-10
   b. Florida Mechanical Code
   c. National Electrical Code
   d. National Fire Prevention Association
   e. Occupational Safety and Health Administration

E. The enclosure components shall meet the HVHZ large missile impact requirements of Section 1626 of the Florida Building Code.

F. The enclosure shall bear the insignia of the Florida Department of Business and Professional Regulation to document compliance with the Florida Building Code Sixth Edition.

G. Drop over type enclosures shall have a rubber gasket under it with a rubber cement type adhesive to keep gasket in place to prevent water intrusion into enclosure as well as keep engine fluids from leaking out.

H. The enclosure shall be constructed of removable side panels and end panels. All fasteners and hardware used in construction of the enclosure shall be stainless steel. The enclosure shall be braced as necessary to support the silencer and designed to withstand wind speeds, as specified in Paragraph 2.07.D, without damage. All bracing and reinforcing members shall be integral to the enclosure.

I. The enclosure shall be complete with fully gasketed access doors, providing a weathertight perimeter seal, locking door handles, and duplicate keys. Number and location of doors shall be adequate to provide easy access for operation and maintenance. Doors and frames shall be factory installed. All exposed screws, bolts and nuts, if used shall be Type 316 stainless steel. A bolt-in-place removable end wall panel located at the generator end shall also be included.

J. Lighting within the enclosure shall incorporate switchable vapor-tight LED light fixtures (5500 lumens each). Provide a minimum of four (4) light fixtures controlled by spring wound 120-minute timer 3-way light switch.

K. A minimum of two (2) 120VAC, 20 Amp GFCI convenience duplex receptacles shall be provided within the enclosure.

L. The CONSTRUCTION CONTRACTOR shall supply one 25A, 480V, three phase power supply to MPZ-GEN to provide electrical service to the enclosure. Manufacturer shall provide a 15KVA, 480-208/120V, 3-phase, 4-wire transformer-panel assembly (MPZ-GEN) within the enclosure, meeting all NEC clearances. The transformer-panel assembly shall be in accordance with Section 16191. All equipment and devices for the generator set and enclosure shall be pre-wired to panel MPZ-GEN which shall include primary and secondary breakers. Equipment and devices include, but are not limited to: convenience duplex receptacles, enclosure lights, fuel transfer pumps, water jacket heaters, and battery charger.

M. Provide appropriate conduit entrances for power, control and signal wiring into the enclosure.

N. The enclosure manufacturer shall provide electrical layout drawings for all equipment supplied.

O. All electrical materials, installations, etc. shall be in strict accordance with Division 16 requirements. Conduit shall be rigid aluminum, minimum size ¾-inch. Wire shall be type THHN/THWN.

P. Radiator discharge will be through a gravity operated damper and into a hood. The system shall not exceed 0.5" w.g. total external static pressure to ensure adequate airflow for cooling and combustion.

Q. Inlet louvers and hoods shall be removable and constructed of aluminum and riveted into an aluminized steel frame to form a rigid water-resistant assembly. The system shall not exceed 0.25 w.g. total external static pressure to ensure adequate airflow for cooling and combustion. All intakes shall be screened with stainless steel mesh to prevent the entrance of rodents or insects.

R. The sound insulation shall comply with the UL Standard 94HF-1 Flammability Test, covering all the inside walls of the enclosure and shall consist of the type, thickness and number of baffles required to limit the resulting noise level of the unit operating at full load to not more than 86 dBA at a distance of 15 feet from the enclosure in any direction. There shall be no puretones. Insulation in walls and roof shall be semi-rigid, thermo-acoustic.

S. The enclosures shall be provided with a four-point lifting system at or near the enclosure base, with capacity suitable for rigging the entire assembly.

2.08 AUTOMATIC TRANSFER SWITCH (FRONT CONNECTED) WITH BYPASS-ISOLATION SWITCH

A. The delayed-transition, 3-pole, double throw type, front connected, automatic transfer switch with bypass-isolation switch shall be rated 800 Amperes, 3-phase, 480 volts, 65 KAIC (minimum) as shown on the Drawings.

B. The delayed transition, 3-pole, double throw type, front connected, transfer switch with bypass-isolation switch shall be electrically operated, mechanically held type switch and shall have Surge Protective Device (SPD) with a minimum surge current rating of 200 kA per phase. The automatic transfer switch shall be equipped with full relay protection and shall transfer load to emergency source when one or more of the 3-phase voltage falls below 85 percent. It shall automatically return load to normal when all normal line voltages have been restored to 90 percent or more.

C. The automatic transfer switch shall be equipped with an engine starting contact and with an emergency lockout relay to prevent switch from closing load on emergency generator until proper voltage and frequency have been reached. The switch shall be equipped with one-time delay, adjustable from 1/6 to 180 seconds in the engine starting contact circuit to prevent contact from closing until a predetermined delay has occurred. The switch shall be equipped with another time delay relay, adjustable from 1/6 to 180 seconds, which, after a predetermined time, will allow the emergency generator circuit to remain closed after normal power has been restored to at least 90 percent voltage. The switch shall be equipped with a time delay relay, to run engine for 5 minutes at no load on retransfer to normal power source. Provide two additional auxiliary contact switches, 1 normally open and 1 normally closed.

D. The two-way bypass isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. Bypass to the load-carrying source shall be accomplished with no interruption of power. The bypass handle shall have three operating modes: “Bypass to Normal”, “Automatic”, and “Bypass to Emergency”. The “Open” mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the “Open” mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools. When the isolation switch is in the “Test” or “Open” mode, the bypass switch shall function as a manual transfer switch.

E. The automatic transfer switch shall be listed under UL 1008.

F. The automatic transfer switch enclosure shall be NEMA 1.

G. The automatic transfer switch shall be ASCO 7000 Series, Zenith Model ZTS-D/L, Russelectric RTS-3 type delayed transition transfer switch with bypass-isolation switch and microprocessor controls per the JEA Facilities Standards Manual, or approved equal by OWNER.

2.09 SURFACE PREPARATION AND SHOP PAINTING

A. The engine generator set and associated equipment shall be shop primed and finished coated in accordance with the Manufacturer's standard practice prior to shipment. The paint shall be suitable to an outdoor environment and approved by the OWNER. An adequate supply of touch-up paint shall be supplied by the Manufacturer.

B. JEA Paint Specification is:

1. Paint Color: Padmount Green

2. Paint Type: Steel-Master 9500, 30% Silicone Alkyd Enamel Ultra Deep/Clear Tint Base distributed by Sherwin-Williams.

2.10 SHOP TEST

A. A complete engine generator unit and the generator main breaker and control panel shall be shop tested prior to shipment. Shop tests shall be performed in northeast Florida. Four copies of the complete certified test record shall be submitted to the ENGINEER within 30 days after the completed test.

B. The Manufacturer shall notify the OWNER at least one week prior to the shop test. The OWNER reserves the right to witness the shop test.

C. If such tests indicate specified performance has not been met, the Manufacturer shall pay the cost of all corrective measures and additional tests until such time as test demonstrate that specified performance has been met.

D. These tests for the unit shall be sufficient to assure that the unit will operate successfully and meet all specified operational requirements. The Manufacturer shall furnish all necessary instruments, filters, starting air, fuel gas, cooling water, electric power and load banks for the test.

E. The shop test shall consist of, but not be limited to, four continuous hours of operation. Voltage and frequency regulation and transient response shall be tested and recorded to show full compliance with this specification. During the shop test, readings shall be taken and recorded every thirty minutes for each of the following:

1. Time

2. Ambient temperature

3. Volts for each phase

4. Load:
    a. Amps for each phase
    b. KW
    c. Power factor
    d. Frequency
    e. Engine jacket water temperature
    f. Cooling water temperature (in and out)
    g. Intake manifold pressure
    h. Lubricating oil pressure
    i. Crankcase pressure
    j. Lube oil temperature
    k. Intake manifold temperature
    l. Exhaust gas temperature
    m. Raw water cooling flow for heat exchanger
    n. Gallons of fuel consumed per hour
    o. Emission compliance

F. The generator shall be shop tested in accordance with IEEE Standard 115. Testing shall include the following:

1. Cold resistance of all windings

2. Insulation resistance of all windings

3. Polarity of field coils

4. High potential on all windings

5. Open circuit saturation

6. Air gap measurement

7. Regulation (with regulator)

8. Transient voltage dip and response

9. Voltage and current balance

G. The procedure for the shop test of the diesel engine shall cover the engine Manufacturer's standard practice and shall also include at least, but not be limited, to the following:

1. Prior to all starts during initial tests and all starts after new running parts have been installed, the engine shall be connected to a separately driven lubricating oil pump and filtered oil circulated through all of the engine channels. The engine shall be thoroughly inspected for oil leaks prior to shipment, paying particular attention to leaks around the shims of bearing shells in engines where shims are used.

2. The engine shall be prelubricated for a sufficient period of time to insure adequate lubrication. Caution shall be taken to avoid the accumulation of oil in the combustion chambers.

3. Engine and generator alignment shall be checked and generator air gap measured prior to the test.

H. Provision shall be made for bypass filtering and full-flow straining of the lubricating oil during the test. The strainer shall be so constructed that it will not pass particles over 0.003-in.

1. The engine shall be tested with the governor intended for permanent use on the engine. New, clean lubricating oil shall be used in the governor.

2. An air filter or cleaner shall be used for the supply of combustion air during all testing.

3. All starting air lines shall be fitted with water traps and lubricators.

4. The engine shall be given a suitable wearing-in run before the witnessed shop test as recommended by the Manufacturer. Before recording any readings, all operating temperatures and pressures shall have become stabilized.

5. All alarm, shutdown, and control functions shall be demonstrated. Transient response shall be measured to indicate compliance with the performance specifications.

I. After completion of all testing, the following is required:

1. The load limit shall be sealed. The seal shall be applied, using a seal press which embosses the Manufacturer's initials on the lead seal.

2. All entrapped water shall be drained, and proper protection applied to prevent the entry of water during shipment or a long period in storage while waiting for installation.

3. The engine shall be given proper treatment for its protection for extended storage at the job site while waiting for completion of installation.

PART 3 EXECUTION

3.01 COORDINATION

A. Coordinate with other trades, equipment, and systems to the fullest extent possible.

3.02 INSTALLATION

A. Provide services of a qualified field representative with a minimum of 5 years' experience in diesel engine generator set installations, training and instruction to check the installation of the generator unit to ensure a proper installation.

B. The complete generator unit shall be mounted on a welded steel sub-base of sufficient rigidity and strength to maintain alignment of the unit. The base shall be suitable for, and there shall be included, spring type vibration isolators for mounting the unit on a level surface of a concrete pad. The spring type vibration isolators shall be supplied by the generator unit Manufacturer.

3.03 EQUIPMENT START-UP

A. Operate unit to demonstrate ability to operate continuously without vibration, jamming, leakage or overheating and to perform specified functions, after installation and after Manufacturer's representative check of installed equipment.

B. Comply with Manufacturer's operating and maintenance instructions during start-up and operation.

C. Promptly correct improper installation of equipment.

D. Cooperate with supplier of equipment at time of start-up and in making of all final adjustments necessary to place equipment in satisfactory working order. Start-up shall not commence without the presence of the Manufacturer's representative.

E. The CONSTRUCTION CONTRACTOR shall be responsible to fill the above ground bulk diesel fuel oil storage tank to 50% full with new diesel fuel oil as recommended by the generator Manufacturer prior to generator system startup and testing. Upon satisfactory completion of all generator system testing, including the switchgear startup and plant SCADA system monitoring, the CONSTRUCTION CONTRACTOR shall be responsible to provide and fill the fuel oil storage tank to 90% full with new diesel fuel oil as recommended by the generator Manufacturer.

3.04 FIELD TESTS

A. Upon completion of the installation and as soon as conditions permit, the emergency power supply system including the engine driven generator, electrical circuits, controls, switchgear and other devices shall be tested in the presence of the ENGINEER by the CONSTRUCTION CONTRACTOR and the service representative for the Manufacturer of the engine driven generator unit to assure that the system functions as specified.

1. Prior to scheduling the test, the CONSTRUCTION CONTRACTOR shall notify the ENGINEER in writing that all requirements and provisions of the Contract Documents have been fulfilled, that all apparatus shall be clean, properly adjusted and ready for

operation and that the Instruction Manuals, parts lists and record drawings described in Paragraph 1.03, have been submitted.

2. The Manufacturers' representatives shall make such changes in wiring or connections and such adjustments, repairs or replacements necessary to make the circuit, device or control system function as specified and otherwise comply with the Contract Documents.

B. The test shall consist of four hours of continuous operation of the unit at full rated load using a portable resistive load bank. During the test, the same readings as outlined under Shop Test Paragraph 2.10E, shall be taken and recorded at 30-minute intervals.

C. As part of the field test, each of the automatic shutdown devices shall be tested and the respective values recorded at which the devices will stop the engine. Any adjustments required shall be made in the devices to make the operating values correspond to those recommended by the engine Manufacturer and as recorded during the stop test.

D. After the four-hour test has been completed, additional testing shall be performed to demonstrate the emergency power supply system's ability to meet the automatic starting, load transfer and motor starting requirements as specified under Paragraph 1.06C.

E. The CONSTRUCTION CONTRACTOR shall provide a person qualified to conduct sound level testing to take and record octave band sound pressure level readings with the portable resistive load shut off and operating the engine driven generator using the station load available at the time the field tests are conducted. These readings shall be within the limits permitted by this specification.

F. Piping shall be tested in strict accordance with the Manufacturers testing requirements. For each double wall fuel oil line entering the building, provide a pressure test port with threaded plug in the double wall piping termination fitting. Piping shall be subjected to an air test of 10 psig maximum.

G. If the emergency power supply system fails to fulfill the performance requirements of this specification, corrective action shall be taken and the system retested to assure full compliance. All expenses associated with the field tests, including any corrective action, shall be borne to the CONSTRUCTION CONTRACTOR.

END OF SECTION

SECTION 16370
VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to manufacture, assemble, shop-test, and install variable frequency drives with integral isolation/phase shift transformers, output filters as shown on the Drawings and as specified herein. All variable frequency drives shall be coordinated with the equipment manufacturer as specified in Division 11.

B. These specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment furnished. They are, however, intended to cover the furnishing, the shop testing, the delivery and complete installation and field testing, of all materials, equipment and appurtenances for the variable frequency drives herein specified.

C. The Contractor shall furnish only one manufacturer of variable frequency drives as specified herein.

D. The variable frequency drives shall also be in accordance with the JEA Water and Wastewater Standards Manual, JEA Facilities Standards Manual, and JEA Shared Services Standards.

E. The work shall include the services of factory representatives of the variable frequency drive manufacturers to inspect the final installation, to perform field acceptance tests on the installed equipment and to instruct the regular operating personnel in the care, operation and maintenance of equipment.

1.02 DESCRIPTION OF SYSTEMS

A. The variable frequency drives specified hereinafter will become part of a complete system as specified in Division 11. The Contractor shall coordinate with the manufacturer of the Division 11 equipment to ensure the compatibility of the equipment.

B. The variable frequency drives will operate motors as specified in Division 11 and Section 16150. The drives furnished herein under shall be totally compatible with the Motors to be supplied.

C. Additional controls shall be provided as required by Division 11 and 13 and as shown on the drawings.

1.03 QUALIFICATIONS

A. Variable speed drives shall be of sufficient size for the duty to be performed and shall not exceed their full-rated capacity when the driven equipment is operating as specified.

B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement. The equipment furnished shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

C. All equipment furnished under these Specifications shall be new and unused and shall be the standard cataloged product of a manufacturer having a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of five (5) years.

D. The variable frequency drive manufacturer shall maintain, as part of a national network (United States), engineering service facilities within 250 miles of the project site to provide start-up service, emergency service, calls, repair work, service contracts, and maintenance and training of customer personnel. When requested by the Engineer, documentation shall be provided showing compliance, capabilities and references for this requirement.

E. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

F. For the equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002 certified.

G. Approved Manufacturers: Eaton SVX9000.

1.04 SUBMITTALS

A. Copies of all materials required to establish compliance with the specifications shall be submitted. Submittals shall include at least the following:

1. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations. Details to also include front elevations with designation of devices and equipment on door(s) and internal to the enclosure. Internal layout of components including dimensions and space requirements. Standard preprinted sheets or drawings simply marked to indicate applicability to this contract will not be acceptable.

2. Descriptive literature, bulletins and/or catalogs of the equipment.

3. Data on the characteristics and performance of the variable frequency drives. Data shall include certification that the variable frequency drives are warranted for use with the motors specified in Division 11 and Section 16150.

4. Complete drawings shall be furnished for approval before proceeding with manufacture and shall consist of job specific master wiring diagrams, elementary or control schematics including coordination with other electrical control devices operating in conjunction with the variable frequency drive, and suitable outline drawings with sufficient details for locating conduit stub-ups and field wiring. Due to the complexity of the system, it is imperative the above drawings be clear and carefully prepared to facilitate interconnections with other equipment. Standard preprinted sheets or drawings simply marked to indicate applicability to this contract will not be acceptable.

5. The total weight of the equipment including the weight of the single largest item.

6. A complete total bill of materials of all equipment.

7. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item.

1.05 OPERATING INSTRUCTIONS

A. The operating and maintenance manuals shall be furnished in accordance with Section 01730. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

B. A factory personnel of the manufacturer who has complete knowledge of proper operation and maintenance of the specified equipment shall provide all the instruction and training as specified herein. This shall be done in conjunction with and coordinated with the O&M instructions to be provided for the equipment, motors and control panels.

C. The cost of training programs to be conducted with Owner's personnel shall be included in the Contract Price. The training and instruction, insofar as practicable, shall be directly related to the System being supplied. The manufacturer shall include the travel and expenses for two Owner personnel attending factory training.

D. The manufacturer shall provide classroom training detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project as per Section 01730.

E. The manufacturer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to Owner.

F. The training program shall represent a comprehensive program covering all aspects of the VFD and maintenance of the system.

G. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.

H. Factory Training: Factory training shall be conducted before System is commissioned, and subsequent to final manual submittals. Factory training shall consist of schooling and hands-on experience. The class shall be for two people and consist of four days of extensive training covering the following:

1. Theory of Operation

2. Use of Software

3. Troubleshooting and Maintenance

I. On-site Training: On-site (field) training shall be conducted at the Owner's site and shall provide detailed hands-on instruction to Owner's personnel covering: system debugging, program modification, trouble-shooting, maintenance procedures, calibration procedures, and system operation. The training shall run at times chosen by the Owner. The training shall be conducted over a period of five days.

1.06 TOOLS AND SPARE PARTS

A. One (1) set of all special tools required for normal operation and maintenance shall be provided.

B. Provide the following spare parts for each size drive in the quantities specified:

1. One (1) DC power board kit
2. One (1) basic control unit
3. One (1) set of all power and control printed circuit boards
4. HMI keypad display
5. One (1) communications network card
6. One (1) human interface module
7. One (1) I/O modules of each type
8. Three (3) of each type of power and control fuses
9. Internal cooling fan kit
10. Heatsink fan kit
11. Two (2) sets of all replacement fan filters
12. Enclosure grill filter
13. One (1) quart of enclosure touch-up paint.

C. Spare parts shall be boxed or packaged for long term storage. Identify each item with manufacturers name, description and part number on the exterior of the package.

1.07 PRODUCT HANDLING

A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

B. All equipment and spare parts must be properly protected against any damage during a prolonged period at the site.

C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

D. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.08 WARRANTY

A. All equipment supplied under this Section shall be warranted by the Contractor and the equipment manufacturers for a period of three (3) years from startup or 24 months from shipment, which ever occurs first in accordance with Section 01740.

B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced and the machine(s) and the unit(s) restored to service at no additional cost to the Owner.

C. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.

PART 2 PRODUCTS

2.01 GENERAL

A. The Contractor shall furnish and supervise installation of variable frequency drives as described in this specification and as detailed on the applicable Drawings.

B. The Contractor shall be responsible for the erection, installation, and start up of the equipment covered by this specification.

C. The variable frequency drive shall comply with the latest applicable standards of ANSI, NEMA, IEEE, and the National Electrical Code.

D. Variable frequency drives shall operate as specified on standby generators or normal power sources.

E. Variable frequency drives shall be 6 pulse.

F. The variable frequency drives shall have a minimum 5% input line reactor on each of the drives.

G. The variable frequency drives shall be provided with a dv/dt output filter to reduce the transient voltage (dv/dt) at the motor terminals.

2.02 CONSTRUCTION

A. The variable frequency drives (VFD) shall be rated at 480 VAC input with features and options as specified.

B. The variable frequency drives shall be rated for the HP, full load current and rpm of the motor. The variable frequency drives shall be designed to provide microprocessor-based continuous speed adjustment of three-phase motors. The variable frequency output voltage shall provide constant volts-per-Hertz excitation for the motor up to 60 Hertz. The variable frequency drives shall be optimized for an adjustable or selectable carrier frequency to reduce motor noise. The carrier frequency shall be field adjustable and adjusted by the manufacturer's field Engineer during start up.

C. The variable frequency drives shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency output via a two-step operation. Variable frequency drives utilizing a third power section are not acceptable. Adjustable Voltage and Current Source variable frequency drives are not acceptable. Transistors shall be used in the inverter section. GTOs and SCRs are not acceptable.

D. The variable frequency drives shall be current regulated. Variable frequency drives permitting instantaneous overcurrent trips other than an output short circuit are not acceptable.

E. The variable frequency drives shall have an efficiency that exceeds 97% at 100% speed and load. The efficiency shall exceed 90% at 50% speed and load. The variable frequency drives shall maintain the line side displacement power factor no less than .95 regardless of speed and load. Variable frequency drive efficiency shall be defined as drive output power at the motor output terminals divided by the input power at the line side of the main circuit breaker.

F. Standard operation conditions shall be:

1. Incoming power: Three phase, 480V (+10% to -10%) and 60 hertz (+/- 2 hertz) power to a fixed potential DC bus level.

2. Humidity: 0 to 95% (noncondensing).

3. Altitude: 0 to 3,300 feet above sea level.

4. Ambient temperature: 0 to 40 degrees C.

G. The variable frequency drives shall be able to start into a spinning motor. The variable frequency drives shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the variable frequency drives shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor in the preset method of starting.

H. Variable frequency drive enclosures shall be NEMA Type 1 gasketed free-standing floor-mounted, force ventilated (with replaceable air filters) construction requiring front access only. Variable frequency drives requiring rear access for any maintenance are not acceptable. The cooling air required to dissipate heat generated by the power electronics shall be isolated from all drive electronics. Variable frequency drives using liquid-cooled assemblies in conjunction with associated pumps, piping, and separate remote mounted exchangers are not acceptable. The inverters and converters shall have complete unobstructed front accessibility with easily removable assemblies. The complete enclosure shall maintain a constant height, width and depth. The height for all floor-mounted enclosures shall be 90" high. The enclosures shall include the integral isolation/phase shift transformer (as required), input line reactor, dv/dt output filters, and shall not be more than:

Booster Pumps 48" in length and 24" in depth (bottom entry/exit for cables)

I. All variable frequency drive programmable parameters shall be adjustable from a digital operator keypad located on the front door of the variable frequency drive. Parameters shall include:

1. Programmable maximum and minimum frequency.

2. Programmable acceleration and deceleration times.

3. Selectable carrier frequencies, V/Hz, and critical frequency avoidance lockout.

4. Adjustable electronic overload and torque limits.

5. Multiple attempt automatic restart following utility outage or fault condition.

6. Jog, thread, and preset speeds.

7. Keypad lockout and factory default overrides.

8. Adjustable slip compensation (+/- 5%).

J. The variable frequency drives shall be additionally equipped with a digital operator station mounted on the enclosure front door. Control operator devices and indication lights shall include:

1. Local digital speed control.

2. Hand-Off-Remote control selector switch.

3. LED status lights for each HOR position.

4. Momentary start/stop push buttons utilized with the HOR in “Hand”.

5. Local-Remote speed control selector switch.

6. LED status lights for each Local-Remote position.

7. LED status lights for run, fault, alarm, up-to-speed, power on, and drive ready status.

8. Additional controls as required by Division 11 and 13 and as shown on the Drawings. Pump Failure will require pump fail timer (as required). Provide for terminations of remote mounted operator control devices and field devices.

K. The variable frequency drives shall have the following system interfaces:

1. Inputs:
   a. Two (2) isolated process control speed reference interfaces to receive and isolate 0-10 Vdc or 4-20 mAdc signals.
   b. Dedicated terminal blocks for interface with remote operator and field devices.
   c. 120 Vac control to allow variable frequency drives to interface with remote contacts and with two or three-wire control.
   d. Additional inputs as required by Division 11 or 13 and as shown on the drawings.

2. Outputs:
   a. Four (4) analog output signals 0-10 Vdc or 4-20 mAdc for external metering.
   b. Run relay with an isolated set of form C contacts.
   c. Dry contact output (N.O.) to indicate protective function trip.
   d. Dry contact output (N.O.) to indicate common alarm.
   e. Additional outputs as required by Division 11 or 13 and as shown on the Drawings.

3. Communications via Profinet. Each VFD shall be provided with Profinet module that supports “ProfiDrive” Communication not just Profinet. Each VFD must support Profinet as a native protocol; a protocol translator between drives is not acceptable. The VFD shall be set up for PPO4 telegrams and data rates in 1.5 M.

4. Monitoring and Displays:
   The variable frequency drives shall have a 40-character vacuum fluorescent display indicating monitored functions as described in the following paragraph.

5. The following parameters shall be monitored:
   a. Input current (3 phases)
   b. Input voltage (3 phases)
   c. Output current (3 phases)
   d. Output voltage (3 phases)
   e. Output frequency
   f. Kilowatts
   g. Drive temperature
   h. Time
   i. Date
   j. Motor rpm
   k. Ten (10) most recent trips/faults

L. Protection Functions:

1. The variable frequency drives shall have the following protective features (with indication for a. through i.):
   a. Speed compensated electronic motor overload current.
   b. Undervoltage.
   c. Overfrequency.
   d. Overtemperature.
   e. Ground Fault.
   f. DC bus protection.
   g. Inrush current limit (adjustable 50 to 150%).
   h. Input and output phase loss.
   i. Emergency stop pushbutton (Red mushroom head and maintained).
   j. Current limiting fuses shall be provided on the input side of the VFDs to protect against fault currents up to 200,000 A sym.
   k. The output side of the VFDs shall be equipped with a current limiting reactor to reduce the amount of fault current to the VFDs.
   l. Phase insensitive to input power.
   m. Surge protective device (SPD) (minimum surge current rating of 200 kA per phase) from input AC line transients at line side of main circuit breaker.
   n. Electrical isolation between the power, control and logic circuits.
   o. Drive to be capable of withstanding output terminal line short or open circuits without component failure.

M. Additional Features shall be provided as follows:

1. All control boards shall have a conformal coating.

2. Input and output line reactors.

3. The variable frequency drives shall be equipped with a flange mounted molded case input circuit breaker (65,000 AIC minimum). The breaker shall be interlocked with the enclosure doors to prevent access to the variable frequency drive unless the breaker is in the open position and to prevent moving the breaker to the ON position while the unit door is open.

The circuit breaker shall have provisions for padlocking in the open position. Provide mechanical interlocks on doors of auxiliary sections of multi-bay or multi-cubical cabinets.

4. Surge protective device (SPD) with a minimum surge current rating of 200 kA per phase from input AC line transients at line side of main circuit breaker.

5. Fused space heaters with thermostat to minimize condensation potential upon drive shutdown.

6. The variable frequency drives shall be variable torque design. Provide constant torque design as required by Division 11.

7. Variable frequency drives shall be capable of unidirectional operation.

8. Variable frequency drives shall have 115 VAC control power for operator devices.

9. Control relays shall be machine tool type, heavy duty type, industrial grade, 600 volt, 10 amp rating, Square D, Class 8501, Type X or equal.

10. All wiring shall be numbered at each end with permanent heat shrink markers. Wiring less than 6 inches may be numbered at only one end.

11. A copper ground bus.

12. Separate door-mounted output ammeter, ammeter switch, non-resettable elapsed time meter (0-99999.9 hour) and speed indicating meter in addition to those specified through the door display.

13. Power unit fan loss protection by automatically switching to a 100% spare cooling fan. Cooling fans shall be on when the variable frequency drive is operating and off when drive is off (fans shall run for a period of time after the variable frequency drive shuts down to dissipate heat and controlled by a thermal switch).

14. All bus and exposed copper shall be tin-plated.

15. All floor mounted enclosures shall have complete 24" (minimum) clear space in bottom of the cubical for line, motor and field cable terminations. All wall mounted enclosures shall have complete 18" (minimum) clear space in bottom of the enclosure for line, motor and field cable terminations.

16. Barriers and warning signs on terminals that are energized with the power disconnect OFF.

17. A 2-inch by 5-inch, nominal, engraved three-layer laminated plastic master nameplates on each VFD fastened with stainless steel screws or rivets. Nameplates shall be black letters with white background core, 3/8-inch high lettering and shall indicate equipment designation as shown on the Drawings.

18. Provide legend plates or 1-inch by 3-inch engraved nameplates with 1/4-inch lettering for identification of pilot devices and meters.

19. Provide permanent warning signs as follows:
    a. "DANGER - HIGH VOLTAGE - KEEP OUT" on all enclosure doors.

b. "WARNING - HAZARD OF ELECTRIC SHOCK - DISCONNECT POWER BEFORE OPENING OR WORKING ON THIS UNIT".

20. A switchable fluorescent light within each floor mounted section of the enclosure.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Field wiring shall be in accordance with manufacturer's recommendations. Anchor bolts shall be set in accordance with the manufacturer's recommendations.

3.02 SHOP PAINTING

A. Prior to shop painting, all surfaces shall be thoroughly cleaned, dry, and free from all mill/scale, rust, grease, dirt, and other foreign matter.

B. Variable frequency drive enclosures shall be shop painted.

3.03 INSPECTION, TESTING AND STORAGE

A. The Contractor shall notify the Engineer two weeks prior to all factory and field tests. The Engineer shall have the option to inspect all tests at the factory and in the field.

B. The manufacturer shall test the variable frequency drive with a motor load (full rated) prior to shipment for 4 hours. All printed circuit boards shall be tested at 50 degrees C for 40 hours. The variable frequency drive manufacturer shall provide the actual test data and certification that the tests have been completed prior to shipment to the Engineer for approval.

C. Field Tests:

1. Field tests of the drive shall be made by the manufacturer who will furnish all equipment and record all data. The Contractor shall be present during testing.

2. Field tests are the basis of demonstrating equipment proficiency and correct operation.

3. If the drive performance does not meet the Specifications, corrective measures shall be taken or the drive shall be removed and replaced with a drive which satisfies the conditions specified. A seven (7) day 24 hour (actual operation) operating period as specified herein of the drive will be required before acceptance. The Contractor shall provide for seven (7) day 24 hour (minimum) on-site supervision of the field acceptance tests. If a drive fails to perform and must be replaced, the rejected drive shall not be removed until the replacement drive has been delivered to the site. If corrective measures are to be taken, such measures shall be done on-site at such times as convenient to the Owner. The Owner shall be allowed to use any drive supplied immediately following installation and testing whether or not the equipment meets the conditions specified.

4. Factory representatives of the manufacturer who are competent and experienced and who have complete knowledge in the proper operation and maintenance of the equipment shall

be provided to inspect and supervise the installation of the equipment and supervise the initial test run. The first visit will be for checking and inspecting the equipment during installation. The second visit will be to operate and supervise the initial field test. If problems are encountered in operation of the equipment additional service shall be provided at no additional cost to the Owner. These services are in addition to the services required for training.

5. Training will not be permitted until all equipment is fully operational. In the event that the equipment becomes inoperable under warranty provisions, additional training will be provided at no additional cost to the Owner as follows:

Inoperable Period	Additional Training
0-2 weeks	None
2-6 weeks	2 days
More than 6 weeks	5 days

6. All training shall be coordinated and conducted concurrently with training to be supplied by the equipment and motor manufacturers.

7. Functional Test: Prior to plant start-up, all equipment described herein shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance by means of a functional test. Submit test procedure for review and approval by the Engineer.

8. Vibration Test: Vibration analyses shall be performed on the equipment when operating the variable frequency drive through its entire speed range. Where loads and drives are separated by intermediate flexible shafting, vibration shall be measured both at the top motor bearing and at two points on the equipment bearing, 90 degrees apart.

9. Performance Testing: Demonstrate system performance by operating the system for a seven (7) day continuous period while varying the application load, as the input conditions allow, to verify system performance. Record all data necessary to document the successful performance of the system. Provide all instruments, equipment, and labor required to accomplish this test. If a unit fails the performance test, the supplier will be allowed to readjust and retest the system. If the unit fails the second test, the unit will be rejected and the Contractor shall furnish a unit that will perform as specified.

10. Check each alarm and detection device for proper operation.

11. The drive manufacturer shall provide all necessary personnel and equipment necessary to properly start-up and pass all tests at no additional cost to Owner.

12. A copy of all tests and checks performed in the field complete with meter readings and recordings, where applicable, shall be submitted to the Engineer.

D. General:

1. All factory and field tests are typical for each variable frequency drive.

2. Electrical equipment shall at all times during manufacture, testing, delivery and construction be adequately protected against mechanical injury or damage by water.

Electrical equipment shall not be stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. Temporary connections shall be provided to operate space heaters and temporary lights required for heat shall be provided to control moisture. If any apparatus has been damaged prior to acceptance the Owner, such damage shall be repaired by the Contractor at his own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, at the cost and expense of the Contractor, or shall be replaced by the Contractor at his own expense.

END OF SECTION

SECTION 16470
PANELBOARDS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install all panelboards as shown on the Drawings and as specified herein.

B. All panelboard wiring shall include wiring numbers and terminal point numbers cross referenced to shop drawing and subsequent record drawing submittals.

1.02 SUBMITTALS

A. Submit to the ENGINEER, in accordance with Section 01300, shop drawings and product data, for the following as a minimum:

1. Equipment outline drawings showing elevation and plan views, dimensions and weight. Indicate all options, special features, ratings and deviations from this Section.

2. Bus arrangement drawings.

3. Product data sheets and catalog numbers for circuit breakers, etc. List all options, trip adjustments and accessories furnished specifically for this project.

4. Instruction and renewal parts books.

5. Test and inspection reports.

6. Complete bill of materials list.

7. The equipment drawings, summary tables, and bill of materials list shall be computer generated (i.e. no hand-drawn drawings, sketches, lists will be accepted).

1.03 REFERENCE STANDARDS

A. Panelboards shall be in accordance with the Underwriter Laboratories (UL) "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code (NEC).

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 MANUFACTURERS

A. 120/240 Volt, single phase, 3 Wire and 120/208 Volt, 3 Phase, 4 Wire panelboards shall be Type NQ as manufactured by Schneider Electric/Square D or Type Pow-R-Line by Eaton/ Cutler Hammer.

B. 277/480 Volt, 3 Phase, 4 Wire panelboards shall be; Type NF as manufactured by Schneider Electric/Square D or Type Pow-R-Line by Eaton/Cutler Hammer.

C. 480 Volt, 3 Phase, 3 Wire panelboards shall be; I-Line series as manufactured by Schneider Electric/Square D or Type Pow-R-Line by Eaton/Cutler Hammer.

D. NEMA 3R and 4X panelboards shall be as specified herein, provided in 316 stainless steel enclosures as manufactured by the Hoffman or equal and completely assembled by the panelboard manufacturer.

E. Refer to additional requirements for manufacturers in Section 16000. Alternate suppliers must be submitted for approval to the ENGINEER in writing four weeks prior to the original bid date with supporting documentation to confirm all aspects of the specifications.

PART 2 PRODUCTS

2.01 GENERAL

A. Rating

1. Panelboard ratings shall be as shown on the Drawings. All panelboards shall be rated for the intended voltage.

2. Circuit breaker panelboards shall be fully rated for the specified circuit breaker fault current interrupting capacity. Series connected short circuit ratings will not be acceptable.

2.02 MATERIALS (NEMA 1)

A. Interiors

1. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type and all shall be suitable for copper wire of the sizes indicated.

2. Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.

3. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.

4. A nameplate shall be provided listing manufacturer's name, panel type and rating.

B. Buses

1. Bus bars for the mains shall be of tin plated copper. Full size tin plated copper neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction. Cross connectors shall be tin plated copper. Each panel shall be provided with a ground bus bar, with removable link/jumper between

neutral and ground bus. The ground bus shall be sized to the maximum number of circuit breakers that can be installed in the panelboard.

2. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

3. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.

4. Tin plated copper equipment ground bars shall be furnished.

C. Boxes

1. Recessed or flush mounted boxes shall be made from galvanized code gauge steel having multiple knockouts, unless otherwise noted. Boxes shall be of sufficient size to provide a minimum gutter space of 4-in on all sides.

2. Surface mounted boxes and trims shall have an internal and external finish as specified in Paragraph 2.02.D.4 below.

3. At least four studs for mounting the panelboard interior shall be furnished.

4. All conduit entrances shall be field punched.

D. Trim

1. Hinged doors covering all circuit breaker handles shall be included in all panel trims.

2. Doors shall have semi flush type cylinder lock and catch, except that doors over 48-in in height shall have a vault handle and 3-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Furnish two keys for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door. All trims shall be door-in-door type construction.

3. The trims shall be fabricated from code gauge sheet steel.

4. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 49 or 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.

5. Trims for flush panels shall overlap the box by at least 3/4-in all around. Surface mounted panel trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.

2.03 MATERIALS (NEMA 3R AND 4X)

A. Interiors and Buses

1. Interiors and buses shall be as hereinbefore specified for NEMA 1 construction.

B. Boxes and Covers

1. Boxes, covers and hardware shall be made from type 316 stainless steel with natural finish.

2. Boxes and covers shall have continuous welded seams and shall be hinged (piano type) together and gasketed.

3. Conduit openings shall be tapped.

2.04 CIRCUIT BREAKERS

A. Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.

B. Circuit breakers shall be molded case, bolt-in type with interrupting capacity as noted on the Contract Documents.

C. GFCI (ground fault circuit interrupter) shall be provided for circuits as required and where indicated the Drawings. GFCI units shall be 1 Pole, 120 Volt, molded case, bolt-on breakers, incorporating a solid-state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be UL listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time) and an interrupting capacity as noted on the Contract Documents.

D. Circuit breakers feeding fire alarm control panels shall be colored red.

E. Circuit breakers shall be manufactured by the panelboard manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mount boxes for surface mounted panelboards so there is at least 1/2-in air space between the box and the wall.

B. Connect panelboard branch circuit loads so that the load is distributed as equally as possible between the phase busses. Record normal base load phase voltages and currents for each phase and the total neutral current and submit to the ENGINEER for review.

C. Install markers on the front cover of all panelboards which identify the voltage rating. Markers shall be made of self sticking B-500 vinyl cloth printed with black characters on an Alert Orange background, 2-1/4-in high by 9-in wide, Style A as manufactured by W.H. Brady Co. or equal.

D. Install a 1-in by 3-in nominal laminated plastic nameplate with 1/2-in white letters on a black background on each panelboard. Nameplate lettering shall be as shown on the Drawings. Nameplates shall be stainless steel screw mounted.

E. Unless otherwise noted on the Drawings, top of cabinets shall be mounted 6 feet-0-inch above the floor, properly aligned and adequately supported independently of the connecting raceways.

F. All wiring in panelboards shall be neatly formed, grouped, and identified to provide a neat and orderly appearance. A typewritten directory card identifying all circuits shall be placed in the card holder inside the front cover.

G. All panelboards shall be protected from physical damage, water damage, moisture, corrosion, dirt and dust during construction. Any panelboard judged to be unacceptable by the ENGINEER shall be replaced by the CONSTRUCTION CONTRACTOR at no additional cost to the OWNER.

H. Standard factory testing shall be performed for the equipment furnished under this section and these tests shall be in accordance with the latest version of NEMA and UL standards. Certified copies of these tests shall be provided to the ENGINEER upon request.

I. Field testing and commissioning shall be done in accordance with the latest revision of the "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" published by the InterNational Electrical Testing Association (NETA Standard ATS) unless otherwise modified by this Section.

3.02 CLEANING

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

END OF SECTION

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SECTION 16480
480 VOLT MOTOR CONTROL CENTERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish, install and test the motor control centers as shown on the Drawings and as specified herein.

B. Motor control centers shall be sized to include all equipment, spares and spaces shown on the Drawings.

1.02 RELATED WORK

A. Electrical Systems Analysis is included in Section 16015.

B. Concrete for equipment pad is included in Division 3.

1.03 SUBMITTALS

A. Submit to the ENGINEER, in accordance with Section 01300, shop drawings and product data, for the following as a minimum:

1. Equipment outline drawings showing elevation and plan views, dimensions, weight, shipping splits and metering layouts. Indicate all options, special features, ratings and deviations from this Section.

2. Conduit entrance drawings.

3. Bus arrangement drawings.

4. Unit summary tables showing detailed equipment description and nameplate data for each compartment.

5. Product data sheets and catalog numbers for overcurrent protective devices, motor starters, control relays, control stations, meters, pilot lights, etc. List all options, trip adjustments and accessories furnished specifically for this project.

6. Provide control systems engineering to produce custom unit elementary and compartment wiring diagrams for metering, relay, power and control circuits in accordance with the NEMA wiring class specified. Elementary drawings shall show interwiring and interlocking between units and to remotely mounted devices. Show all field devices, switches, lights, wire, terminal numbers, etc. and indicate special identifications for electrical devices per the Drawings.

7. Instruction and renewal parts books.

8. Itemized list of spare parts furnished specifically for this project, including quantities, description and part numbers.

9. Test and inspection reports.

10. Complete bill of materials list.

11. The equipment drawings, summary tables, elementary drawings/diagrams, spare parts list and bill of materials list shall be computer generated (i.e. no hand-drawn drawings, sketches, lists will be accepted).

1.04 REFERENCE STANDARDS

A. Motor control centers shall be designed, built and tested in accordance with the latest editions and revisions of NEMA Standard ICS-2 and Underwriters Laboratories (UL) Standard No. UL-845. Equipment shall conform to ANSI C19.3 test standards and the requirements of the National Electrical Code (NEC).

1.05 QUALITY ASSURANCE

A. The motor control centers shall be the product of a manufacturer who shall also be the manufacturer of all the circuit breakers, fused switches and motor starters included in the motor control center and who has produced the same type of equipment for a period of at least 15 consecutive years.

B. Motor control centers shall be designed, assembled and tested by the manufacturer of the motor control equipment included in the control center assembly.

C. All units and sections shall be UL labeled. Motor control centers containing service entrance equipment shall be UL labeled "Suitable For Use As Service Equipment."

1.06 OPERATING AND MAINTENANCE MANUALS

A. Operating and maintenance manuals shall be furnished in accordance with Division 01 and Section 16000.

B. The manuals shall be bound and shall also include:

1. A list of "as left" settings for all motor circuit protectors and circuit breakers.

2. A table listing cubicle number, load description, installed overload heater size and motor horsepower, Amps, service factor and starting code letter.

1.07 MANUFACTURERS

A. The general arrangement of the motor control centers is shown on the Drawings. Motor control enters shall be one of the following products:

1. Eaton / Cutler Hammer "2100 Series".

2. Schneider Electric / Square D Corp. "Model 6".

1.08 SPARE PARTS

A. Provide the following spare parts in the quantities specified:

1. One dozen each size of cover bolts, cage nuts and door fasteners.

2. 2 cans of aerosol touch-up paint.

3. 50 percent replacement fuses, all types and sizes.

4. 24 replacement lamps for pilot lights.

5. 6 of each color replacement lens caps for pilot lights.

6. 2 starter coils for each size furnished.

7. 2 replacement overload heaters of each size/type used.

8. 2 overload relays for each size used.

9. 2 motor circuit protectors for each size used.

10. 2 circuit breaker rating plugs for each size used.

B. Spare parts shall be boxed or packaged for long term storage. Identify each item with manufacturers name, description and part number on the exterior of the package.

PART 2 PRODUCTS

2.01 RATING

A. Service: 480 Volt, 3 Phase, 3 Wire, 60 Hz.

B. The overall short circuit withstand and interrupt rating of the equipment and devices shall be not less than 65,000 Amps, RMS symmetrical at 480 Volts unless otherwise shown on the Drawings. Main and feeder circuit protective devices shall be fully rated for the specified short circuit duty. Systems employing series connected ratings for main and feeder devices shall not be used. Motor starter units shall be tested and UL labeled for the specified short circuit duty in combination with the motor branch circuit protective device.

C. The continuous current rating of the main horizontal bus shall be as shown on the Drawings. Vertical busses shall be sized for the structure load and shall have a minimum rating of 300 Amps. Bus bracing shall equal or exceed the specified equipment short circuit rating.

D. Motor control centers, including devices, shall be designed for continuous operation at rated current in a 40-degree C ambient temperature.

2.02 CONSTRUCTION

A. Enclosure

1. Enclosure type shall be NEMA Type 1A unless otherwise noted on the drawings.

B. Structure

1. Motor control centers shall consist of a series of metal enclosed, free-standing, dead front vertical sections bolted together to form double wall construction between sections. Individual vertical sections shall be nominally 90-in high, 20-in wide and 20-in deep unless otherwise shown on the Drawings. Bottom channel sills shall be mounted front and rear of the vertical sections extending the full width of each shipping split. Top of each section

shall have removable plates with lifting angle. Make provisions for field installation of additional sections to each end and provide full depth cover plates (rodent barriers) at each end of the motor control center channel sills.

2. Provide continuous top and bottom horizontal wireways extending the full width of the line-up, isolated from the horizontal bus. Provide a 4-in wide, full height, vertical wireway in each section, equipped with a hinged door and cable supports. Vertical wireway shall be isolated from the bus and device compartments. Wireways openings shall have rolled edges or protective grommets.

3. Provide individual, flange formed, pan type door with concealed hinges and quarter turn latches for each device compartment and future space. Doors shall be removable. Door removal shall not be required to withdraw starter units or feeder tap devices.

4. Motor control centers shall be designed for against-the-wall or back-to-back mounting. All wiring, bus joints and other mechanical parts requiring tightening or other maintenance shall be accessible from the front or top.

C. Unit Compartments

1. Provide individual compartments for each removable combination starter and feeder tap device unit. Each vertical section shall accommodate a maximum of six compartments. Each size 1 or 2 combination starter shall be a minimum of 18 inches high. Steel barriers shall isolate the top, bottom and sides of each compartment from adjacent units and wireways. Removable units shall connect to the vertical bus in each section with tin plated, self aligning, pressure type copper plug connectors. Size 5 and larger starter units may be wired directly to the bus. Removable units shall be aligned in the structure on guide rails or shelves and secured with a cam latch mechanism or racking screw.

2. Provide individual, isolated compartments for all fixed mounted devices including circuit breakers, cable lugs, metering, relaying and control devices. Main and bus tie circuit breakers shall be wired directly to the main horizontal bus. All bus connections shall be fully rated.

3. Provide the following features:
   a. Provision to padlock removable units in a partially withdrawn TEST position, with the bus stabs disengaged.
   b. Provision to padlock unit disconnect handles in the OFF position with up to three padlocks.
   c. Mechanical interlock with bypass to prevent opening unit door with disconnect in the ON position, or moving disconnect to the ON position while the unit door is open.
   d. Mechanical split-type terminal blocks for disconnecting external control wiring.
   e. Auxiliary contact on unit disconnect to isolate control power when fed from an external source.
   f. Disconnect operating handles and control devices mounted on the removable units.
   g. All compartments shall have laminated wiring diagrams fastened to the inside of each compartment door. Compartments containing motor starters shall have laminated wiring diagrams and heater tables fastened to the inside of the compartment door. Compartments containing panelboards shall have circuit directories consisting of two ply laminated plastic, with black face and white core fastened to the inside of the compartment door.

D. Bus Systems

1. Main horizontal bus: Tin plated copper, bolted joints, accessible from the front of the structure, fully rated throughout the lineup.

2. Vertical section bus: Tin plated copper, full height, totally insulated and isolated by glass polyester barriers with shutters to cover stab openings when units are withdrawn. Provide fishtape barriers to isolate bottom wireways from lower ends of vertical bus.

3. Vertical buses used for a tie circuit breaker or tie feeder lugs shall be rated for a continuous capacity equivalent to the main horizontal bus rating.

4. Horizontal ground bus: Provide a 1/4-inch by 2-inch (minimum) tin plated copper uninsulated ground bus in each section equipped with lugs for termination of feeder and branch circuit ground conductors. Connect to ground bus in adjacent sections with splice plates.

5. The buses shall be sized for a maximum current density of 1200 Amps per square inch.

E. Wiring

1. Wiring: Stranded copper, minimum size No. 14 AWG, with 600 Volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation, NEMA Class II-S, Type B. Line side power wiring shall be sized for the full rating or frame size of the connected device.

2. Identification: All wiring shall be numbered with type written heat shrinkable type wire markers at each termination point, color coding per NEMA Standards and the NEC. Foreign voltage control wiring shall be yellow.

F. Signage

1. Each motor control center shall be furnished with a sign marked "DANGER - 480 VOLTS - KEEP OUT". Letters shall not be less than 1-in high, 1/4-in stroke. Signs shall be laminated plastic, engraved white letters with a red background.

2. Compartments with voltages from sources outside of the compartment shall have a sign mounted inside the compartment door marked "CAUTION - THIS UNIT CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE". Letters shall be black on a high visibility yellow background.

3. Provide a 2-in by 6-in nominal engraved master nameplate, of two ply laminated plastic, black face, 3/8-in high by 1/8-in stroke white letters, screw fastened to the top wireway of each lineup with stainless steel screws. Include MCC designation and service ratings.

4. Provide 1-in by 3-in nominal engraved unit nameplates of two ply laminated plastic, black face, 3/8-in high by 1/16-in stroke white letters, screw fastened to each door with stainless steel screws. Equipment names shall be as shown on the drawings.

2.03 COMPONENTS

A. General

1. The Drawings indicate the approximate horsepower and intended control scheme of the motor driven equipment. Provide the NEMA size starter, circuit breaker trip ratings, control power transformers and thermal overload heater element ratings matched to the motors and control equipment actually supplied, in compliance with the NEC and the manufacturers heater selection tables. All variations necessary to accommodate the motors and controls as actually furnished shall be made without extra cost to the OWNER.

B. Circuit Breakers

1. Power circuit breakers (400 Amps and larger): 100 percent equipment rated, 600 Volt, molded case circuit breakers with integral fully adjustable solid-state trip device. Trip device shall be temperature insensitive and have the following characteristics and functions:
   a. Independently adjustable long-time pick-up and delay.
   b. Independently adjustable short time pick-up and delay with i^2t in and out switch.
   c. Adjustable instantaneous.
   d. Independently adjustable ground fault pick-up and delay.
   e. Trip mode targets for over load, short circuit and ground fault.
   f. Long time pick-up light.

2. Circuit breakers (Less than 400 Amps): Thermal-magnetic trip type, 600 Volt, 2 or 3 Pole as required, labeled in accordance with UL 489. Provide integral current limiting fuses as required to meet the specified equipment short circuit rating. Provide independently adjustable magnetic trips on 225A frame breakers and larger.

C. Combination Starter Units

1. Combination starters shall include a motor circuit protector (MCP) in series with a motor controller and an overload protective device. The MCP shall have an adjustable magnetic trip range up to 1000 percent of rated continuous current and a trip test feature. MCP's shall be labeled in accordance with UL489.

2. Motor starters: 3 Pole, 600 Volt, electrically operated, of the types shown on the Drawings. Provide NEMA sizes as required for the horsepowers shown on the Drawings. Minimum size shall be NEMA Size 1. Fractional size starters are not acceptable. IEC rated starters shall not be acceptable. Starters shall have 120 Volt encapsulated operating coils; individual control power transformers with primary and secondary fuses and silver cadmium oxide renewable line contacts.

3. Multi-speed and reversing starters shall include two motor rated contactors mechanically and electrically interlocked so that only one device may be energized at any time.

4. Reduced voltage starters: Solid state, six SCR, full wave type with adjustable current limit and voltage ramp to control starting torque, automatic load sensing circuit to minimize energy consumption, line and load side surge protection and noise suppression and controlled deceleration adjustment to reduce the effects of surges caused by centrifugal pump loads. Provide heat sinks and ventilation to remove heat from the structure. Each

starter shall include a motor horsepower rated isolation contactor to positively disconnect the line voltage when the SCR control is off.

5. Wye-delta starters shall be closed circuit transition for use with 6 or 12 lead motors.

6. Contactors: Electrically held, 120 VAC coil operator, suitable for tungsten, ballast, or resistive non-motor loads, with over current protection, control transformer and contact ratings and poles as shown on the Drawings.

7. Motor overload protection: Standard, 3 Pole, ambient compensated, thermal bi-metallic Class 20 for standard motors or quick trip melting alloy type Class 10 for submersible pump motors, with push-to-test feature. Electronic overload relays will be acceptable. Overload relays shall be manually reset from outside the enclosure by means of an insulated pushbutton. Provide auxiliary alarm contacts where shown on the Drawings.

8. Auxiliary contacts: Form C, NEMA A600 rating, as required by the control schemes on the Drawings. Provide 1-normally open and 1-normally closed spare contacts on each starter. Additional auxiliary contacts shall be furnished as shown on the Drawings or as required by the control schematic and this Section.

9. Control power transformers: Two winding type, 120 VAC secondary, fused on primary and secondary, secondary grounded. Provide extra capacity as required or where shown on the Drawings.

D. Instrumentation and Metering

1. Instrumentation transformers: Indoor, 600 Volt, butyl-rubber molded, metering class designed in accordance with ANSI and NEMA standards. Window type current transformers, with burden capacity as low as 50 VA, may be used where such capacity is sufficient. Current transformer accuracy ratings shall be at least equal to NEMA standard requirements for the particular application.

2. Instrument transducers: Inputs matched to the corresponding metering circuit, 4-20 mADC output, 0.5 percent accuracy, as manufactured by Rochester Instrument Systems or equal.

3. Elapsed time hour meters: Five digit, non-reset type, with 120 Volt synchronous motor.

4. Power circuit monitors shall be provided on the units as indicated in the one line power diagrams. The power circuit monitors shall be Siemens PAC4200 with Profibus DP expansion card. Refer to Section 16191, for additional requirements.

E. Relays and Timers

1. Control relays and timers: Heavy duty machine tool type, with 10 Amps, 600 Volt convertible contacts, General Electric Co., CR120 Series; Cutler Hammer/Westinghouse, Type M-600; Square D, Type X or equal. Provide pneumatic timing or latching attachments as required by the control schemes shown on the Drawings.

2. Panel mounted timers: Provide as noted on the drawings, flush mounted, plug-in type, Eagle Signal, Bulletin 125 Cycle-Flex or equal, with ranges as shown on the Drawings.

F. Protective Relays

1. 3 Phase voltage relays: Solid state, Westinghouse Type SVM3 or equal, with the following features:
   a. Undervoltage protection, 10 to 20 percent, adjustable.
   b. Phase Unbalance, 5 to 10 percent, adjustable.
   c. Phase loss/reversal protection.
   d. Restart timer, 0 to 5 minutes, adjustable.
   e. LED trip indicators.
   f. Automatic or manual reset.
   g. Isolated NO and NC output contacts for alarm and trip.

2. Single phase current sensing relays: Solid state, Allen Bradley Bulletin 809S or equal, with the following features:
   a. Independently adjustable trip setting and differential.
   b. Adjustable trip time delay.
   c. Restart timer.
   d. LED trip indicator.
   e. Automatic reset.
   f. Isolated NEMA B600 output contact
   g. 5 Amp window type current transformer for input.

G. Pilot Devices

1. Control operators: Heavy duty, full size, oiltight, with NEMA A600 contact rating. Types and quantities as shown on the Drawings.

2. Indicator lights: Full size, oiltight, low voltage, LED type, with push-to-test feature. Colors and quantities as shown on the Drawings.

H. Miscellaneous Units

1. Bus connected and breaker (or fused disconnect) connect Surge Protective Device (SPD) per MANUFACTURER'S standard. The SPD shall have a minimum surge current rating of 200 kA per phase. Refer to Section 16191 for additional requirements.

2. General purpose transformers: Open, dry-type, with primary and secondary overcurrent protection in accordance with the NEC, size and voltage ratings as shown on the Drawings. Refer to Section 16191 for additional requirements.

3. Lighting and Distribution Panelboards: Factory wired to transformer, bolt-on branch circuit breakers, size and voltage rating as shown on the Drawings. Refer to Section 16470 for additional requirements.

2.04 SURFACE PREPARATION AND SHOP COATINGS

A. All non-current carrying metal parts of the control center assembly shall be cleaned of all weld spatter and other foreign material and given a heat cured, phosphatized chemical pre-treatment to inhibit rust.

B. Unpainted non-current carrying parts shall receive a protective zinc plating to prevent corrosion.

C. Indoor equipment shall be finish painted with one coat of manufacturers standard electrocoated, heat cured enamel. Color shall be ANSI-49 or 61 light grey.

2.05 SHOP TESTING

A. Perform manufacturers standard production testing and inspection in accordance with NEMA and ANSI standards. If requested by the ENGINEER, the manufacturer shall submit certified copies of the test results and reports.

PART 3 EXECUTION

3.01 INSTALLATION

A. Motor control center floor sills shall be bolted directly to the finished floor or equipment pad. Structure shall be leveled and plumb. Anchor bolts shall be ½-inch (minimum). Provide hardware and shims for installation.

B. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed.

C. In general, all conduit entering or leaving a motor control center shall be stubbed up into the bottom horizontal wireway directly below the vertical section in which the conductors are to be terminated, or shall enter the motor control center from the top. Conduits shall not enter the motor control center from the side unless approved in writing by the ENGINEER.

D. Housekeeping pads shall be included for the motor control centers as detailed on the Drawings with the exception of motor control centers which are to be installed adjacent to an existing unit. Housekeeping pads for these (if used) should match the existing installation.

E. Where motor control centers are to be installed on existing floor slabs, concrete anchor bolts sized and installed per the requirements of this Section shall be used.

F. Install the equipment in accordance with the manufacturer’s instructions.

G. Remove temporary lifting angles, lugs and shipping braces. Touch-up damaged paint finishes.

H. Make wiring interconnections between shipping splits.

I. Install bus splice plates and torque connections.

J. No operator devices shall be located over 6 ft. 6 in. above the operating floor. Circuit breaker operating handles located more than 6 ft. 6 in. above the operating floor shall have operating arm extensions.

3.02 FIELD TESTING

A. Make the following minimum tests and checks before the manufacturer's representative is called in for testing and adjustment.

1. Megger incoming line terminals and buses, phase-to-phase and phase-to-ground after disconnecting devices sensitive to megger voltage.

2. Remove current transformer shunts after completing secondary circuit. Check polarity and continuity of metering and relaying circuits.

3. Check mechanical interlocks for proper operation.

4. Test ground connections for continuity and resistance.

5. Adjust unit compartment doors.

6. Check control circuit interlocking and continuity with starters in the TEST position. Provide external source of control power for this test.

7. Adjust motor circuit protectors and voltage trip devices to their correct settings.

8. Install overload heaters for actual motor nameplate currents.

B. In the event of an equipment fault, notify the ENGINEER immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the CONSTRUCTION CONTRACTOR, ENGINEER, OWNER and the equipment manufacturers factory service technician. Repair or replace the equipment as directed by the ENGINEER prior to placing the equipment back into service.

3.03 ADJUSTMENT

A. The motor control center manufacturer shall provide the services of a factory trained service technician for start-up and training of the OWNER's personnel. The first trip shall be coordinated with the equipment start-up. The second trip shall include any necessary follow-up or punch list work and shall also include instructions to the OWNER or to his/her designated personnel. The manufacturer's service technician shall demonstrate and test all operational features of the installed equipment to the satisfaction of the OWNER. Submit a certified copy of the field inspection to the ENGINEER. No equipment shall be energized without the written approval of the ENGINEER.

B. The motor control center manufacturer's factory service technician shall make the following inspection, tests and adjustments:

1. Calibrate and test main and feeder circuit breaker trip devices and protective relays per the approved Coordination Study specified in Section 16000.

2. Inspect the installation for compliance with the manufacturers recommended installation practices and report all deviations to the ENGINEER.

3.04 CLEANING

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

END OF SECTION

SECTION 16500
LIGHTING SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install complete lighting systems including panelboards, transformers, lighting fixtures, receptacles, switches, contactors, and all necessary accessories and appurtenances required as hereinafter specified and shown on the Drawings.

1.02 RELATED WORK

A. All concrete and reinforcing steel required for exterior lighting pole bases shall be as specified under Division 3, but the responsibility of furnishing and installing the material shall be that of Division 16.

B. Conduit is included in Section 16110.

C. Wire is included in Section 16120.

D. Transformers are included in Section 16191.

E. Panelboards are included in Section 16470.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300. Submittals shall include those set forth in Section 16000, Paragraph 1.03.

1.04 REFERENCE STANDARDS

A. All lighting fixtures shall be in accordance with the National Electrical Code (NEC) and shall be constructed in accordance with the latest edition of the Underwriters Laboratories (UL) "Standards for Safety, Electric Lighting Fixtures." All lighting fixtures shall be UL labeled.

PART 2 PRODUCTS

2.01 MATERIALS

A. Lighting Fixtures

1. Lighting fixture types shall be furnished as required by the "Lighting Fixture Schedule" on the Drawings. The catalog numbers are given as a guide to the design and quality of fixture desired. Equivalent designs and equal quality fixtures of other manufacturers will be acceptable upon approval by the ENGINEER.

B. Lamps

1. Fluorescent lamps shall be medium bi-pin, recessed, double contact, rapid start, standard cool white as shown on the "Fixture Schedule".

2. Metal halide lamps shall be clear and of the size and type as shown on the "Lighting Fixture Schedule."

3. All lamps shall be of one manufacturer and shall be as manufactured by Osram/Sylvania Electric Products, Inc.; General Electric Co.; North American Philips Lighting Corp. or equal.

C. Ballasts

1. Fluorescent ballasts shall be electronic, high-frequency, full-output rapid-start type for use on 265 mA, T8 lamps.
   a. All ballasts shall be UL listed, ETL certified, Class "P", high power factor (minimum 0.90).
   b. Ballasts shall have a "A" sound rating or better.
   c. All ballasts used in exterior applications shall have a minimum starting temperature of 0 degrees F unless otherwise specified.
   d. All interior ballasts shall have a minimum starting temperature of 50 degrees F.
   e. Ballasts shall be series wired type and designed to operate the number and length of lamps specified.
   f. The total harmonic distortion (THD) of each ballast shall be in accordance with the requirements of the utility company and in no case shall it be less than 10 percent THD.
   g. Ballasts shall have a minimum ballast factor of 0.88.
   h. Ballasts shall have nominal power factor 0.90 or higher.
   i. Ballasts shall have a maximum lamp current crest factor of 1.7.
   j. Ballast shall provide normal rated life for the lamp specified.
   k. All electronic ballasts shall be warranted for parts and replacement for 1 full year from the date of installation.
   l. Electronic ballasts shall be as manufactured by Advance, Model Mark V, similar by Valmont; Osram/Sylvania; MagneTek or equal.

2. Metal halide ballast shall be pulse start type of the correct size and voltage for the fixture it is to serve as shown on the "Lighting Fixture Schedule". All ballasts shall be as manufactured by Holophone Lighting; MagneTek Universal Manufacturing; Advance Transformer Co. or equal.

D. Flexible Fixture Hangers

1. Flexible fixture hangers used in non-hazardous areas shall be type ARB and flexible fixture supports used in hazardous areas shall be Type ECHF as manufactured by the Crouse-Hinds Co., similar by Appleton Electric Co.; Killark Electrical Mfg. Co. or equal.

2. Where required in Section 16000 all pendent mounted and recessed in suspended ceilings, recessed lighting fixtures shall be provided with four anti-sway supports to meet Type II seismic requirements.

E. Emergency Lighting Battery Units

1. Emergency lighting units and remote lighting heads shall be as specified in the "Lighting Fixture Schedule" shown on the Drawings.

2. Battery units shall be of the self-contained, fully automatic type with sealed lead acid batteries.

3. Unit enclosures shall be compatible to their environment and units shall comply with the requirements of NFPA 70 (NEC).

4. All necessary mounting hardware shall be provided.

F. Photo Electric Controls

1. Photo electric control with time delay for outdoor lighting shall be completely self-contained and not affected by moisture, vibration or temperature changes.

2. ON/OFF adjustments are to be made by movement of a light level selector without the use of tools in a range from 2 to 50 foot candles.

3. Photo electric control device shall be SPST, and have 2000 watt tungsten capacity and be Tork Catalog Number 2101 (120V); 2104 (208-277V) or approved equal by Intermatic Inc., Carlon, or approved equal.

G. Device Color

1. In administrative office areas, conference rooms, breakrooms, restrooms, and control rooms, switches, receptacles and other devices shall be white.

2. In all other areas (electrical, mechanical, process, etc.), switches, receptacles and other devices shall be gray.

H. Switches

1. Wall switches shall be of the indicating, toggle action, flush mounting quiet type. All switches shall conform to Federal Specification WS896-E.

2. Wall switches shall be the manufacturer's "industrial specification grade". Wall switches shall be the following types and manufacturer or approved equal.
   a. Single pole - Arrow-Hart, Series 1991, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc., or approved equal.
   b. Double pole - Arrow-Hart, Series 1992, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc., or approved equal.
   c. Three way - Arrow-Hart, Series 1993, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc., or approved equal.
   d. Four way - Arrow-Hart, Series 1994, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc., or approved equal.
   e. Single pole, key operated - Arrow-Hart Catalog Number 1991-L, or approved equal.
   f. Single pole, pilot indicating, Bryant Catalog Number 4901-PLR120, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc., or approved equal.
   g. Momentary contact, 2 circuit, center off - Arrow-Hart, Series 1895, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc., or approved equal.
   h. Weatherproof cover for standard toggle switches - Crouse-Hinds Catalog Number DS181, or approved equal by Appleton Electric Co., L.E. Mason Co., or approved equal.

i. Explosion-proof single pole switches shall be for 20 amperes, 120/277 volts, mounted in cast boxes and be similar and equal to Crouse-Hinds EDS Series, or approved equal by Appleton Electric Co., L.E. Mason Co., or approved equal.

I. Receptacles

1. Receptacles shall be the manufacturer's "industrial specification grade". Receptacles shall be of the following types and manufacturer or approved equal. Receptacles shall conform to Federal Specification WC596-F.
   a. Duplex, 20A, 125V, 2P, 3W; Arrow-Hart, Series 5362, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc., or approved equal.
   b. Weatherproof or corrosion resistant single, 20A, 125V, 2P, 3W; by Harvey Hubbell, Inc., Pass & Seymour, Inc., with TayMac Corp., #30310G cover, or approved equal.
   c. Weatherproof or corrosion resistant duplex, 20A, 125V, 2P, 3W; by Harvey Hubbell, Inc., Pass & Seymour, Inc., with TayMac Corp., #10310G cover, or approved equal.
   d. Ground fault interrupter, duplex, 20A, 125V, 2P, 3W; Arrow-Hart Series GF 5342, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc., or approved equal.
   e. Duplex, 20A, 125V, 2P, 3W with transient voltage surge suppressor and indicator light; Pass & Seymour Series 6362-5P, approved equal by Harvey Hubbell Inc., Bryant Electric Co., or approved equal.
   f. Stainless steel indoor mounting plate for G.F.I. receptacle; Arrow-Hart Catalog Number 97061, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc. or approved equal.
   g. Weatherproof cover for G.F.I. receptacle shall be TayMac Corp., #20310G, or approved equal.
   h. Explosion-proof, 20A, 125V, 2P, 3W; Appleton Electric Co. Catalog Number EFS175-2023 or EFSC175-2023 or approved equal by Crouse-Hinds Co., Killark Electric Manufacturing Co., or approved equal. Furnish one Appleton Electric Co. Catalog Number ECP-1523 cap or approved equal by Crouse-Hinds Co., Killark Electric Manufacturing Co., or approved equal for every two receptacles (minimum of one).
   i. Single, 20A, 250V, 2P, 3W; Arrow-Hart Catalog Number 5861, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc., or approved equal.
   j. Single, 30A, 125V, 2P, 3W; Arrow-Hart Catalog Number 5716; cap: Arrow-Hart Catalog Number 5717.
   k. Single, 30A, 250V, (3 phase) 3P, 4W; Arrow Hart Catalog Number 8430N; Cap: Arrow-Hart Catalog Number 8432AN.

J. Device Plates

1. Plates for flush mounted devices shall be of the required number of gangs for the application involved and shall be:
   a. Smooth high strength thermoplastic or nylon of the same manufacturer as the device for all administrative office type areas. Color to match device.
   b. Type 302 (18-8) high nickel stainless steel of the same manufacturer as the device for all other areas.

2. Plates for surface mounted device boxes shall be of the same material as the box.

PART 3 EXECUTION

3.01 INSTALLATION

A. Each fixture shall be a completely finished unit with all components, mounting and/or hanging devices necessary, for the proper installation of the particular fixture in its designated location and shall be completely wired ready for connection to the branch circuit wires at the outlet.

B. All flush mounted fixtures shall be supported from the structure and shall not be dependent on the hung ceilings for their support.

C. Fixtures noted to be installed flush in suspended ceilings shall be of mounting types suited for the type ceiling involved. It shall be the responsibility of the electrical contractor to verify the ceiling types prior to ordering fixtures.

D. Flexible fixture hangers shall be used for all pendant mounted fixtures. Fixtures 2-ft long and larger shall be supported with a minimum of two fixture hangers.

E. Conduit run in areas with hung ceilings shall be installed in the space above the hung ceiling as close to the structure as possible. Conduits shall be supported from the structure.

F. Exterior lighting poles shall be mounted plumb.

G. Fixture locations are shown on the Drawings in approximate locations; however, exact locations shall be coordinated so as to avoid conflicts with HVAC ducts, equipment and other obstacles.

H. Switch and receptacle outlets shall be installed flush with the finished floor or wall when raceways are shown as "concealed" on the Drawings.

I. Device Mounting Height

1. Switches and occupancy sensors shall be mounted 48” AFF (above finished floor) to center of box, located on the strike side of the door.

2. Wall mounted receptacles shall be vertically mounted, AFF to the center of the box as follows, unless otherwise noted on the Drawings.
   a. Process areas and shops – 36”
   b. Administration office areas – 18”
   c. Corridors and hallways – 18”
   d. Electrical and mechanical rooms – 18”
   e. Restrooms – 18”
   f. Exterior walls – 18”

3. Where the wall and partitions are of unplastered brick or masonry, the height of wall outlets as given above shall be adjusted so that one horizontal edge of the box lines up with a horizontal joint in the masonry.

J. Provide circuit identification at devices as specified in Section 16000.

K. Photo electric sensors shall be placed facing north whenever possible.

3.02 REPLACEMENT

A. Lamps (except for H.I.D.) used during the building construction, prior to 2 weeks from completion of the work, shall be removed and replaced with new lamps.

3.03 CLEANING UP

A. Plastic dust cover bags to be provided with new parabolic reflector lighting fixtures shall be removed after all construction activity that may cause dust formation on reflector surfaces has been completed.

B. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the ENGINEER.

END OF SECTION

SECTION 16502
LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide a complete lightning protection system for the following buildings and structures at JEA Robena Road Pump Station: Electrical Building and Standby Generator Enclosure. The system shall be UL Master Labeled and shall be designed and installed in compliance with provisions of UL 96A and NFPA 780.

B. The CONSTRUCTION CONTRACTOR shall employ the services of a licensed lightning protective systems engineering company to design and install the lightning protection system and prepare detailed installation drawings and material specifications. These drawings and specifications shall be submitted for review in accordance with Section 01300.

C. The lightning protection system shall be checked by a UL field inspector upon completion of the installation. The CONSTRUCTION CONTRACTOR shall assume full responsibility for the correctness of the installation and shall make any and all corrections and additions deemed necessary by the UL inspector. The CONSTRUCTION CONTRACTOR shall pay for all costs of the UL inspection and any subsequent re-inspections as required.

D. The lightning protection system for the buildings shall consist of conductors, air terminals and accessories which shall be grounded to the building structural steel or ground grid at regular intervals. The CONSTRUCTION CONTRACTOR may submit alternate methods of lightning protection with his proposal, provided the alternate provides equal or greater lightning protection than specified.

E. The lightning protection system contractor shall coordinate his work with the electrical contractor.

F. Each bidder or his authorized representatives shall, before preparing his proposal, visit all area of the existing buildings and structures in which work under this section is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that he or his representative has visited the buildings and noted the locations and conditions under which the work will be performed and that he takes full responsibility for a complete knowledge of all factors governing his work.

1.02 RELATED WORK

A. Refer to Section 16660 for Grounding Systems.

1.03 SUBMITTALS

A. CONSTRUCTION CONTRACTOR shall submit to the Engineer/ Owner for review the facility lightning protection system. The submittal data shall contain the following minimum information.

1. Plan view of site showing buildings and structures, locations of air terminals, and associated zone of protection for each air terminal; show all equipment on roofs which require protection.

2. Schematic diagram of lightning protection system showing air terminals, conductors, and other connectors or fittings required for the complete system. Provide details showing bonding requirements to structural steel, water piping, etc.

3. Locations of connection points of lightning protection system to facility grounding system.

4. Bill-of-materials.

1.04 REFERENCE STANDARDS

A. Underwriters Laboratories (UL)

1. UL 96 – Standard for Lightning Protection Components

2. UL 96A – Standard for Installation Requirements for Lightning Protection Systems

B. National Fire Protection Association (NFPA)

1. NFPA 780 – Standard for the Installation of Lightning Protection Systems

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.01 MATERIALS

A. All materials shall be new and shall comply in weight, size, and composition with the requirements of UL and NFPA.

B. Grounding materials and methods shall be equal to those specified under Section 16660.

C. The following is a brief description of the various items of material.

1. Air Terminals
   a. Buildings 75 feet and less in height shall use Class I air terminals. Aluminum air terminals shall be solid aluminum, ½" minimum diameter. Copper air terminals shall be nickel plated solid copper, 3/8" minimum diameter. Length 18".
   b. Buildings over 75 feet tall shall use Class II air terminals. Aluminum air terminals shall be solid aluminum, 5/8" minimum diameter. Copper air terminals shall be nickel plated solid copper, ½" minimum diameter. Length 18".
   c. Air terminal type shall be copper unless the following applies. Copper lightning protection materials shall not be installed on aluminum roofing, siding or other aluminum surfaces.
   d. Air terminal base supports shall be specifically designed for the surface where used. All air terminal bases shall be cast bronze with stainless steel bolt pressure cable connectors. Air terminal bases for flat roof areas shall be of the adhesive type.

2. Conductors
   a. Buildings 75 feet and less in height shall use Class I conductors. Main conductors shall be either aluminum 14 AWG, 28 strand (weighing 105 lbs. per 1,000 feet) or tinned copper 17 AWG, 32 strand (weighing 220 lbs. per 1,000 feet).
   b. Buildings over 75 feet tall shall use Class II conductors. Main conductors shall be either aluminum 13 AWG, 37 strand (weighing 200 lbs. per 1,000 feet) or tinned copper 14 AWG, 28 strand (weighing 380 lbs. per 1,000 feet).
   c. Conductor type shall be copper unless the following applies. Copper lightning protection materials shall not be installed on aluminum roofing, siding or other aluminum surfaces. Aluminum lightning protection materials shall not be embedded in concrete, masonry, or on or below copper surfaces.

3. Fasteners
   a. Conductor fasteners shall be an approved type of non-corrosive metal and have ample strength to support conductors.

4. Cable Connectors
   a. All cable connectors shall be per NFPA standards, cast bronze with screw pressure type stainless steel bolts and nuts. For buried and non-accessible connections, exothermic weld process shall be used.

PART 3 EXECUTION

3.01 INSTALLATION

A. All materials shall be installed by a UL listed lightning protection contractor. The lightning protection system shall be installed per approved shop drawings and UL and NFPA recommended practices.

B. The lightning protection system engineering company shall provide jobsite assistance and supervision of the installation as required, and shall be present during the UL inspection.

C. Lightning Protection System shall be installed in a neat and inconspicuous manner.

D. All mounting and penetration of roof surface shall be coordinated with roofing contractor to assure maximum roofing guarantee. All through-roof penetration flashings shall be furnished, sealed and guaranteed by a licensed roofing contractor.

E. Excavate and backfill as required. Finish grade and restore to original condition.

F. All metal bodies within 6 feet of the conductor shall be bonded to the system with approved fittings and conductors. Connections between dissimilar metals shall be made with approved bimetallic connections.

G. As the work progresses, legibly record all field changes on a set of project contract drawings. When the project is complete, furnish a complete set of reproducible "As-built" drawings for the Project Record Documents per Section 01720.

H. Air Terminals:

1. Air terminals shall be spaced so as not to exceed 20 feet apart around the outside perimeter of the roof or ridge and not over 50 feet apart through the center of flat roof areas.

2. Air terminals shall not project more than 24 inches nor less than 10 inches above the protected object.

I. Conductor Routing:

1. All main conductors shall maintain a downward or horizontal course, free from "U" or "V" pockets.

2. Conductors shall not form an angle of less than 90 degrees nor less than an 8-inch radius bend.

3. Metal roofing and siding, eave downspouts or other metal parts subject to displacement will not be permitted as substituted parts of the lightning conductor system.

4. Fasteners shall be spaced not more than 3 feet horizontally or vertically and shall be the same material as the conductor.

5. Bimetallic fittings shall be used for all connections between dissimilar metals.

J. Down Conductors:

1. Down conductors shall follow the most direct patch possible between roof conductors and ground terminals.

2. All buildings with a ground perimeter less than 250 feet shall have a minimum of two down conductors installed at the diagonally opposed corners of the building.

3. Any building with a ground perimeter in excess of 250 feet shall have down conductors installed so that the distance between the conductors does not exceed 100 feet.

4. Within the building, the down conductors shall be placed in Schedule 80 PVC conduit in the wall. Care shall be taken not to damage the conductors. Connections through roof shall be made with through-roof connectors.

5. Splices will not be permitted on conductors embedded in concrete.

6. Down conductors shall be installed concealed. When conductors cannot be concealed they shall be substantially guarded to prevent mechanical injury or displacement. The guards shall protect the conductor from grade level to a height of at least 6 feet. All conduit used for physical protection of down conductors shall be Schedule 80 PVC.

K. Roof Conductors:

1. Roof conductors shall interconnect and provide a two-way path from all air terminals.

2. Roof conductors shall bond together all air terminals and shall be installed exposed except that where connections are made to equipment located under roof.

3. Conductors on perimeters of flat roofs shall form closed loops.

4. Dead end air terminals shall not be permitted.

5. All interconnecting cables from air terminals to roof conductors or metal roof decks shall be similar to roof conductor.

L. Pitch Pockets:

1. CONSTRUCTION CONTRACTOR shall subcontract all pitch pocket work to a qualified roofing contractor.

M. Grounding System:

1. Ground rods shall be provided at each down conductor and they shall be installed a minimum of 3 feet away from the foundation walls.

2. The ground rods shall be in addition to the ground rods provided for the system grounding grid.

3. Connectors used to connect ground rods to the down conductors shall make contact with the ground rods for a distance of 1-1/2" measured parallel to the ground rod. In addition, ground terminals shall be interconnected with the grounding grid, and all grounding mediums. This shall include electric and telephone service grounds and underground metallic piping systems.

4. Bonding of down conductors to the system grounding grid and splicing of conductors in concealed work shall be made by an exothermic weld process.

5. Where conductors are bonded to structural steel or metal roof decks, a bolted-on bonding plate shall be used. All other bonding of the lightning protection system shall be made with pressure clamps.

6. CONSTRUCTION CONTRACTOR shall notify design Engineer prior to concealment for Engineer’s inspection.

3.02 TESTING

A. General:

1. The Lightning Protection System shall be tested for continuity of all conductors and air terminals.

2. Maximum resistance of system shall not exceed five (5) ohms unless otherwise specified or scheduled.

3. CONSTRUCTION CONTRACTOR shall submit written test results to the Engineer.

B. Indicators:

1. Stamped metal tags shall be attached to, or adjacent to, each down conductor indicating in feet the exact vertical depth in the ground of each ground terminal.
   a. Down leads connected to water pipes shall also be indicated.
   b. Tags shall be of a corrosion resistant metal and shall be placed at a height of 5 feet above finish grade.

END OF SECTION

SECTION 16600
UNDERGROUND SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install a complete underground system of raceways, manholes and handholes as shown on the Drawings and as specified herein. This work includes all underground raceways which are direct buried or concrete encased.

1.02 RELATED WORK

A. All concrete and reinforcing steel shall be as specified in Division 3, but the responsibility of furnishing and installing the material shall be that of this Section.

B. All trenching, excavation and backfilling, including gravel and sand bedding and surface restoration shall be as specified in Division 2, but the responsibility of furnishing and installing the material shall be that of this Section.

C. Conduit, fittings, installation, etc. shall be as specified in Section 16110.

D. Ground rods and other grounding materials and methods shall be as specified in Section 16660.

E. Precast electrical concrete manholes and handholes shall be furnished under Division 16 and shall be in compliance with precast concrete structures as specified in Section 02605.

1.03 SUBMITTALS

A. Submit to the ENGINEER, in accordance with Section 01300, shop drawings and product data, for the following:

1. Manholes and handholes,

2. Plastic duct spacers,

3. Manhole and handhole frames and covers,

4. Buoyancy calculations for manholes.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cable racks, supports, pulling-in irons, manhole steps and hardware shall be hot dipped galvanized steel as manufactured by Line Materials Co. or equal.

B. Precast concrete manholes and handholes shall be heavy duty type, designed for a Class H20 wheel load. Precast manholes and handholes shall be as manufactured by Brooks Products Co.

C. Manhole frames and covers shall be cast iron heavy duty type for class H-20 wheel loading, and shall be as manufactured by Neenah, or equal. Manhole covers shall be marked “ELECTRIC”.

D. Handhole covers and frames shall be hot dipped galvanized and designed for a Class H-20 wheel load. Handhole covers and hatches shall have 316 stainless steel security bolts. Handhole covers shall be marked “ELECTRIC”.

E. Bell ends and plastic duct spacers shall be as manufactured by Carlon or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install raceways to drain away from buildings. Raceways between manholes or handholes shall drain toward the manholes or handholes. Raceway slopes shall not be less than 3-in per 100-ft.

B. Reinforce raceway banks as shown on the Drawings.

C. Lay raceway lines in trenches on a clean backfill bedding not less than 6 inches thick and well graded and compacted.

D. Use plastic spacers located not more than 4-ft apart to hold raceways in place. Spacers shall provide not less than 2-in clearance between raceways.

E. The minimum cover for raceway banks shall be 30-in unless otherwise permitted by the ENGINEER.

F. Make raceway entrances to buildings and vaults with rigid aluminum conduit not less than 10-ft long. Conduits which are not concrete encased for runs below floor slabs in slab-on-grade construction shall be rigid aluminum conduit. Conduits which are concrete encased for runs below floor slabs in slab-on-grade construction shall be encased under the slab to their respective equipment.

G. Raceway terminations at manholes shall be with end bells for PVC conduit and insulated throat grounding bushings with lay-in type lugs for metal conduit.

H. For bends in 2 inch and larger raceways, long radius elbows, sweeps and offsets shall be used.

I. All 2 inch and larger raceways shall have a mandrel drawn through followed by a swab to clean out any obstructions which may cause cable abrasions. The mandrel shall be 12 inches in length and the diameter 1/2 inch less than the inside diameter of the raceway. All 1-1/2 inch and smaller raceways shall be swabbed clean before installing cables.

J. Plug spare raceways and seal them watertight at all buildings and structures.

K. Raceways in use shall be sealed watertight at all buildings and structures.

L. Install pulling-in irons opposite all raceway entrances to manholes.

M. Cables shall be trained in manholes and supported on racks and hooks at intervals not greater than 3 feet-0 inches and supports shall be installed on each side of all splices. Furnish inserts on all manhole walls for mounting future racks as well as racks required for present installation. Branch circuit conductors shall not be run in manholes.

N. All joints shall be made so as to prevent the passage of concrete inside the conduit to form obstructions or cause cable abrasions.

O. Manhole covers in streets shall finish flush with finished paving and in other areas shall finish 3 inches above crown of adjacent roadway. Floor elevations of manholes shall be so set that the center line of the lowest conduit entering will be not less than 1-foot above the floor and center line of the highest conduit entering will be not less than 1 foot below the roof slab.

P. Concrete monuments shall be provided at each stubbed conduit location. Monuments shall be as shown on the Drawings and shall be installed in the same manner outlined for manhole covers.

Q. A #6 bare copper wire (stranded) shall be installed in each 4-inch PVC conduit containing control cable unless otherwise noted.

R. A 3/4-inch by 10-foot copperclad ground rod shall be driven in the bottom of each manhole. All bond wires, galvanized conduits and metal cable racks shall be bonded to the ground rod.

S. Polyethylene warning tape shall be provided for all underground raceways, duct banks etc. Tape shall be placed along the raceways entire length and shall be installed 18" above the raceways on compacted backfill material.

T. Spare and empty conduits shall have a pull wire (3/16-inch polypropylene) installed.

U. As-built drawings shall be furnished showing each conduit terminations, elevations, locations, manholes, handholes, etc.

END OF SECTION

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SECTION 16660
GROUNDING SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code (NEC), IEEE Standard 142-2007, as shown on the Drawings and as specified herein.

B. All raceways, conduits and ducts shall contain equipment grounding conductors sized in accordance with the NEC. Minimum sizes shall be No. 12 AWG.

1.02 SUBMITTALS

A. Submit to the ENGINEER, in accordance with Section 01300, shop drawings and product data, for the following:

1. Manufacturer's name and catalog data for ground rods, materials and exothermic welding methods and materials.

PART 2 PRODUCTS

2.01 MATERIALS

A. Conduit shall be as specified under Section 16110.

B. Wire shall be as specified under Section 16120.

C. Ground rods shall be 3/4-in diameter by 10-ft copper clad steel and constructed in accordance with UL 467. The minimum copper thickness shall be 0.25 mm (10 mil). Ground rods shall be Copperweld or equal.

D. Grounding conduit hubs shall be malleable iron type, manufactured by Thomas & Betts Co.; Catalog No. 3940 (3/4-in conduit size), similar to Burndy; O.Z./Gedney Co. or equal, and of the correct size for the conduit.

E. Waterpipe ground clamps shall be cast bronze saddle type, manufactured by Thomas & Betts Co. Cat. No. 2 (1/2-in, 3/4-in, or 1-in size), similar by Burndy; O.Z./Gedney Co. or equal, and of the correct size for the pipe.

F. Buried grounding connections shall be by Cadweld process, or equal exothermic welding system.

G. Ground Enhancement Material (GEM) shall be a low-resistance, non-corrosive, carbon dust based material that improves grounding effectiveness. GEM shall contain cement, which hardens when set to provide a permanent, maintenance-free, low-resistant grounding system that never leaches or washes away. GEM shall be suitable for installation in trenches or backfilling around ground rods. GEM shall have a resistivity of no more than 20 ohm-cm. GEM shall be ERICO Part No. GEM25A or equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. The service entrance equipment ground bus shall be grounded to a ¾-inch cold water pipe and to the ground as indicated on the Drawings. Run grounding electrode conductors in Schedule 80 PVC conduits and seal conduits watertight. Do not allow water pipe connections to be painted. If the connections are painted, disassemble them and re-make them with new fittings.

B. Install equipment grounding conductors with all feeders and branch circuits.

C. Bond all steel building columns in new structures together with ground wire in rigid conduit and connect to the distribution equipment ground bus, as shown on the Drawings.

D. Ground wire connections to structural steel columns shall be made by exothermic welding.

E. Metal conduits stubbed into a motor control center shall be terminated with insulated grounding bushings and connect to the motor control center ground bus. Bond boxes mounted below motor control centers to the motor control center ground bus. Size the grounding wire in accordance with NEC Table 250.122, except that a minimum No. 12 AWG shall be used.

F. Ground bus in all motor control centers and unit substations shall be connected to the service entrance equipment ground bus with a No. 1/0 conductor or as noted on the Drawings.

G. Ground transformer neutrals to the nearest available grounding electrode with a minimum conductor sized in accordance with NEC Article 250 or as shown on the drawings.

H. Grounding electrodes shall be installed vertically and not allowed to be deformed or driven at an angle. Where driving is difficult or where rock is encountered, CONSTRUCTION CONTRACTOR shall use purpose-designed drilling equipment, install the rod into the drilled hole and backfill around rod using ground enhancement material (GEM) mixed with water to form a slurry in accordance with the Manufacturer’s instructions.

I. Install ground grids as shown on the Drawings.

J. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and all other equipment and materials required by the NEC to be grounded, shall be grounded and bonded in accordance with the NEC.

K. Seal exposed connections between different metals with No-Oxide Paint Grade A or equal.

L. Lay all underground grounding conductors slack and, where exposed to mechanical injury, protect by pipes or other substantial guards. If guards are iron pipe, or other magnetic material, electrically connect conductors to both ends of the guard. Make connections as specified herein.

M. Care shall be taken to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

N. All grounding type receptacles shall be grounded to the outlet boxes with a No. 12 green conductor (insulation type to match phase conductor listed in Section 16120) connected to the ground terminal of the receptacle and fastened to the outlet box by means of a grounding screw.

3.02 INSPECTION AND TESTING

A. Inspect the grounding and bonding system conductors and connections for tightness and proper installation.

B. Use Biddle Direct Reading Earth Resistance Tester or equivalent test instrument to measure resistance to ground of the system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method. Notify the ENGINEER in writing at least two weeks prior to scheduling any testing. Provide certified calibration sheets including dates for all equipment to be used for testing with notice of scheduled testing. Calibration sheets shall also indicate that the units have been calibrated within six months of the testing date.

C. All test equipment shall be provided under this Section and approved by the ENGINEER.

D. Resistance to ground testing shall be performed during dry season. Submit test results in the form of a graph showing the number of points measured (12 minimum) and the numerical resistance to ground.

E. Testing shall be performed before energizing the distribution system.

F. A separate test shall be conducted for each building or system.

G. Dry season resistance of the system at each testing location shall not exceed five ohms. If such resistance cannot be obtained with the system, provide additional grounding, as directed by the ENGINEER, at no additional cost to the OWNER.

END OF SECTION

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SECTION 16900
CONCRETE ELECTRICAL DUCT ENCASEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and place concrete encasement around underground electrical ductwork as shown on the drawings and as specified herein.

1.02 RELATED WORK

A. All trenching, excavation and backfilling, including gravel and sand bedding and surface restoration shall be as specified in Division 2, but the responsibility of furnishing and installing the material shall be that of this Section.

B. Furnishing and installing electrical raceways are specified in Section 16110 and 16600.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement, lime, aggregate and all other concrete components shall be as specified in Section 03300 except that aggregate size shall not exceed 3/8-in. Concrete shall have a minimum compressive strength at 28 days of 2500 psi.

PART 3 EXECUTION

3.01 GENERAL

A. Concrete shall be measured, mixed and placed, and compacted as required in Section 03300 for 2500 psi concrete and as specified below.

B. Provide not less than 3-inches of concrete between the outside of a duct and the earth. Provide not less than 2-inches of concrete between adjacent ducts. Refer to drawings for spacing requirements.

C. All duct line concrete pours shall be continuous between manholes or handholes and between manholes or handholes and structures.

D. Where duct lines pass through concrete walls, concrete envelopes shall be extended through the finished flush with inside surfaces. Watertight construction joints of an approved type shall be provided.

E. Duct banks shall be reinforced when laid on backfill covering new pipelines, roads, parking lots or any are subject to vehicular traffic. Beneath these areas, install reinforcing bars as shown on the Drawings, extending 10-ft beyond area needing protection.

F. Duct lines shall be laid in trenches on mats of gravel not less than 6-inches thick and well graded.

G. The minimum cover for duct banks shall be 30-inches.

H. All electrical duct banks shall be colored red for safety purposes.

END OF SECTION

SECTION 16950
ELECTRICAL SYSTEM TESTING AND SETTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The CONSTRUCTION CONTRACTOR shall engage the services of a recognized corporately- and financially-independent testing firm and the equipment manufactures as required for the purpose of performing inspections and tests as herein specified.

B. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.

C. It is the purpose of these tests to assure that all tested electrical equipment, both CONSTRUCTION CONTRACTOR- and OWNER-supplied, is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

D. The tests and inspections shall determine suitability for energizing equipment.

E. Test systems and equipment furnished under Division 16 and repair or replace all defective work and equipment. Refer to the individual equipment sections for additional specific testing requirements.

F. Field testing and commissioning shall be performed in accordance with the latest revisions of NETA Standard ATS "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" unless otherwise modified by these Sections.

G. A typed test report for each component tested shall be submitted to the ENGINEER for the project record files as indicated.

H. Make adjustments to the systems and instruct the OWNER's personnel in the proper operation of the systems.

I. In addition to the specific testing requirements listed in the individual Sections, perform the additional testing, inspections and adjust settings as specified herein.

J. Testing shall be scheduled and coordinated with the OWNER and ENGINEER at least 2 weeks in advance.

K. Provide qualified test personnel, instruments and test equipment.

L. Provide a test report verifying compliance with the testing requirements included under Division 16.

M. Before proceeding with the energization of equipment, notify the OWNER and ENGINEER to schedule the start-up of the equipment.

1.02 RELATED WORK

A. Electric motors are provided with the driven equipment under Divisions 11 and 15 and Section 16150 are specified in the individual equipment specifications and sections.

B. Control panels are provided with the driven equipment under Divisions 11, 15 and 13 and are specified in the individual equipment specifications.

1.03 SUBMITTALS

A. Test Report

1. The test report shall include the following:
   a. Summary of project
   b. Listing of equipment tested
   c. Test results
   d. Recommendations

2. Furnish copies of the complete report to the OWNER/ENGINEER's representative as directed in the contract documents.

B. The report shall include a Table of Content and a data sheet for each component tested. The Table of Content shall identify each component by a unique number. The Number shall appear on the technical data sheet for identification. Submit cable test results, grounding test results, circuit breaker, motor circuit protector, and protective device settings, fuse type and rating for each piece of equipment. Test report shall be submitted in a three-ring binder. Three copies shall be furnished.

C. The report shall include a Table of Contents, a technical data sheet for each component (i.e., cable, circuit breaker, transformer, relay, etc.) tested. The Table of Content shall include the name of each component, location, the major piece of equipment the component is located within, and a sheet number on which the technical information is presented. Each data sheet shall include a unique sheet number, the name of the component under test, the major piece of equipment in which the component is located and the weather conditions at the time of the test including the temperature and relative humidity at the time of the test. The firm doing the testing shall include, in the report, their opinion whether or not the equipment being tested complies with the specification and recommended measures to correct the deficiency. Any discrepancies shall be noted in the concluding summary of the report. Test report forms shall be in compliance with NETA standards. Three complete copies shall be provided. Reports shall be signed by the person in responsible charge of the field testing, an officer of the firm performing the tests and an officer of the Electrical Contracting Firm.

D. The reports shall be submitted to the ENGINEER for review, comment and record purposes. Each report shall include a Table of Content, a technical data sheet, for each component (i.e., cable, circuit breaker, transformer, relay, etc.) tested. The Table of Content shall include the name of each component, the major piece equipment the component is located within, and a sheet number on which the technical information is presented. Each data sheet shall include a unique sheet number, the name of the component under test, The major piece of equipment in which the component is located, the weather conditions at the time of the test (i.e., temperature, humidity, sunny, rain, etc.) the tester's observation and findings, discrepancies, any remedial work performed or act to resolve problems, technical parameters obtained during the tests, as

left settings of all devices, and a statement indicating the equipment is ready to be energized. The report shall contain a statement indicating the equipment was tested in accordance with the procedures outlined in the latest edition of The International Testing Association Acceptance Testing Specifications.

1.04 APPLICABLE CODES, STANDARDS, AND REFERENCES

A. All inspections and tests shall be in accordance with the following codes and standards except as provided otherwise herein:

1. National Electrical Manufacturers Association - NEMA

2. ASTM International - ASTM

3. Institute of Electrical and Electronic Engineers - IEEE

4. InterNational Electrical Testing Association - NETA Acceptance Testing Specifications (ATS) – Latest Revision

5. American National Standards Institute - ANSI C2: National Electrical Safety Code

6. State and local codes and ordinances

7. Insulated Cable Engineers Association - ICEA

8. Association of Edison Illuminating Companies - AEIC

9. Occupational Safety and Health Administration - OSHA

10. National Fire Protection Association - NFPA
    a. ANSI/NFPA 70: National Electrical Code
    b. ANSI/NFPA 70B: Electrical Equipment Maintenance
    c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
    d. ANSI/NFPA 78: Lightning Protection Code
    e. ANSI/NFPA 101: Life Safety Code

B. All inspections and tests shall utilize the following references:

1. Project design specifications

2. Project design drawings

3. Project short-circuit, coordination and arc flash study

4. Manufacturer's instruction manuals applicable to each particular apparatus

5. Project list of equipment to be inspected and tested

1.05 QUALITY ASSURANCE

A. Qualifications of testing firm

1. The testing firm shall be a corporately- and financially-independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.

2. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

3. The testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or be a Full Member company of the InterNational Electrical Testing Association.

4. The lead, on-site, technical person shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing.

5. The testing firm shall utilize engineers and technicians who are regularly employed by the firm for testing services. Resumes of key staff proposed for the project shall be submitted to the ENGINEER for review.

6. The testing firm shall submit proof of the above qualifications with bid documents, when requested.

7. The terms used here within, such as test agency, testing laboratory, or CONSTRUCTION CONTRACTOR's test company shall be construed to mean the testing firm.

1.06 DIVISION OF RESPONSIBILITY

A. The CONSTRUCTION CONTRACTOR shall perform routine insulation-resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.

B. The CONSTRUCTION CONTRACTOR shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the specific power requirements.

C. The CONSTRUCTION CONTRACTOR shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

D. The project electrical engineer is responsible for obtaining and approving a short-circuit analysis and coordination study prepared by an independent testing firm or consulting engineer.

E. The project electrical engineer shall supply a short-circuit analysis and coordination study, a protective device setting sheet, a complete set of electrical plans, specifications, and any pertinent change orders to the testing firm prior to commencement of testing.

F. The testing firm shall notify the OWNER/ENGINEER's representative prior to commencement of any testing.

G. Any system, material, or workmanship which is found defective on the basis of acceptance tests shall be reported to the OWNER/ENGINEER's representative.

H. The testing firm shall maintain a written record of all tests and, upon completion of project, shall assemble and certify a final test report.

I. Safety and Precautions

1. Safety practices shall include, but are not limited to, the following requirements:
   a. Occupational Safety and Health Act (OSHA)
   b. Accident Prevention Manual for Industrial Operations, National Safety Council (NSC)
   c. Applicable state and local safety operating procedures
   d. OWNER's safety practices (Lockout/Tagout)
   e. National Fire Protection Association - NFPA 70E
   f. National Fire Protection Association – NFPA 79
   g. American National Standards for Personnel Protection

2. All tests shall be performed with apparatus de-energized. Exceptions must be thoroughly reviewed to identify safety hazards and devise adequate safeguards.

3. The testing firm shall have a designated safety representative on the project to supervise the testing operations with respect to safety.

1.07 TEST EQUIPMENT REQUIREMENTS

A. Suitability of Test Equipment

1. All test equipment shall be in good mechanical and electrical condition.

2. Selection of metering equipment should be based on a knowledge of the waveform of the variable being measured. Digital multimeters may be average or RMS sensing and may include or exclude the dc component. When the variable contains harmonics or dc offset and, in general, any deviation from a pure sine wave, average sensing and average measuring RMS scaled meters may be misleading. Use of RMS measuring meters is recommended.

3. Field test metering used to check power system meter calibration must have an accuracy higher than that of the instrument being checked.

4. Accuracy of metering in test equipment shall be appropriate for the test being performed.

5. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.

B. Test Instrument Standards

1. All equipment used for testing and calibration procedures shall exhibit the following characteristics:
   a. Maintained in good visual and mechanical condition
   b. Maintained in safe operating condition

2. Test equipment should have operating accuracy equal to, or better than, the following limits:
   a. Portable multimeters should be true RMS measuring.
   b. Multimeters should have the following accuracy limits, or better:
      1) AC voltage ranges: .75% +/-3 last single digits @ 60 Hz
      2) AC current ranges: .90% +/-3 last single digits @ 60 Hz, including adapters, transducers
      3) DC voltage ranges: .25% +/-1 last single digit
      4) DC current ranges: .75% +/-1 last single digit
      5) Resistance ranges: .50% +/-1 last single digit
      6) Frequency range: .10% +/-1 last single digit @ 60 Hz
   c. Clamp-on ammeters: ac current +/-3% of range +/-1 last single digit @ 60 Hz
   d. Dissipation/power factor field equipment
      1) +/-0.1% power factor for power factor values up to 2.0%
      2) 5% of the reading for power factor values above 2.0%
   e. Low-range dc resistance equipment: 1.0% of reading, +/-2 last single digits
   f. Transformer turns-ratio test equipment: 0.5% or better @ 60 Hz
   g. Ground electrode test equipment: +/-2% of range
   h. Insulation test sets: 0-1000V dc +/-20% of reading at mid-scale
   i. Electrical load survey equipment
      1) +/-5% total error, including sensors
      2) 1% resolution
      3) Current transformers +/-2% of range @ 60 Hz
      4) Voltage transformers +/-0.5% of range @ 60 Hz
   j. Liquid dielectric strength test equipment: +/-2% of scale
   k. Infrared scanning equipment: sensitivity of 2 degrees C
   l. Phase shifting equipment: +/-1.0 degree C over entire range
   m. High-current test equipment: +/-2% of range
   n. DC high potential test equipment: +/-2% of full scale
   o. AC high potential test equipment (60 Hz): +/-2% of full scale

C. Test Instrument Calibration

1. The testing firm shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

3. Instruments shall be calibrated in accordance with the following frequency schedule:
   a. Field instruments: 6 months maximum
   b. Laboratory instruments: 12 months
   c. Leased specialty equipment: 12 months (Where accuracy is guaranteed by lessor)
   d. Dated calibration labels shall be visible on all test equipment.
   e. Records, which show date and results of instruments calibrated or tested, must be kept up-to-date and available upon request.
   f. Up-to-date instrument calibration instructions and procedures shall be maintained for each test instrument.
   g. Calibrating standard shall be of higher accuracy than that of the instrument tested.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PREPARATION

A. Testing shall be scheduled and coordinated with the OWNER and ENGINEER at least 2 weeks in advance

3.02 ACCEPTANCE TESTING

A. Provide acceptance testing for all equipment provided under Division 16 in accordance with the individual specification sections.

B. Provided acceptance testing for all motors provided under Divisions 11 and 15.

C. Tests all electrical equipment, both CONSTRUCTION CONTRACTOR- and OWNER-supplied, is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications prior to energizing equipment.

D. Test systems and equipment furnished under Division 16 and repair or replace all defective work and equipment. Refer to the individual equipment sections for additional specific testing requirements.

E. Make adjustments to the systems and instruct the OWNER's personnel in the proper operation of the systems.

F. Mechanical inspection, testing and settings of circuit breakers, protective relays, disconnect switches, motor starters, overload relays, control circuits and equipment for proper operation.

G. Check and record the full load current draw of each motor. Where power factor correction capacitors are provided, the capacitor shall be in the circuit at the time of the measurement. Check ampere rating of thermal overloads for motors and submit a typed record to the ENGINEER of the same, including MCC cubicle location and driven load designation, motor service factor, horsepower, and Code letter. If incorrectly sized thermal overloads are installed replace same with the correct size overload.

H. Check power and control power fuses for the correct type and ratings. Replace fuses if they are found to be of the incorrect size.

I. Check settings of the motor circuit protectors. Adjust settings to lowest setting that will allow the motor to be started when under load conditions.

J. Check motor nameplates for correct phase and voltage.

K. Check rotation of motors prior to testing the driven load. Disconnect the driven equipment if damage could occur due to wrong rotation. If the rotation of the motor shaft is not correct, for the driven equipment, change the motor connections at the motor terminal box.

L. Check interlocking, control and instrument wiring for each system and/or part of a system to prove that the system will function properly as indicated by control schematic and wiring diagrams.

M. Inspect each piece of equipment in areas designated as HAZARDOUS to ensure that equipment of proper rating is installed. In the case where HAZARDOUS rated equipment is installed outdoors or in "WET" locations, verify that equipment furnished is also rated for use in WET locations and that conduit and equipment drains are provided. If equipment is not properly rated advise the ENGINEER and OWNER.

N. Verify proper phase sequence connection at transformers, equipment, and panels by producing a 1, 2, 3 / A, B, C phase rotation from left to right.

O. Verify all circuit breaker ratings and settings are as required by the Contract Documents or as amended during shop drawing review. Advise the ENGINEER of discrepancies and make changes as directed by the ENGINEER.

P. Verify proper operation of automatic and manual transfer switches, accessories devices and associated motor interlocks provided to either delay or prevent motor starting after transfer. Verify that the upstream protective device for each automatic and manual transfer switch is of the proper type and rating to achieve the specified short-circuit withstand rating. If a specific upstream protective device is required to obtain the proper short circuit withstand rating, verify that the proper signage is installed on the upstream protective device and on the automatic/manual transfer switch enclosures indicating the proper replacement parts. If signage is not installed on both the upstream protective device and the transfer switch advise the ENGINEER and OWNER and provide the signage as specified in the transfer switch specification section.

Q. Assist in the testing of the emergency/standby engine generator(s). The Electrical Contractor shall provide a journeymen electrician for the duration of the test to assist in the setup and operation of the emergency/standby engine generator(s) test(s).

R. Provide load bank and assist in the testing of the emergency/standby engine generator(s). The testing firm shall provide the load bank, transformer, cooling system, cables and ancillary equipment required to test the emergency generator. The Electrical Contractor shall provide a journeymen electrician for the duration of the test to assist in the setup, connection and operation of the emergency/standby engine generator(s) test(s).

S. Verify grounding of instrumentation equipment and line surge protection equipment.

T. Test and calibrate protective relays and circuit breakers.

U. Perform over potential, high potential, insulation resistance and shield continuity test for all medium voltage cables. Megger test all low voltage power system cable.

V. Assist in performing a complete plant power outage test to will demonstrate that the automatic power transfer equipment, individual equipment programming and the plant's process control system reestablishes plant operations in the proper sequence once normal or standby power is established. The test shall be repeated until proper plant restoration is demonstrated.

END OF SECTION

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