SECTION 16050

SPECIAL ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. General requirements for providing basic electrical materials and methods.

B. Related Work Specified in Other Sections Includes:

1. Certain items of equipment, and various control devices including conduit and wiring which are indicated on electrical drawings to be connected, but are specified in other sections pertaining to plumbing, heating, ventilating, air conditioning, temperature control systems, process equipment, process control systems, and instrumentation. Install and connect these items to the electrical system as indicated or required in accordance with the Contract Documents.
2. Excavation and backfilling, including gravel or sand bedding for underground electrical work is specified in other Divisions.
3. Cast in place concrete work, including concrete encasements for electrical duct banks, equipment pads, and reinforcing steel, is specified in other Divisions.

C. Overall Application of Specifications: This Section applies to all sections of Division 16 and to other sections that include electrical equipment requirements except when in these individual sections requirements are otherwise specified to provide and install all materials necessary for a complete operational system.

D. Where the requirements of another Division, section, or part of these specifications exceed the requirements of this Division, those requirements shall govern

E. Temporary Requirements: This Section applies to any temporary circuits, overcurrent devices, conduit, wiring, and other equipment required during changeover from existing to a new electrical system. This Section also applies to temporary rewiring of lighting and power circuits, instruments and devices.

1.02 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete and make operational, electrical and process instrumentation systems for the Collier County Utilities Department 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 Specifications and shown on the Drawings. Provide all required coordination and supervision where work connects to or is affected by work of others, and comply with all requirements affecting this Division. Work required under other divisions, specifications or drawings, indicated to be performed by this Division shall be coordinated with the Contractor and such work performed at no additional cost to Owner including but not limited to electrical work required for roll-up doors, control panel installation, instrumentation and control installation, etc.

C. 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. The work shall include but not be limited to furnishing and installing the following:

1. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions of these specifications.
2. 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.
3. Power wiring for all heating, ventilating, and air conditioning (HVAC) equipment furnished under other divisions of the specifications, including power wiring for 120 volt motors, thermostats, fan motors, dampers and other HVAC in line unit wiring.
4. The drawings and specifications describe specific sizes of switches, breakers, fuses, conduits, conductors, motor starters and other items of wiring equipment. These sizes are based on specific items of power consuming equipment (heaters, lights, motors for fans, compressors, pumps, etc.). Wherever the contractor provides power consuming equipment which differs from, the basis of design, drawings and specifications, the wiring and associated circuit components for such equipment shall be changed to proper sizes to match at no additional expense to the Owner.
5. A complete raceway system for the Data Network Cables and specialty cable systems. Install the Data Network Cables and other specialty cable systems furnished under other divisions in accordance with system integrator and the system manufacturers' installation instructions. Review the raceway layout, prior to installation, with the system integrator and the cable manufacturer to ensure raceway compatibility with the systems and materials being furnished.
6. Provide a complete grounding system and special grounds as required or noted.
7. Provide Instrumentation and control conduit and wiring systems and installation of field instrumentation.
8. Provide Electrical testing of equipment.

D. Each bidder or their authorized representatives shall, before preparing their proposal, visit all areas of the existing site and structures in which work under this Division is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that their representative has visited the site and structures and noted the locations and conditions under which the work will be performed and that the bidder takes full responsibility for a complete knowledge of all factors governing the work.

E. Field verify all existing underground electrical and mechanical piping. Locate all openings required for work performed under this section.

F. Provide sleeves, guards or other approved methods to allow passage of items installed under this section.

G. The 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, 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 22 x 34 sheets.

H. 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.

I. A single manufacturer shall provide panelboards, main breakers, transformers, disconnect switches, etc.

J. Contractor shall provide their own temporary power for miscellaneous power (drills, pumps, etc.). No facility circuits shall be used unless approved by the engineer. Any temporary added shall be removed at job completion.

K. Complete coordination with other contractors. Contractor shall coordinate with all other contractors equipment submittals and obtain all relevant submittals.

L. Mount transmitters, process instruments, operator's stations, etc. furnished under other Divisions of these specifications.

M. Concrete electrical duct encasement, including but not limited to excavation, concrete, conduit, reinforcement, backfilling, grading and seeding is included. Excavation, bedding material, forms, concrete and backfill for underground raceways; forms and concrete for electrical equipment furnished herein is included in this Division.

1.03 DEFINITIONS

A. Hazardous Areas: Equipment, materials and installation in areas designated as hazardous on the Drawings shall comply with NEC Articles 500, 501, 502 and 503. Hazardous areas as defined by the NEC as Class I, Division 1, Group D, or Class I, Division 2, Group D; hazardous areas as follows:

1. Class 1, Division 1, Group D
    a. Wet Wells
    b. Pretreatment
2. Class 1, Division 2, Group D
    a. Pump Rooms and Dry Well
    b. Odor control

1.04 QUALIFICATIONS

A. The electrical contractor shall have regularly engaged in the installation of industrial electrical power systems for a minimum period of ten (10) years. When requested by

the engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. Provide a Florida Licensed field superintendent who has had a minimum of ten (10) years previous successful experience on projects of comparable size and complexity. Superintendent shall be present at all times that work under this Division is being installed or affected. A resume of the Superintendent's experience shall be submitted to Engineer before starting work.

1.05 QUALITY ASSURANCE

A. Codes: Provide all electrical Work in accordance with applicable local codes, regulations and ordinances. If there is a conflict between the requirements specified in the Contract Documents and the codes, follow the more stringent requirements as determined and approved.

B. Testing: As a minimum, provide standard factory and field tests for each type of equipment. Other tests may be specified in the applicable equipment section.

C. Labeling: Provide all electrical equipment and materials listed and approved by Underwriters Laboratories with the UL label or other OSHA recognized testing laboratories attached to it.

D. Standard Products: Unless otherwise indicated, provide electrical materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer's latest standard design that conforms to these Specifications. When two or more units of the same class of material and equipment are required, provide the products of the same manufacturer.

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 all outdoor locations, rooms below grade (buried vaults), "DAMP" and "WET" 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 CODES, INSPECTION AND FEES

A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction. The installation shall comply with the governing state and local codes or ordinances. Completed electrical installation shall be inspected and certified by all applicable agencies that it is in compliance with all codes. Comply with latest utility company regulations.

B. Obtain all necessary permits and pay all fees required for permits and inspections. It is the contractor's responsibility to contact the required Utility Company to determine if any fees, charges or costs will be due the Utility Company, as required by the

Utility Company for temporary power, installations, hook-ups, etc. This fee, charge or cost will be invoiced to the County paid directly by the County.

1.08 PHASE BALANCING

A. The Drawings do not attempt to balance the electrical loads across the phases. Circuits on 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 herein.

1.09 SAFETY REQUIREMENTS

A. The 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 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 Contractor shall give the Power Company or overhead power line owner prior notice of such proposed operation.

1.10 PROJECT CONDITIONS

A. The Drawings indicate the extent and general arrangement of the principal electrical elements, outlets and circuit layouts. Connect and install all electrical elements and devices to form a workable system as required by the Contract Documents whether the connections and installations are specifically stated in the Specifications or shown. Provide necessary materials and installation wherever required to conform to the specific requirements of the furnished equipment and for proper installation of the Work.

B. Schematics: In general the runs of feeders are shown schematically and are not intended to show exact routing and locations of raceways. Verify actual and final arrangement, equipment locations, and prepare circuit and raceway layouts before ordering materials and equipment. Equipment locations are approximate and are subject to modifications as determined by equipment dimensions.

C. Coordination of Work: Coordinate the Work so that the electrical equipment may be installed without altering building components, other equipment or installations.

D. Coordinate arrangement, mounting, and support of electrical equipment:To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated. To provide for ease of disconnecting the equipment with minimum interference to other installations. To allow the right of way for piping and conduit installed at the required slope. To clear connecting raceways, cables, wireways, cable trays, and busways of obstructions and of the working and access space of other equipment. Coordinate the installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed. Coordinate electrical testing of electrical, mechanical, and architectural items, so that functionally interdependent equipment and systems demonstrate successful interoperability.

E. Departure from Design: If departures are deemed necessary due to structural conditions, obstructions or other problems, provide details of such departures and the reasons for requesting approval as soon as practicable but not later than the submittal of the raceway layout drawings. Do not make any departures without written approval.

1.11 MATERIALS

A. Reference: "General Conditions of the Contract".

B. Where several brand names, make or manufacture are listed as acceptable each shall be regarded as equally acceptable. Where a manufacturer's model number is listed, this model shall set the standard of quality and performance required. Where no brand name is specified, the source and quality shall be subject to Engineer's review and acceptance.

C. When a product is specified to be in accordance with a trade association or government standard, at the request of Engineer, Contractor shall furnish a certificate that the product complies with the referenced standard. Upon request of Engineer, Contractor shall submit supporting test data to substantiate compliance.

1.12 SUBSTITUTIONS

A. Each bidder represents that his bid is based upon the materials and equipment described in this division of the specifications.

B. No substitutions will be considered unless written request has been submitted to the Engineer for approval at least ten days prior to the bid date. Submittal shall include the name of the material or equipment for which it is to be substituted, drawings, cuts, performance and test data and any other data or information necessary for the Engineer to determine that the equipment meets all specification and requirements. If the Engineer approves any proposed substitutions, such approval will be set forth in an addendum.

C. Substituted equipment or optional equipment where permitted and approved, must conform to space requirements. Any substituted equipment that cannot meet space requirements, whether approved or not, shall be replaced at the Contractor's expense. Any modifications of related systems as a result of substitutions shall be made at the Contractor's expense.

PART – 2 PRODUCTS (NOT USED)

PART – 3 EXECUTION

3.01 SUBMITTALS

A. General: Provide submittals for all electrical material and devices. Including the following.

1. Product Data and Information: Provide complete list of electrical equipment and materials to be furnished showing manufacturer, catalog number, size, type, voltage rating and other pertinent information.
2. Provide catalog data on manufacturer's standard equipment and materials. Clearly indicate on catalog cuts the equipment and devices being proposed.
3. Identification: Provide complete schedule and listing of system and equipment identification labels with legends.
4. Material shall not be ordered or shipped until the shop drawings have been approved.
5. The Engineer's shop drawing review 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 Contractor from the responsibility of providing materials and workmanship required by the Specifications and the Drawings.
6. Shop drawings shall be stamped with the date checked by the contractor and a statement indicating that the shop drawings conform 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.

B. CONTRACTOR's Shop Drawings: Provide shop drawings on items manufactured for the Contract.

1. Provide connection diagram and schematic for each piece of electrical equipment. A manufacturer's standard connection diagram or schematic showing more than one method of connection is not acceptable unless it is clearly marked to show the intended method of connection.
2. Provide diagrams showing connections to field equipment. Clearly differentiate between manufacturer's wiring and field wiring.
3. Provide raceway layout drawings showing conduits, boxes, and panels which contain the conductors to be provided. Include schedules listing conduit sizes and conductor content and identification.
4. Where additions and modifications are made to existing equipment, provide drawings which include both retained existing equipment and new Work.

C. Coordination Drawings: Prepare to scale coordination drawings (1/4"=1'-0"); detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including but not necessarily limited to the following:

1. Indicate the proposed locations of major raceway systems, equipment, and materials. All dimensions shall be field verified at the job site and coordinated with the work of all other trades. Include the following:
   a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.

b. Exterior wall and foundation penetrations.
c. Fire-rated wall and floor penetrations.
d. Equipment connections and support details.
e. Sizes and location of required concrete pads and bases.

D. Record Documents: Prepare record documents, and in addition to the requirements specified in Division 1. As the work progresses, legibly record all field changes on a set of Project Contract Drawings, (the "Record Drawings"). indicate installed conditions for:

1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Approved substitutions, and actual equipment and materials installed.
4. Record Drawings shall accurately show the installed condition of the following items: Power Riser Diagram(s). Equipment elevations (front views). Raceways and pullboxes. Conductor sizes and conduit fills. Control Wiring Diagram(s). Underground raceway and duct bank routing. Plan view, sizes and locations of distribution transformers and outdoor electrical equipment enclosure.
5. Submit a schedule of control wiring raceways and wire numbers, including the following information: Circuit origin, destination and wire numbers. Field wiring terminal strip names and numbers.
6. 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. Comply with PLC tag designation on all instrumentation and control cabling in and out of PLC racks.
7. The schedule of control wiring raceways and wire numbers and the point to point connection diagrams shall be in electronic Autocad and Word format (i.e. no hand-written or drawn schedules, drawings, or diagrams will be accepted)

E. Operation and Maintenance Manuals: Prepare operation and maintenance manuals, and in addition to the requirements specified in other Divisions, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and catalog numbers of replacement parts. Complete parts list with stock numbers, including spare parts. A complete bill of material supplied, including serial numbers, ranges and pertinent data.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting

instructions.

4. A comprehensive index.
5. A complete "As Built" set of approved shop drawings.
6. A table listing of the "as left" settings for all timing relays and alarm and trip setpoints. A complete listing of As left programmable parameters for all drives, soft-starters and other microprocessor controlled equipment.
7. System schematic drawings "As Built", illustrating all components, piping and electric connections of the systems supplied under this Section.

3.02 ROUGH-IN

A. Final Location: Verify final locations for rough-ins with field measurements, vendor shop drawings and with the requirements of the actual equipment to be connected.

B. The Drawings are not intended to show exact locations of conduit runs. Coordinate the conduit installation with other trades and the actual supplied equipment.

C. Install each 3 phase circuit in a separate conduit unless otherwise shown.

D. 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 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.

E. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.

F. 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.

3.03 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.

3.04 CONCRETE PADS

A. Furnish and install reinforced concrete pads for transformers, switchgear, and motor control centers, of size as shown on the drawings or required. Unless otherwise noted, pads shall be four (4) inches high and shall exceed dimensions of equipment

being set on them, including future sections, by three (3) inches on all sides, except when equipment is flush against a wall, then the side or sides against the wall shall be flush with the equipment. Chamfer top edges 1". Trowel all surfaces smooth. Reinforce pads with 6" X 6" X 6/6 welded wire fabric. Conduit stub up area within the pad area shall remain void. Coordinate with equipment shop drawings stub up areas.

3.05 CUTTING AND PATCHING

A. Perform cutting and patching as specified in Division 1. In addition to the requirements specified in Division 1, the following requirements apply:

1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
   a. Uncover Work to provide for installation of ill-timed Work.
   b. Remove and replace defective Work.
   c. Remove and replace Work not conforming to requirements of the Contract Documents.
   d. Remove samples of installed Work as specified for testing.
   e. Install equipment and materials in existing structures.
   f. Locate existing structural reinforcing where core drilled penetrations are required so as not to cut the steel reinforcing.
2. Cut, remove, and properly dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work. Deliver all the existing removed to the OWNER as directed.
3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
6. Provide non-destructive imaging methods (radar, x-ray) to locate embedded conduit in concrete prior to demolition, saw cutting and core drilling. Relocate and reconstruct affected conduit and wire per electrical specifications.
7. Patch finished surfaces and building components using new materials as specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

B. Supplementary Requirements: Any cutting of work in place shall be patched and decorated by such mechanics and in such a manner that the quality of workmanship and finish shall be compatible with that of adjacent construction.

3.06 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 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 at no additional cost to the Owner.

E. Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
   1. Coordinate electrical systems, equipment, and materials installation with other building components.
   2. Verify all dimensions by field measurements. 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.
   3. 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.
   4. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
   5. Coordinate the installation of required supporting devices and sleeves to be set in cast-in-place concrete and other structural components, as they are constructed.
   6. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
   7. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
   8. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
   9. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the ENGINEER for resolution.
   10. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
   11. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect

equipment for ease of disconnecting, with minimum of interference with other installations.

12. Install access panel or doors where units are concealed behind finished surfaces.
13. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

F. Surface mounted fixtures, outlets, cabinets, conduit, panels, etc. shall have finish or shall be painted as directed by Engineer. Paint shall be in accordance with other applicable sections of these specifications.

3.07 TESTS AND SETTINGS

A. Test systems and equipment furnished under Division 16 and other divisions supplying electrical equipment. Repair or replace all defective work and equipment. Refer to Acceptance Testing section and the individual equipment sections for additional specific testing requirements.

B. Make adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

C. In addition to the specific testing requirements listed and the individual Sections, the following minimum tests and settings shall be performed. Submit test reports upon completion of testing.

1. Mechanical inspection, testing and settings of circuit breakers, disconnect switches, motor starters, overload relays, control circuits and equipment for proper operation.
2. Check 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 driven load designation, motor service factor, horsepower, and Code letter. If incorrect thermal overloads are installed replace same with the correct size overload.
3. Check power and control power fuse ratings. Replace fuses if they are found to be of the incorrect size.
4. Check settings of the motor circuit protectors. Adjust settings to lowest setting that will allow the motor to be started when under load conditions.
5. Check motor nameplates for correct phase and voltage. Check bearings for proper lubrication.
6. 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 is incorrect for the driven equipment correct motor connections at the motor terminal box.
7. 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.
8. Inspect each piece of equipment in areas designated as HAZARDOUS to ensure that equipment of proper rating is installed.
9. Verify all terminations at transformers, equipment, panels and enclosures by producing a 1, 2, 3 rotation on a phase sequenced motor when connected to "A", "B" and "C" phases.
10. Check all wire and cable terminations. Verify to the Engineer connections

meet the equipments torque requirements.

11. Field set all transformer taps as required to obtain the proper secondary voltage.

3.08 MANUFACTURERS SERVICE

A. Provide manufacturer's services for testing and start-up of all major electrical equipment: VFDs, ATS, Gensets, MCCs, Switchboards, Switchgear, Etc.

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 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 Contractor shall be submitted to the Engineer.

3.09 TRAINING

A. 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.

B. 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.

C. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance including trouble-shooting of each system.

D. 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 each class member.

E. The Contractor shall 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. Recommended types of attendees.
   4. Course Content - A topical outline.
   5. Course Format - Lecture, laboratory demonstration, etc.
   6. Schedule of training courses including dates, duration and locations of each class.

3.10 WARRANTY

A. The work under this Division shall include a two-year warranty. This warranty shall be by the Contractor to the Owner for any defective workmanship or material that has been furnished under this Contract at no cost to the Owner for a period of two years from the date of substantial completion of the System. This guarantee shall not include light bulbs or batteries in service after six months from date of Substantial Completion of the System.

END OF SECTION

SECTION 16110

CONDUIT SYSTEMS

PART 1 - GENERAL

1.01 Description

A. Description of System: This Section includes requirements for raceways, fittings, boxes, enclosures, and cabinets for electrical, instrumentation and control system wiring.

B. Use heavy wall PVC (Schedule 80) for all raceways trapped underground without concrete encasement protection. Conduits in concrete encasement use Schedule 40-PVC. Above ground use Schedule 80-PVC. Where PVC conduit penetrates a floor from underground or in a slab; a black mastic coated rigid aluminum conduit elbow shall be used for all conduits.

C. Minimum conduit size for all systems shall be 3/4". All conduits shall be U.L. listed and labeled. Conduit sizes shown on the drawings are to aid the contractor in bidding only; the contractor is responsible for conduit sizes as required by NEC fill tables but do not provide smaller conduits than indicated. The contractor is responsible to coordinate the required conduit sizes and conductor quantities for all control and instrumentation system conduit and wiring with the controls subcontractor prior to installation.

D. Provide stainless steel or non-metallic conduit supports and 316 stainless steel hardware in all areas except air conditioned spaces.

1.02 Submittals

A. Product Data:
   1. Product data shall be submitted on:
      a. Conduit, raceways, wireways.
      b. Conduit fittings, boxes, enclosures and cabinets.
      c. Surface metal raceway

PART 2 - PRODUCTS

2.01 FLEXIBLE CONDUIT

A. Flexible, Nonmetallic, Liquid-Tight Conduit: Type B.

   1. Material: PVC core with fused flexible PVC jacket. UL 1660 listed for:
      a. Dry Conditions: 80 degrees C insulated conductors.
      b. Wet Conditions: 60 degrees C insulated conductors.
   2. Manufacturers and Products:
      a. Carlon; Carflex or X Flex.
      b. T & B; Xtraflex LTC or EFC.
      Or Equal

2.02 PVC Conduit

A. PVC conduit shall be composed of High Impact Virgin homopolymer, PVC (polyvinyl chloride C-200 Compound), and shall conform to industry standards, and be UL 651 listed in accordance with Article 347 of National Electrical Code for underground and exposed use and NEMA standard TC-2. Materials must have tensile strength of 55 PSI, at 70oF, flexural strength of 11,000 PSI, compression strength of 8600 PSI. Manufacturer shall have five years' extruding PVC experience. Consistent with requirements provide PVC conduit products by one of the following manufacturers:
   1. Carlon
   2. Cantex
   3. J.M. Plastics
   4. Queen City Plastics

2.03 Conduit Fitting

A. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

B. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

C. Conduit locknuts shall be aluminum throughout except steel is acceptable within air conditioned spaces.

D. Conduit expansion fittings shall be malleable iron, and shall be hot dipped galvanized inside and outside. These fittings shall have a four-inch expansion chamber to allow approximately two-inch movement parallel to conduit run in either direction from normal. They shall have factory-installed packing and internal tinned copper braid packing to serve as an emergency bonding jumper. Unless the fitting used is listed by Underwriters' Laboratories for use "without external bonding jumpers", an external copper bonding jumper shall be installed with each expansion fitting with one end clamped on each conduit entering fitting.

E. Flexible, Nonmetallic, Liquid-Tight Conduit shall meet requirements of UL 514B with High strength plastic body, complete with lock nut, O-ring seal, threaded ferrule, sealing ring. Threaded ferrule designed to ensure high mechanical pullout strength and watertight seal. Manufacturer, Carlon; Type LN or approved equal.

PART 3 - EXECUTION

3.01 Installation

A. All raceways shall be run in neat and workmanlike manner and shall be properly supported in accordance with latest edition of NEC with approved conduit clamps, hanger rods and structural fasteners except for PVC conduit installed in exterior locations. PVC conduit installed in exterior locations shall be supported at two foot intervals. Supporting conduit and boxes with wire or tie wraps is not approved. All raceways except those from surface-mounted switches, outlet boxes or panels shall be run concealed from view. Exposed raceways shall be supported with clamp

fasteners with toggle bolt on hollow walls, and with lead expansion shields on masonry. Rigid steel box connections shall be made with double locknuts and bushings. Where PVC penetrates a floor from underground or in slab, a black mastic coated steel conduit elbow shall be used on all conduits. All individual bare copper ground conductors (i.e. service, transformer, or lightning protection grounds) shall be installed in PVC conduit, not metal conduit. This does not apply to bare copper ground conductors run with feeders (as specified in this section). Conduits shall be run parallel to building walls wherever possible, exposed or concealed, and shall be grouped in workmanlike fashion. Crisscrossing of conduits shall be minimized.

B. All raceways runs, whether terminated in boxes or not, shall be capped during the course of construction and until wires are pulled in, and covers are in place. No conductors shall be pulled into raceways until construction work which might damage the raceways has been completed.

C. All raceways shall be kept clear of plumbing fixtures to facilitate future repair or replacement of said fixtures without disturbing wiring. Except where it is necessary for control purposes, all raceways shall be kept away from items producing heat.

D. All raceways shall be run from outlet to outlet exactly as shown on the drawings, unless permission is granted to alter arrangement shown. If permission is granted arrangement shall be marked on field set of drawings as previously specified.

E. All underground raceways (with exception of raceways installed under floor slab) shall be installed in accordance with Section 300-5 of the NEC except that the minimum cover for any conduit shall be two feet. Included under this Section shall be the responsibility for verifying finished lines in areas where raceways will be installed underground before the grading is complete.

F. All raceways shall have an insulated copper system ground conductor throughout the entire length of circuit installed within conduit in strict accordance with NEC. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not included or shown on drawings. Grounding conductors run with feeders shall be bonded to portions of conduit that are metal by approved ground bushings.

G. Spare conduit stubs shall be capped and location and use marked with concrete marker set flush with finish grade or terminated in a manhole. Marker shall be 6" round X 6" deep with appropriate symbol embedded into top to indicate use. Also, tag conduits in panels where originating.

H. All conduit stubbed above floor shall be separated with plastic interlocking spacers manufactured specifically for this purpose, or shall be strapped to Kindorf channel supported by conduit driven into ground or tied to steel.

I. Raceways which do not have conductors furnished under this Division of the specifications shall be left with an approved nylon pullcord in raceway.

J. Flexible steel conduit and PVC conduit shall be manufactured within the United States.

K. All connections to motors or other vibrating equipment (except dry type transformers) or at other locations where required shall be made with not less than 12" nor more than 20” of flexible liquid-tight steel conduit, using special type of connectors with strain relief fittings at both terminations of conduit. Flex connectors shall have insulated throat and shall be T & B 3100 Series or approved substitution. Use angle connectors wherever necessary to relieve angle strain on flex conduit. Connections to dry type transformers shall be made with flexible conduit. Typical length of flex conduit shall be limited to 20” unless specifically approved by the engineer.

L. PVC joints shall be solvent welded. Threads will not be permitted on PVC conduit and fittings, except for rigid steel to PVC couplings. Installation of PVC conduit shall be in accordance with manufacturer's recommendations. PVC conduit shall not be used to support fixture or equipment. Field bends shall be made with approved hotbox. Heating with flame and hand held heat guns are prohibited.

M. Expansion fittings shall be installed in the following cases: In each conduit run wherever it crosses an expansion joint in the concrete structure; on one side of joint with its sliding sleeve end flush with joint, and with a length of bonding jumper in expansion equal to at least three times the normal width of joints; in each conduit run which mechanically attached to separate structures to relieve strain caused by shift on one structure in relation to the other; in straight conduit run above ground which is more than fifty feet long and interval between expansion fittings in such a runs shall not be greater than 100 feet for steel conduit and 50 feet for PVC conduit.

N. Underground cable identification: bury a continuous, pre-printed, bright colored metalized plastic (electronically traceable) ribbon cable marker with each underground conduit (or group of conduits), regardless of whether conduits are in ductbanks. Locate directly over conduits, 6" to 8" below finished grade. Delete this requirement under building slabs.

O. Provide for separation of instrumentation, control and power conductors. Provide a minimum of 24" inch separation for parallel runs of power conduit to instrumentation or control conduit with PVC conduit. This separation can be reduced to 8" if metallic grounded separation is provided.

END OF SECTION

SECTION 16120

LOW VOLTAGE WIRES AND CABLES

PART 1 – GENERAL

1.01 General

A. Referenced Standards:

1 Institute of Electrical and Electronics Engineers, Inc./American National Standards Institute (IEEE/ANSI):

2. Standard for Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies.
3. National Electrical Manufacturers Association (NEMA): ICS 4, Industrial Control and Systems: Terminal Blocks.
4. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA): WC 57/S-73-532, Standard for Control Cables: WC 70/S-95-658, Non-Shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
5. National Fire Protection Association NFPA-70, National Electrical Code (NEC).
6. Underwriters Laboratories, Inc. (UL44): Standard for Safety Thermoset-Insulated Wires and Cables; (UL83): Standard for Safety Thermoplastic-Insulated Wires and Cables; UL467 Standard for Safety Grounding and Bonding Equipment. UL486A Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors; UL 486C, Standard for Safety Splicing Wire Connections. UL510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.

1.02 Definitions:

A. Building Wire: Copper single conductor, cross link polyethylene insulated; type XHHW-2;

B. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.

C. Instrumentation Cable (Analog signal cable): Multiple conductor, insulated, twisted Pair/Triad, with individual Pair/Triad shield and outer overall shield and outer sheath. Used for the transmission of low current (e.g., 4-20mA DC) using No. 16 AWG conductors. Common Types, TSP: Twisted shielded pair, TST: Twisted shielded triad.

D. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, No. 14, AWG. With overall shield where specified. Type SIS and MTW approved for use in the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers; otherwise type XHHW-2.

E. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 12 AWG and larger. Rated XHHW-2

F. Digital signal cable: Used for the transmission of digital signals between computers,

PLC's, RTU's, Ethernet field devices etc. Common Types: Ethernet UTP-unshielded twisted pair.

PART 2 – PRODUCTS

2.01 Power Conductors:

A. Branch circuits and feeder conductors for all three phase electric power shall be stranded copper type XHHW-2 cross-link polyethylene (XLP) insulation and derated to 75 degrees Centigrade. No aluminum wiring shall be permitted. Wire shall be in accordance to NEC and minimum No. 12, except that branch "homeruns" over 50 ft. in length shall be minimum No. 10 for 120/208V circuits. All branch lighting circuits serving HID and Fluorescent fixtures shall be minimum #10 with each circuit provided with a separate neutral. All wire shall be manufactured in the USA.

B. Motor leads from variable frequency drives to driven motor shall be shielded VFD drive cable for all VFD motors. Provide flexible VFD shielded drive cables, 3 Class-I conductor cable plus 3 trisectional green insulated ground wires. Provide electrostatic shielding of tinned copper braided shield with aluminum-polyester laminated tape shielding system. Cross-linked polyolefin insulation system and neoprene outer jacket, type TC cable as manufactured by Rockbestos-Surprenant Cable Corp. or equal. Shielded VFD motor cables require increased conduit sizes over standard wire installations. Contractor to verify conduit sizes.

C. Taps and Splices:

1. All power wiring taps and splices in No. 8 or smaller wire shall be fastened together by means of terminal strips except within lighting fixtures and wiring devices where conformance to NEC practices will be acceptable (Twist/screw on type connectors). All taps and splices in wire larger than No. 8 shall be made with compression type connectors and taped to provide insulation equal to wire. Tape shall be heavy duty, flame retardant and weather resistant vinyl electrical tape, minimum 7 mil premium grade with an operating temperature of 0 degree F. to 220 degree F. Provide tape meeting UL 510 and CSA standard C22.2.

2. All taps and splices in manholes or in ground pull boxes, etc. shall be approved by the engineer on a case by case basis; be made with high press long barrel double crimp compression type connectors and covered with Raychem heavy wall cable sleeves (type CTE or WCS) with type "S" sealant coating. Install sleeve kits as per manufacturer's installation instructions.

D. Color Coding:

1. All power feeders and branch circuits No. 6 and smaller shall be wired with color-coded wire with the same color used for a system throughout the building. Power feeders above No. 6 shall either be fully color-coded or shall have black insulation and be similarly color-coded with tape or paint in all junction boxes and panels. Tape or paint shall completely cover the full length of conductor insulation within the box or panel except for the wire markings.

2. Unless otherwise approved, color-code shall be as follows: Neutrals to be white for 120/208V system, natural grey for 277/480V system; ground wire

green, bare or green with yellow strips. Nominal Voltage: 120/208V, Phase A -black; Phase B - red; Phase C - blue. 480/277V, Phase A brown; Phase B - orange; Phase C -yellow. All switch legs, other voltage system wiring, control and interlock wiring shall be color-coded other than those above. In exiting or expansion projects, comply with existing color coding established within the facility.

2.02 Instrumentation and Control Cable:

A. Multiconductor and Multi pair Process instrumentation cable shall be #16 AWG stranded, twisted pair, 600 V, (XLP) cross link polyethylene insulated, aluminum tape pair shielding, cross link polyethylene or chlorinated polyethylene (CPE) overall sheathed and shielded, type TC instrument cable as manufactured by the American Insulated Wire Co., Belden Wire Co. or equal.

B. Multiconductor control cable shall be #14 AWG stranded, 600V, (XLP) cross link polyethylene insulated or polyolefin, with cross link polyethylene or chlorinated polyethylene (CPE or Hypalon) overall sheathed type TC control cable except for control cable into and out of VFD cabinets. Multiconductor control cable into and out of VFD cabinets shall be as indicated above and in addition include an aluminum polyester tape overall shield and drain wire. As a contractor alternate to shielded control cable into and out of VFD cabinets, provide twisted shielded instrument cable as specified above. Contractor to provide increased conduit size as required if instrument cable alternate is used into and out of VFD cabinets.

C. Connections:
1. All conductor connections shall be on terminal strips including all spare conductors. Provide terminal strips in all cabinets; motor control centers; etc.
2. All connections of stranded wire to screw terminals shall be by insulated spade lugs, crimp fastened to wire. Provide stranded wire crimp ferrules for all stranded wire connections not requiring spade lugs for screw type terminal blocks. The stranded wire ferrule is to be crimped to all stranded wire using a crimping tool specifically approved for crimping the size and type of ferrule.
3. All conductors shall be marked with mylar wrap type "Brady" labels. Identification labels shall be permanent type and be machine printed. All terminal block terminations shall be labeled. The inside portion of the terminal cabinet doors shall display a protected terminal cabinet drawing with all connections shown and described as to color code, number assigned to connection function of conductor and destination.
4. Wire shall be guided within terminal cabinets by cable supports. All conductors shall be neatly led to terminations.
5. Instrumentation and control field cables on the unprotected side of SPD devices within the cabinet shall not run in parallel to the cables on the protected side of the SPD device. Separate cable supports (duct) will be provided.
6. Cabinets: All cabinets shall be labeled with an engraved plastic laminate label riveted to the door.
7. No splices shall be made within a conduit run or in manholes.

D. All plant control system field wiring shall be labeled per the instrumentation and

control contractor loop drawings from the field device, through the intermediate cabinets, to the PLC cabinet. The labeling system shall be consistent throughout the loop and follow the standard tag designation: PLC#-Rack#-Slot#-Point# (example PLC1-R2-S3-P4).

E. Provide for separation of instrumentation, control and power conductors. Provide a minimum of 24" inch separation for parallel run of power conduit and instrumentation or control conduit. This separation can be reduced to 6" if metallic grounded separation is provided.

PART 3 - SUBMITTALS

3.01 Submit:

A. Cut sheets on all major types of wires and cables including splicing tape, and terminating/splicing lugs, conductor identification systems and connectors and cable sleeves. Submit sample of all instrumentation and control cable. Sample shall be a minimum of 24" with exterior sheath clearly marked.

B. Sample of all cable identification systems products.

END OF SECTION

SECTION 16180

OVERCURRENT PROTECTIVE DEVICES

PART 1 – GENERAL

Not Used

PART 2 - PRODUCTS

2.01 Manufacturers

A. Provide Cutler Hammer JD series circuit breakers. Equal approved manufacturers will be considered. Manufacturers desiring approval are required to submit a complete arc flash hazard analysis for review.

2.02 Molded Case Circuit Breakers – 800A and Below

A. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics and shall be Eaton or approved equal.

B. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

C. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings.

D. Circuit breakers 400ampere frame and below shall have thermal-magnetic trip units and inverse time-current characteristics.

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

PART 1 - GENERAL

1.01 Scope;

A. The work under this sections includes conduit and equipment supports, straps, clamps, steel channel, etc, and fastening hardware for supporting electrical work. Furnish and install all supports, hangers and inserts required to mount fixtures, conduit, cables, pull boxes and other equipment furnished under this Division. All supporting devices and hardware exterior of buildings or interior of structures except in air conditioned spaces shall be stainless steel. Aluminum and non metallic supports (fiberglass) and hardware will be reviewed by the Engineer on a case-by-case basis.

B. All items shall be supported from the structural portion of the building. Supports and hangers shall be of a type approved by Underwriters' Laboratories. Wire shall not be used as a support. Boxes and conduit shall not be supported or fastened to ceiling suspension wires or to ceiling channels.

C. The Contractor shall furnish and install all sleeves that may be required for openings through floors, wall etc. Where plans call for conduit to be run exposed, the Contractor shall furnish and install all inserts and clamps for the supporting of conduit. If the Contractor does not properly install all sleeves and inserts required, contractor to provide cutting and patching to the satisfaction of the Engineer.

1.02 Related Work: Applicable provisions of Division 1 govern work under this Section. Section 16110 – Conduit Systems

1.03 Submittals: Product Data: Provide data for support channel.

1.04 Quality Assurance: Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.01 Material

A. Support Channel: Stainless steel throughout except galvanized steel in conditioned interior areas.

B. Hardware: Stainless steel throughout

C. Minimum sized threaded rod for supports shall be 3/8”.

D. Conduit clamps, straps, supports, etc., shall be stainless steel. One-hole straps shall be heavy duty type.

PART 3 - EXECUTION

3.01 Installation

A. All PVC conduits shall be securely fastened in place on maximum of 3 foot intervals vertically and 2 foot intervals horizontally. Hangers, supports or fastenings shall be provided at each elbow and at the end of each straight run terminating at a box or cabinet. The required strength of the supporting equipment and size and type of anchors shall be based on the combined weight of conduit, hanger and cables. Horizontal and vertical conduit runs may be supported by two-hole malleable straps, clamp-backs, or other approved devices with suitable bolts, expansion shields (where needed) or beam-clamps for mounting to building structure or special brackets.

B. All screws, bolts, washers, etc., used for supporting conduit or outlets shall be fabricated from stainless steel, or approved substitution.

C. File and de-bur cut ends of support channel and spray paint with cold galvanized paint to prevent rusting. Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not drill structural steel members unless approved by the engineer.

D. Fabricate supports from stainless steel or aluminum channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch (25 mm) off wall.

E. Furnish and install all supports as required to fasten all electrical components required for the project, including free standing supports required for those items remotely mounted from the building structure, catwalks, walkways etc.

END OF SECTION

SECTION 16410

ELECTRIC SERVICE

PART 1 - GENERAL

1.01 Description of System:

A. The Electrical Utility Company will provide the electrical service of the characteristics as shown on the Drawings. This Contractor's work will begin where the Utility Company's work ends.

B. The Contractor shall furnish all labor, materials, etc., necessary for a complete approved electrical service as required for this project, including inspection and approval by the Utility and local Inspection Departments (if any) and inform the Engineer prior to energizing power lines.

C. This Contractor shall notify the Utility Company in writing, with two copies to the Engineer, no later than ten (10) days after signing contracts as to when this Contractor anticipates the building power service will be required.

1.02. Construction Facilities:

A. The facilities and equipment required to provide all electrical power for construction, lighting and balancing and testing consumed prior to final acceptance of the project shall be provided under this section of the specifications. All wiring, outlets and other work required to provide this power at the site and within the building for all trades shall be arranged for, furnished and installed under this section of the specifications including any fee, charge or cost due the utility company for temporary power installation or hook-ups.

B. Facilities shall be furnished in a neat and safe manner in compliance with governing codes, good working practices and OSHA regulations.

1.03. Underground Electrical Service:

A. Furnish and install underground 240V 3 phase, 4 wire (PS 308.08, PS309.16) or 480V 3 phase, 4 wire (PS308.06, PS308.09, PS309.23 & PS309.30) service from power company pole base handhole or pad mount transformer to main service equipment. Seal conduit with duct-seal where entering a building.

B. The underground service shall comply with all the requirements of the NEC, local Utility Company and local enforcing authority.

1.04. Utility Company Fees, Charges and Costs

A. It is the contractor's responsibility to contact the required Utility Company to determine if any fees, charges or costs will be due the Utility Company, as required by the Utility Company for temporary power, installations, hook-ups, etc. Payment of this fee, charge or cost shall be the responsibility of the contractor.

1. PS308.08, PS309.16, PS308.06, PS308.09 & PS309.30 project was coordinated with FPL Distribution Engineer: Mannat Khanna 239-315-9181 or Mannat.Khanna@fpl.com. He was provided a set of the final plans and specs for the project.
2. PS309.23 project was coordinated with FPL Technical Specialist II: Gretchen Myers at 239-353-6025 or Gretchen.Myers@fpl.com. She was provided a set of the final plans and specs for the project.

B. Fees, charges or costs due to the utility company for installation of project specific polebase handhole and riser modifications shall be the responsibility of the contractor. Payment to be issued by contractor to FPL.

1.05 Submittals

A. Submit product data on:
1. Meter base and CT, cabinet if applicable.
2. Copy of Contractors notice to FPL
3. Copy of Contractors transmittal of FPL invoice and completed FPL SAP One Memo

PART 2 – PRODUCTS

2.01 Metering:

A. Meter bases shall be furnished and installed by this contractor. Provide aluminum meter bases. Metering bases and conduits must be installed in accordance with the Utility Company requirements.

B. FP&L requirements. Work to be completed under this section shall be in accordance with FP&L documentation and standards.

PART 3 – EXECUTION

Not used

END OF SECTION

SECTION 16450

GROUNDING AND BONDING

PART 1 - GENERAL

1.01 Description; the terms “connect”, “ground” and “bond” are used interchangeably in this specification and have the same meaning

A. This section specifies general grounding and bonding requirements of electrical equipment operations and to provide a low impedance path for possible ground fault currents.

B. “Grounding electrode system” refers to all electrodes required by NEC, as well as including made, supplementary, perimeter counterpoise ground, lightning protection system grounding electrodes.

1.02 Related Work

A. Section 16050, Basic Material and Methods: General electrical requirements.

B. Section 16120, Conductors & Cables

1.03 Submittals

A. Submit in accordance with Section 16050

B. Shop Drawings:
1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

C. Test Reports: Provide certified test reports of ground resistance.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Project Engineer:
1. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.04 Applicable Publications

A. American Society for Testing and Materials (ASTM):

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

C. National Fire Protection Association (NFPA):
National Electrical Code (NEC) 2014

D. Underwriters Laboratories, Inc. (UL):
Thermoset-Insulated Wires and Cables
Thermoplastic-Insulated Wires and Cables
Grounding and Bonding Equipment
Wire Connectors

PART 2 – PRODUCTS

2.01 Grounding and Bonding Conductors

A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 2 AWG and smaller may be solid copper unless noted otherwise noted on the drawings. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 4 AWG and larger shall be permitted to be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 2 AWG and smaller may be ASTM B1 solid bare copper wire.

C. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.

2.02 Splices and Termination Components

A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.03 Ground Connections

A. Above Grade:
1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lock washers.
2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.

PART 3 – EXECUTION

3.01 General

A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.

B. System Grounding:
1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames,

and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.02 Grounding Connections

A. Make grounding connections that are below grade by exothermic weld. Make grounding connections that are above grade but are otherwise normally inaccessible (poured columns, within walls) with exothermic weld.

3.03 Secondary Equipment and Connections

A. Transformers:
1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the ground bar at the service equipment.

B. Conduit Systems:
1. Ground all metallic conduit systems. All conduit systems shall contain an equipment grounding conductor (except service entrance with grounded neutral). Ground conductor shall be bonded to metallic conduit systems at the entrance and exit from the conduit.

C. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes.
2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

D. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.

E. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

3.04 Corrosion Inhibitors

A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.05 Conductive Piping

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system.

3.06 Ground Resistance

A. Grounding system resistance to ground shall not exceed 2 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the owner. Final tests shall assure that this requirement is met.

B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

C. Below-grade connections shall be visually inspected by the Project Engineer prior to backfilling. Provide ground inspection wells at all ground rod locations.

3.07 Ground Rod Installation

A. Drive each rod vertically in the earth, not less than 20 feet in depth.

B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make above grade accessible ground connections with mechanical pressure type ground connectors.

C. Where rock prevents the driving of vertical ground rods, drill rock then install rod. Backfill with flowable fill or concrete mix. Obtain the necessary permits if required for drilling.

END OF SECTION

SECTION 16460

LOW-VOLTAGE TRANSFORMERS

PART 1 – GENERAL

1.01 DESCRIPTION-this section specifies the furnishing, installation and connection of the dry type general-purpose transformers.

1.02 RELATED WORK
- A. Section 16051, Special Electrical Requirements
- B. Section 16110, Conduit Systems
- C. Section 16120, Low-Voltage Wire and Cables
- D. Section 16450, Grounding and Bonding For Electrical Systems:

1.03 SUBMITTALS
- A. In accordance with Section 16050 Special Electrical Requirements.

- B. Shop Drawings:
  1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  2. Include electrical ratings, impedance, dimensions, weight, mounting details, decibel rating, terminations, temperature rise, no load and full load losses, and connection diagrams.
  3. Complete nameplate data including manufacturer's name and catalog number.
- C. Manuals:
  1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets and wiring diagrams.

1.04 REFERENCES
- A. National Fire Protection Association (NFPA) 70-08 National Electrical Code (NEC)

- B. National Electrical Manufacturers Association (NEMA): ST 20-97 Dry-Type Transformers for General Applications

PART 2 – PRODUCTS

2.01 GENERAL PURPOSE DRY TYPE TRANSFORMERS
- A. Unless otherwise specified, dry type transformers shall be in accordance with NEMA, NEC and as shown on the drawings. Transformers shall be UL listed or labeled.

- B. Dry type transformers shall have the following features:
  1. Self-cooled by natural convection, isolating windings, indoor, dry type. Autotransformers will not be accepted.
  2. Rating shall be as shown on the drawings. Ratings shown on the drawings are for continuous-duty without the use of cooling fans.

3. Transformers shall have copper windings.
4. Insulation systems:
   a. Transformers 30 KVA and larger: UL rated 220 degrees C system having an average maximum rise by resistance of 150 degrees C in a maximum ambient of 40 degrees C.
   b. Transformers below 30 KVA: Same as for 30 KVA and larger or UL rated 185 degrees C system having an average maximum rise by resistance of 115 degrees C in a maximum ambient of 40 degrees C.
5. Core and coil assemblies:
   a. Rigidly braced to withstand the stresses caused by short circuit currents and rough handling during shipment.
   b. Cores shall be grain oriented, non-aging, and silicon steel.
   c. Coils shall be continuous windings without splices except for taps.
   d. Coil loss and core loss shall be minimum for efficient operation.
   e. Primary and secondary tap connections shall be brazed or pressure type.
   f. Coil windings shall have end fillers or tie downs for maximum strength.
6. Certified sound levels determined in accordance with NEMA, shall not exceed the following:

Transformer Rating	Sound Level Rating
0 - 9 KVA	40 dB
10 - 50 KVA	45 dB
51 - 150 KVA	50 dB
151 - 300 KVA	55 dB
301 - 500 KVA	60 dB

7. Nominal impedance shall be as per NEMA.
8. Single phase transformers rated 15 KVA through 25 KVA shall have two, 5 percent full capacity taps below normal rated primary voltage. All transformers rated 30 KVA and larger shall have two, 2-1/2 percent full capacity taps above, and four, 2-1/2 percent full capacity taps below normal rated primary voltage.
9. Core assemblies shall be grounded to their enclosures by adequate flexible ground straps.
10. Enclosures:
    a. Not less than code gage steel.
    b. Outdoor enclosures shall be NEMA 3R stainless steel.
    c. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformer has been placed in service.
    d. Ventilation openings shall prevent accidental access to live components.

e. Thoroughly clean and paint enclosure at the factory with manufacturer's prime coat and standard finish.

11. Standard NEMA features and accessories including ground pad, lifting provisions and nameplate with the wiring diagram and sound level indicated on it.
12. Dimensions and configurations shall conform to the spaces designated for their installations.
13. Transformers shall meet the minimum energy efficiency values per NEMA TP1 as listed below:

kVA Rating	Output efficiency (%)
15	97
30	97.5
45	97.7
75	98
112.5	98.2
150	98.3
225	98.5
312	98.6

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installation of transformers shall be in accordance with the NEC, as recommended by the equipment manufacturer and as shown on the drawings.

B. Install the transformers with adequate clearance at a minimum of 4 inches from wall and adjacent equipment for air circulation to remove the heat produced by transformers.

C. Install transformers on vibration pads designed to suppress transformer noise and vibrations.

D. Use flexible metal conduit to enclose the conductors from the transformer to the raceway systems.

END OF SECTION

SECTION 16709

SURGE PROTECTIVE DEVICES (SPDs)

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection should be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers. Refer to related sections for surge requirements in:

1.02 RELATED SECTIONS

A. Section 26 29 13 - Control Panels

B. Section 26 24 16 – Panelboards

1.03 REFERENCES

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

B. ANSI/IEEE C62.41.1-2002 – Guide on surge environment in low-voltage (1000 V and less) AC power circuits.

C. ANSI/IEEE C62.41.2-2002 – Recommended practice on characterization of surges in low-voltage (1000 V and less) AC power circuits.

D. ANSI/IEEE C62.45-2002 – Recommended practice on surge testing for equipment connected low-voltage (1000 V and less) AC power circuits.

1.03 SUBMITTALS

A. The following information shall be submitted to the Engineer:

1. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL).

2. For sidemount mounting applications (SPD mounted external to electrical assembly), electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

B. Where applicable the following additional information shall be submitted to the engineer:

1. Descriptive bulletins

2. Product sheets

C. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed and shall incorporate all changes made during the manufacturing process

1.04 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. 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.

1.05 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be provided with each SPD shipped.

1.06 MANUFACTURERS

A. Eaton / Cutler-Hammer products

B. SquareD by Schneider Electric: Surgelogic

C. EDCO

D. Erico

E. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

PART 2 – PRODUCTS

2.01 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.

2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.

3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

5. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.

6. SHORT CIRCUIT CURRENT RATING (SCCR): Per NEC 286.6, the short circuit current rating of the SPD shall be equal to or greater than the available short circuit current at the point where installed

7. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	2500

Modes	240D	480D	600D
L-L; L-G	1200	2000	2500

8. SPDs installed internal to the distribution equipment shall be of the same manufacturer as the equipment. The equipment shall be fully tested and certified to the following UL standards:

   UL 67 = Panelboards
   UL 845 = Motor Control Centers
   UL 857 = Busway
   UL 891 = Switchboards
   UL 1558 = Low Voltage Switchgear

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance.

3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

4. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

   a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

      i. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

b. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location.

c. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed.

5. Remote Status Monitor: The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

6. Overcurrent Protection

a. The SPD shall be designed in a way that it will take itself off-line before any damaging external effects to the suppressor or surroundings will occur.

2.02 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	240kA	120 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120kA	60 kA

C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.03 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.

2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.

3. The panelboard shall be capable of re-energizing upon removal of the SPD.

4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.

5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.

6. The SPD shall be of the same manufacturer as the panelboard.

7. The complete panelboard including the SPD shall be UL67 listed.

B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly)

1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

C. Switchgear, Switchboard, MCC and Busway Requirements

1. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations.

2. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway

3. The SPD shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer

4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.

5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.

6. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.

7. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.04 ENCLOSURES

A. All enclosed equipment mounted for indoor application shall be NEMA 1 general purpose enclosures. Provide NEMA 4X enclosures for all outdoor applications.

1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).

2. NEMA 4X – Constructed of stainless steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, splashing water, and hose directed water).

2.05 POWER SUPPRESSORS FOR ELECTRONIC EQUIPMENT

A. Each item of electronic equipment provided under this contract and connected by line cord or direct wired to the building electrical system shall be provided with a three-stage single or multi-phase hybrid suppressor. Fusing shall be provided which removes the protective elements from the circuit upon failure. Visual indication or loss of output power shall be used to notify the user of device failure.

B. Suppressors shall be rated for a minimum of 125% of their continuous electrical load. Suppressors for cord connected equipment shall be equipped with standard NEMA cordsets one of which includes a molded grounding receptacle and the other, a molded grounding plug. Suppressor shall be installed in series with the power cord for the protected equipment. Where several items of equipment are grouped within the same cluster of equipment, one suppressor may be used in conjunction with properly sized grounding plugstrip to serve the equipment.

C. Suppressors for direct wired equipment shall be identical in internal design to the unit described for cord connected applications, however, protected screw

terminals suitable for termination of solid copper wire shall be used for wiring terminations. One suppressor may be used to support several equipment cabinets provided all cabinets are located within the same equipment cluster and the maximum connected load shall not exceed eighty percent of the rated suppressor capacity.

D. Suppressors shall be constructed with a phenolic non-flammable exterior housing with provisions for mounting to the interior of equipment racks, cabinets, or to the exterior of free-standing equipment. Suppressors shall be constructed as three-stage devices. The first stage shall include a high-energy varistor clamp between line and neutral and from neutral to ground. The second stage shall consist of series air-core inductor installed in the line conductor(s) to properly coordinate the action of the first and third stages. The third, fast acting, hard clamping stage shall consist of a network of silicon avalanche bipolar surge suppression diodes between the neutral and line conductor(s).

E. Minimum suppressor performance characteristics shall be as follows:

1. Maximum single impulse line-to-neutral current withstand: 15,000 Amperes (8 x 20 us waveform)

2. Maximum single impulse neutral-to-ground current withstand: 10,000 Amperes (8 x 20 us waveform)

3. Pulse lifetime rating Category B worst case current waveform (8 x 20 us @ 3000 Amperes): 1200 occurrences

4. Pulse lifetime rating for 200 Ampere (8 x 20 us waveform): 10,000 occurrences

5. Worst case response time: Five Nanoseconds

6. Worst case (Maximum Single Impulse Current Conditions) clamping voltage: 400% of nominal phase-to-ground RMS voltage.

7. Initial breakdown voltage: 200% of nominal phase-to-ground RMS voltage.

2.06 SUPPRESSORS FOR CONDUCTOR PAIR PROTECTION

A. Suppression devices for conductor pair protection shall be provided in single-circuit pluggable packages suitable for the circuitry to be protected. Units for protection of data circuits which utilize standard connector configurations shall be equipped with connectors which install in series with the data cable to the protected equipment. Units intended for use with multiple wiring pairs shall be equipped with accessory terminal blocks or strips suitable for the type of wiring being used. Single pair units shall be configured as encapsulated units with wire leads or screw-terminal wiring terminations. Suppressors installed outside of terminal or equipment cabinets (except at designated terminal boards) shall be provided with a housing to afford physical protection for the surge suppression modules.

B. Suppression for each pair shall consist of a three-element gas tube first stage, an isolating element in series with each conductor of the pair, and a silicon avalanche second stage. Second stage clamping shall be provided across the pair for differential mode protection and from each side of the pair to ground for common mode protection. Resistive limiting elements may be used on low current circuits where the effect of voltage drop across the series resistance has no effect on circuit operation. Inductive series elements shall be used on higher current circuits to effectively pass direct or low frequency alternating currents while limiting passage of fast risetime surge waveforms. Silicon avalanche devices shall be designed for surge suppressor applications and shall be polarized or bipolar as appropriate for each circuit.

C. Minimum performance criteria (each circuit) shall be as follows:

1. Maximum single impulse conductor-to-ground or conductor to conductor current withstand: 10,000 Amperes (8 x 20 us waveform)

2. Pulse lifetime rating Category B worst case current waveform (8 x 20 us @ 3000 Amperes): 10 occurrences

3. Pulse lifetime rating for 100 Ampere (10 x 1000 us waveform): 1,000 occurrences

4. Worst case response time: Five Nanoseconds

5. Worst case (Maximum Single Impulse Current) clamping voltage: 200% of normal operating voltage amplitude and polarized or bipolar as appropriate for each circuit type.

6. Initial breakdown voltage: 150 percent of normal operating voltage peak amplitude plus or minus five percent.

7. Capacitance: Capacitance for DC or low frequency lines shall not exceed 2000 picofarads measured line to line or line to ground at the rated diode breakdown voltage. Suppressors intended for use on high frequency or high baud rate circuits shall be designed for use on such lines. Capacitance of such units shall be equated to equivalent cable feet based on the type of cabling used for the particular circuit. The sum of equivalent cable feet for suppressors and actual cable footage shall not exceed manufacturers recommended maximum values for the system on which these devices are installed.

8. Circuit compensation: Any additional circuit compensation (gain or equalization) required to compensate for the insertion of surge suppression devices shall be provided as part of this contract.

PART 3 - EXECUTION

3.01 BONDING AND GROUNDING CONDUCTORS AND MATERIALS

A. Conductors utilized for surge suppressor bonding shall be a minimum of #6 AWG solid insulated copper unless otherwise specified.

B. Ground bus or strip material shall be copper, a minimum of 26 gauge in thickness and three inches wide unless otherwise specified. Bus materials may be secured to surfaces with an appropriate mastic material or mechanical fasteners. Bus connections shall be bolted or brazed and reinforced as necessary on thin bus material to provide a permanent and secure connection.

C. Unless otherwise specified, all surge suppression grounding electrodes shall be 5/8" diameter copperweld rods, twenty feet in length.

D. Connectors, splices, and other fittings used to interconnect grounding conductors, bond to equipment or ground bars, shall comply with requirements of the National Electric Code and be approved by Underwriters Laboratories for the purpose.

E. Connectors and fittings for grounding and bonding conductors shall be of the compression or set-screw type in above grade locations. Connections below grade shall be exothermically welded or brazed.

F. Bonding connections between electrically dissimilar metals shall be made using exothermic welds or using bi-metal connectors designed to prevent galvanic corrosion.

3.02 SEGREGATION OF WIRING

A. All system wiring shall be classified into protected and non-protected categories. Wiring on the exposed side of suppression devices shall be considered unprotected. Surge suppressor grounding and bonding conductors shall also fall into this category.

B. All wiring between surge suppressors and protected equipment shall be considered protected. Isolated circuitry exempted from surge suppression requirements in part one of this section shall also be considered protected.

C. A minimum of three inches of separation shall be provided between parallel runs of protected and unprotected wiring in control panels, terminal cabinets, terminal boards and other locations. In no case shall protected and unprotected wiring be bundled together or routed through the same conduit. Where bundles of protected and unprotected wiring cross, such crossings shall be made at right angles.

3.03 INSTALLATION OF SUPPRESSORS

A. Suppressors shall be installed as close as practical to the equipment to be protected consistent with available space. Where space permits and no code restrictions apply, suppressors may be installed within the same cabinet as the protected equipment. Suppressors installed in this manner shall utilize the equipment chassis as a medium for bonding of their ground terminals. Bonding jumpers not exceeding two inches in length shall be installed between the

chassis and suppressor ground terminals. Bolted connections with star washers shall be used to insure electrical and mechanical integrity of connections to the equipment chassis.

B. Suppressors shall be installed in a neat, workmanlike manner. Lead dress shall be consistent with recommended industry practices for the system on which these devices are installed.

C. Bonding between ground terminals for power and signal line suppressors serving a particular item or cluster of equipment shall be kept as short as possible. Where practical, suppressors shall be installed in a common location for the cluster with their ground terminals bonded closely together. For installations requiring separation between the various suppressor grounds and equipment chassis within an equipment cluster, the following table shall be used to determine bonding conductor requirements (distances are measured between most distant suppressor or chassis grounds):

BONDING DISTANCE	MATERIAL
0 - 10 feet	#6 AWG Bare Copper (Solid)
10- 25 feet	1-1/2" Copper Strip 26ga. Min.
25- 50 feet	3" Copper Strip 26ga. Min.
Over 50 feet	6" Copper Strip 26ga. Min.

Care shall be exercised to avoid connection of incidental grounds to the bonding bus system.

D. Where terminal cabinets are used to house surge suppressors, painted steel backboards shall be used to serve as a low impedance ground plane for bonding surge suppressor leads together. Terminal boards used for the same purpose shall be laminated with a single sheet of 14 ga. galvanized steel to serve as a ground plane for suppressors. Suppressors with ground terminals not inherently bonded to the ground plane through their mounting shall be bonded to this plane using a two-inch maximum length of #12AWG copper wire and suitable lug. Ground planes and backboards shall be drilled to accept self tapping screws, any paint in the area of the bond shall be removed and star washers shall be used.

E. Supplementary grounding and bonding connections required between the bonding bus or ground plane for each equipment cluster and other locations as indicated herein shall be accomplished using #6 AWG bare copper conductors and approved connections unless otherwise noted.

3.04 WARRANTY

A. The manufacturer shall provide a full ten (10) year replacement warranty from the date of shipment against any SPD part failure in material or workmanship when installed in compliance with manufacturer's written instructions and any applicable national or local code.

END OF SECTION

SECTION 16910

CONTROL PANELS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish all labor, equipment, and materials for control panels as indicated on the drawings and specified herein. The panel supplier shall be a UL listed panel shop and all panels shall be UL-508 certified.

B. Control panel equipment shall be coordinated to provide all the specified control as indicated in the elementary diagrams or specified herein.

C. The Contractor shall be responsible for coordinating and interfacing with equipment and instrumentation supplied under other sections of the Contract Documents that are an integral part of the pump station control systems. This interfacing shall be incorporated in the detailed systems drawings and data sections to be submitted by the Contractor prior to rough-in work.

D. Modifications and additions to existing Collections Department Data Flow TAC II SCADA server.

E. Furnish all labor, equipment, and materials for Antenna Subsystem and telemetry system hardware.

1.02 SUBMITTALS

E. The Contractor shall submit to the Engineer for approval complete shop drawings, wiring diagrams, data, and operation and maintenance manuals of all equipment to be furnished under this section.

F. Coordination and Shop Drawings: Prepare and submit coordination drawings for installation of products and materials fabricated. Coordination and shop drawings shall be prepared using a computer aided drafting system compatible with Autodesk Autocad version 2013 or greater. Coordination and shop drawings shall be submitted on hard copy and electronic disk format.

1. Submit component interconnect drawings showing the interconnecting wiring between each component including equipment supplied under other sections requiring interfacing with the control system. Diagrams shall show all component and panel terminal board identification numbers, and external wire and cable numbers. Note, this diagram shall include all intermediate terminations between field elements and panels (e.g., terminal junction boxes, pull boxes, etc.). Diagrams' devise designations, and symbols shall be in accordance with NEMA ICS 1-101.
2. Panel Wiring Diagrams: Elementary diagrams shall be similar to those diagrams shown in the drawings, but with the addition of all auxiliary devices such as additional relays, alarms, fuses, lights, fans, heaters, etc.
3. Panel wiring diagrams shall identify wire numbers and types, terminal numbers, tag numbers and PLC I/O identification (address) numbers.

Wiring diagrams shall show all circuits individually; no common diagrams shall be allowed.

4. Submit arrangement and construction drawings for consoles, control panels, and for other special enclosed assemblies for field installation. Include dimensions, identification of all components, preparation and finish data, nameplates, enough other details to define the style and overall appearance of the assembly and a finish treatment. Drawings shall show the location of all front panel mounted devices to scale, and shall include a panel legend and a bill of materials. The panel legend shall list and identify all front of panel devices by their assigned tag numbers, all nameplate inscriptions, service legends and annunciator inscriptions. The bill of materials shall list all devices mounted within the panel that are not listed in the panel legend, and shall include the tag number, description, manufacturer and complete model number for each service.
5. Submit installation, mounting, and anchoring details for all components.

G. Operation, Maintenance and Repair Manuals:
   1. Submit operation and maintenance manuals.

1.03 CODES AND STANDARDS:

H. Equipment, materials, and workmanship shall comply with the latest revisions of the following codes and standards:
   1. Instrumentation: Instrument Society of America (ISA).
   2. Wiring: National Electrical Code (NEC), ISA S5.3 and S5.4, latest issue.
   3. Control Panels and equipment: NEMA, UL and ANSI.
   4. Control Logic: Joint Industrial Council (JIC).

PART 2 - PRODUCTS

2.01 GENERAL

A. The electrical control equipment shall be mounted within a pad-lockable NEMA Type 3R SS (Derated: NEMA 4X) ventilated dead-front enclosure constructed of not less than 304 stainless steel and shall be quipped with a 3-point latch with all hardware and exterior components construction of 300 series stainless steel. The enclosure shall be equipped with a removable, aluminum or stainless steel back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. All hardware shall be stainless steel.

B. Components: 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.

C. A circuit breaker shall be provided on each control panel as a means of disconnecting power to the control panel.

D. Control transformers shall be installed where shown to provide 120VAC and 24VAC for control circuits. Transformers shall be fused on the primary and

secondary circuits. The transformer secondary shall be grounded on one leg.

E. All control panel wiring shall be identified at both ends with type written heat shrinkable wire markers with the numbering system shown on the control submittal drawings.
   1. Control wiring shall be stranded copper, minimum size #14 AWG (except for shielded instrumentation cable may be #16 AWG), with 600 volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation.
   2. Fused terminal blocks shall be provided for all inputs and outputs that extend beyond the controller enclosure and that are not separately fused within the equipment. Blocks shall be permanently marked to indicate the appropriate I/O address of each circuit on the pump controller.

F. 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. Nameplates shall be laminated plastic, engraved white letters with a black background.

G. Corrosion Inhibitor Emitter: Provide an industrial corrosion inhibitor emitter on all exterior mounted control panels that will protect internal components of the control panel from corrosion for one year. Provide one spare emitter for each control panel.

H. Fused terminal strips shall be provided for all signals as indicated on the drawings plus all spare conductors as specified. Terminal strips shall be switch type with integral fuses equal to Allen Bradley 1492-H6. Wiring from the control panel to the terminal strips shall be factory installed. All spare conductors shall be terminated and identified.

I. RELAYS
   1. Control circuit switching shall be accomplished with relays. These relays, for interfacing and control applications, shall be the compact general purpose plug-in type having low coil inrush and holding current characteristics. A neon status-indicating light shall be provided with each relay. Contact arrangements shall be as noted or shown, and shall be rated for not less than 10 amperes at 120V ac or 28V dc. Coil voltage shall be as noted or shown. Non-latching relays shall have a single coil. Latching relays shall have two coils, unlatching being accomplished by energizing one coil, and latching being accomplished by energizing the other coil. Relays shall have plain plastic dust covers, test buttons, and mounting sockets with screw terminals and holddown springs. Relays shall be UL recognized. Relays shall be Potter and Brumfield, Struthers-Dunn, or equal.
   2. Time delay functions shall be accomplished with time delay relays. Units shall be adjustable time delay relays with the number of contacts and contact arrangements as shown. A neon status-indicating light shall be provided with each relay. Contacts shall be rated for 10 amperes at 120V ac. Integral knob with calibrated scale shall be provided for adjustment of time delay. Initial setting shall be as shown with time delay range approximately three times the initial setting. Time delay rangeability shall be at least 10:1. Operating voltage shall be 120V ac, plus 10 percent, -15 percent at 60-Hz. Operating temperature shall be -20 degrees F to 165

degrees F. Repeat timing accuracy shall be plus or minus 10 percent over the operating range. Units shall be Socket-mounted relays, octal plug-in, adjustable range as shown on drawings, equal to SSAC model PRM-43, or Cutler-Hammer Series D87, or equal.

3. All relays shall have a screw terminal interface with the wiring. Terminals shall have a permanent, legible identification. Relays shall be mounted such that the terminal identifications are clearly visible and the terminals are readily accessible.

J. Front Panel Operating Controls and Instruments:

1. All operating controls and instruments shall be securely mounted on the control compartment door. All controls and instruments shall be clearly labeled to indicate function.
2. Indicator lamps shall be LED full voltage push to test type and mounted in NEMA 4X (800H) modules, as manufactured by Allen Bradley or SKPI as manufactured by Square D. Lamp modules shall be equipped to operate at 24 or 120 volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position. Units shall be heavy-duty, oiltight, industrial type with screwed on prismatic glass lenses in colors as shown, and shall have factory engraved legend plates. LED's shall be high illumination type (5ma at 130V ac).
3. Selector switches shall be heavy-duty, oiltight, industrial type selector switches with contacts rated for 120V ac service at 10 amperes continuous. Units shall have standard size, black field, legend plates with white markings, as indicated. Operators shall be black knob type. Units shall have the number of positions and contact arrangements and spring return function (if any) as shown. Units shall be single-hole mounting, accommodating panel thickness from 1/16-inch minimum to 1/4-inch maximum. Units with up to four selection positions shall be Allen Bradley 800H, Square D Type K, Cutler-Hammer Type T, or equal. Units with up to 12 selection positions shall be Rundel-Idec Standard Cam Switch, Electroswitch 31, or equal. Key type switches shall be keyed in conformance with Collier County Water Department key set requirements.

K. Starters

1. Motor starters shall be combination type across-the-line magnetic unless noted otherwise, rated in accordance with NEMA Standards sizes and horsepower ratings. Disconnect shall be a motor circuit protector (magnetic only breaker) current limiting type for short circuit protection where noted on the drawings. Final magnetic settings shall be field set and recorded. Combination starter shall be rated 42,000 AIC Sym. minimum or as noted on drawings. Overload relays shall be provided in each phase, and shall be melting alloy or bimetallic type. Thermal units shall be one-piece construction and interchangeable.

2. Starters shall be equipped with auxiliary contacts as required for proper control functions; minimum of two normally open auxiliary contacts in addition to the normally open auxiliary seal-in interlock, and shall be suitable for the addition of at least two additional external electrical interlocks of any arrangement normally open or normally closed. All starters shall have red, green and amber pilot lights for "run", "off", and

"trip" or as indicated on the drawings; "HAND-OFF-AUTO" selector switch or other selector or pushbutton switches as required or indicated on the drawings, nameplate and control transformer. Starters shall have provisions in the cover for future addition of pushbutton or selector switch.

3. Starters shall be rated in accordance with NEMA sizes and horsepower ratings. All starters shall be gravity dropout. All starters Size 5 and smaller shall have double break silver alloy contacts; starters 6 and larger shall employ single break contacts. All contacts must be capable of being inspected, and must be removable, without removing line or load wiring. Coils on starters, Size 5 and smaller, shall be molded construction. ON size 6 and larger, coils may be form wound, taped, varnished and baked. All starter coils shall be equipped with coil surge suppressors.

4. Each starter shall contain fused control transformer to provide 120V control voltage. The control transformers shall be sized for additional loads of motor space heaters and other items indicated; contractor shall coordinate requirements in shop drawings. Provide Elapsed Time Meters in control panel fronts. Meters shall be synchronous motor driven and 0 to 9999.9 hour range; rated for 120 volt 60HZ operation; Eagle Signal type 705, Agastat or equal.

5. Starters shall include a time delay on pick up relay to control momentary power interruptions. Time delay relay contacts shall delay the reclosing of the starter on momentary power loss; delay time adjustable 0-300sec. The time delay on pick up relay circuit shall also control the 27/47 device (phase monitor) contacts on the incoming main as detailed on the drawings. The phase monitor relay shall be 2-10% phase imbalance adjustable and time delayed. The unit shall sense phase imbalance, phase loss, undervoltage and phase sequence. Provide phase monitor by Diversified Electronics model SLU-600. Also provide an undercurrent relay sensing dry well conditions; Diversified Electronics model CMG.

6. Starters shall be Square-D Class 8536 or equal. Provide starters as specified above and as shown on the drawings.

L. Pump Controller/RTU

1. Provide TAC Pack TCU (RTU) as manufactured by Data Flow Systems, Inc for pump controlling purposes. TAC Pack TCU shall include:
   a. An integrated 2-Watt digital radio.
   b. A back-up battery for TCU.
   c. Manufacturers prefabricated wire harness.
   d. All manufacturer recommended surge protection.
   e. Suitable devices for measuring wastewater flow.
   f. Three on board fail safe HOA switches.
   g. Triplex/Duplex/Simplex configurable operation mode.
   h. On board 240VAC or 480VAC phase monitor.
   i. On board 4 by 20 character LCD display for elapsed runtime of each pump.

2. Pump Control Panel alarm light shall be activated by the RTU and the external push button alarm silence switch shall be wired into the

RTU.

3. During automatic sequence the pumps shall be controlled in an alternate mode.

M. Antenna Subsystem

1. Provide a High Gain RTA209 Yagi Antenna as manufactured by Data Flow Systems Inc for use to transmit and receive TAC PAC TCU data to and from the County's existing TAC II SCADA server. Antenna shall have a single radiator element connected to a type N female connector.

2. Antenna mast/pole shall be 25 foot by 1.25 inch SCH80 galvanized pole. Mounting of the antenna mast/pole shall be in accordance with all applicable local and state building codes as they pertain to structural strength and wind velocity requirements.

3. All mounting hardware shall be stainless steel.

4. Utilize type N connectors at both ends of the coax, sealed with 3 inch sections of Alpha FIT321-1-0 sealant shrinktubing.

5. Start up and successful testing of Data Flow telemetry equipment by Data Flow representatives, the engineer and County Wastewater Collections instrumentation and telemetry representatives is required prior to final acceptance.

6. Provide latitude and longitude coordinates of the station to the County.

7. All required FCC licensing shall also be provided.

N. Ball Float Switches

A. Units shall be direct-acting float type level sensing device. The switch shall be chemical resistant polypropylene, normally open, type-S suspended type with built-in weight. The float cable shall be rated "continuous service" for high flexibility. All mounting hardware shall be 316 SS. All float fittings shall be flared and incorporate strain relief jacketing.

B. Cable shall be rugged and flexible with heavy neoprene or PVC jacket. The actuation/deactivation differential shall not exceed 4 inches. Units shall be pipe mounted or suspended type as noted, and provided with 40 feet of cable unless otherwise noted. Each pipe mounted type shall be provided with a clamp to secure the cable to 1-inch support pipe.

C. Each suspended type shall be provided with necessary brackets and clamps to suspend the unit from the top of a tank or vessel. The suspended type shall include an integral weight assembly for stabilization and positive operation of the unit. All mounting clamps shall be PVC or neoprene.

D. Provide Anchor Scientific suspended type Roto-Float switch.

O. MAGNETIC FLOW METER SYSTEMS:

A. Magnetic flow meter systems shall include a flanged spool piece style magnetic flow tube and a remote microprocessor based transmitter that is capable of converting and transmitting a signal from the flow tube. The magnetic flow meters shall utilize the characterized field principle of pulsed electromagnetic induction, and shall produce DC signals directly proportional to the liquid flow rate.

B. Provide meters of 304 stainless steel material with a Polyurethane liner. Liner shall have a minimum thickness of 0.125 inches. The inside diameter of the liner shall be within 0.125 of the inside diameter of the adjoining pipe. Liner protectors shall be provided on all flow tubes.

C. Provide flow tubes with flush mounted Hastelloy-C electrodes, or as recommended by the manufacturer(Alloy C22). Size flow tube as shown on mechanical drawings.

D. Grounding rings shall be provided for all meters.

E. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum 316L stainless steel or compatible with the process fluid for each meter in accordance with the manufacturer’s recommendations.

F. Flow tube shall be rated for temperatures of up to 180°C and pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of -20 to +50°C. Meter shall meet IP68/NEMA-6P requirements for submersible service. Transmitter shall meet IP66/67/NEMA-4X requirements. When meter and transmitter are located in classified explosion hazard areas, the meter and transmitter housings shall be selected with rating to meet the requirements for use in those areas.

G. The transmitter shall utilize Ethernet/IP communication protocol. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self diagnostic routines and report errors via English language messages.

H. The transmitter shall be shipped equipped with RJ-45 EtherNet/IP ports.

I. The transmitter's preamplifier input impedance shall be a minimum of 109-1011 ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.

J. The transmitter shall provide an automatic low flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external unpowered signal.

K. The transmitter shall be capable of communicating over an Ethernet/IP network with a remote configuration device. The remote configuration device shall be capable of being placed anywhere in the loop. A security lockout feature shall be provided to prevent unauthorized modification of configuration parameters. Provide one remote handheld configuration device for communication with all "smart" instruments furnished under this specification. The device shall be capable of performing configuration, test, and format function

L. Accuracy shall be 0.5% of rate over the flow velocity range of +/- 1 mm/s. Repeatability shall be 0.1% of rate; minimum rangeability shall be 100:1. Minimum required liquid conductivity shall not be greater than 5 uS/cm. Maximum response time shall be adjustable between 5 and 200 milliseconds as a minimum. Transmitter ambient temperature operating limits shall be -40 to +60 degrees Celsius. Power supply shall be 120VAC, 60 Hz.

M. Provide flow tubes that are factory calibrated and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes. Flow Meters shall be factory calibrated to NIST traceable standards. Provide certified factory calibration records.

N. Provide flow meter systems cable of onboard calibration verification. Provide field verification system (including software key code) that automatically tests the flow measurement system and is capable of producing a printed certificate of calibration verification that is traceable.

O. The transmitter shall be remote to the flowtube. Transmitter shall be wall mounted or mounting to instrument stand as shown in the Drawings or as specified. Provide manufacturer cable, field verify exact length with electrical contractor prior to bidding. Provide manufactures sunshield cover to protect transmitter face.

P. Manufacturer’s representative shall conduct a field inspection after installation, conduct start-up of the flow meters, certify in writing the meters’ proper installation, and verify calibration of flowmeters after installation.

Q. Magnetic flow meter systems shall comply with ISO9001 standards and be as manufactured by Endress Hauser Proline Promag 400W. No other manufacturers will be considered acceptable. Manufacturer to provide a written five year extended warranty from (a) date of issuance of “Certificate of Proper Installation” and Operation and (b) production of self-calibration report acceptable to Engineer and Owner, whichever is later.

PART 3 - EXECUTION

3.01 Installation and Startup Services

A. The work included in this section consists of furnishing, installing and placing in operation the instruments and appurtenances, including all conduit, wiring and circuitry, necessary to provide the Owner with a fully operable system properly calibrated and installed. Install and mount equipment in accordance with the Contract Documents, and installation detailed shop drawings. Mount equipment so that they are rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock and vibration; and freedom from interference with other equipment, piping, and electrical work.

B. Provide services of panel manufacturer to test the completed system after installation to assure that all components are operating with the specified range and all interlocks are functioning properly. Panel manufacturer shall certify functional operation and calibration in written startup report. Perform field tests on all completed control assemblies to demonstrate conformance to specifications and functional compatibility.

C. Include the services of a factory trained, qualified service engineer of the equipment manufacturer to inspect the complete equipment installation to assure that it is installed in accordance with the manufacturer's recommendations, make all adjustments necessary to place the system in trouble-free operation and instruct the operating personnel in the proper care and operation of the equipment furnished. All workmanship utilized in the manufacture and installation of this system shall be of the highest quality and performed in a manner which is consistent with all accepted practices for industrial controls.

D. The Contractor shall guarantee that installation of the system is in accordance with the manufacturer's instructions. The supplier shall construct and verify proper operation of each assembled system before shipment to the site. These performance tests shall be repeated once the system is installed and re assembled at the site. The service technician shall calibrate all gauges and instruments. A documented calibration and settings report shall be included in the O&M manuals.

E. The system supplier shall provide a qualified service technician to inspect all final connections and check the system prior to start up of the system. The service technician shall coordinate with the Owner's representative for functional check out of the complete system.

F. System verification marking end of suppliers on site start-up obligations will be issued after system functionality can be demonstrated for a period of 168 continuous hours without interruptions due to engineering error on the part of the supplier.

G. All products mentioned herein must be warranted by the supplier for a period of two (2) years from the date of system verification. The system supplier shall also provide (2) days of training instruction to the Owners personnel to include; operator training, system repair and maintenance.

END OF SECTION

Collier County

WATER – SEWER DISTRICT

REHABILITATION PLANS FOR PUMP STATION 308.06

Permits

April 2024

Bowman

Note: Attached are the following Permits obtained by Collier County. The Contractor shall be responsible for obtaining all other Permits required for their work. These Contractor obtained Permits may include, but not be limited to, Collier County Right of Way Permit, FDEP Stormwater Permit and a Collier County Building Permit.

A. Site Development Plan Insubstantial Change Permit (SDPI)

Bowman Project No. 340342-01-001/2023.001

Collier County

October 17, 2024

Roy Vinas Larrechea
950 Encore WAY
Naples, FL 34110

RE: Insubstantial Change No. PL20240008698
Rehabilitation Plans for Pump Station 308.06 (SDPI)

Dear Applicant:

This is in response to your submittal of plans showing modification to PL20120000163 rehabilitation will include the removal of the existing valve vault, wet well rehab, new pumps, new wet well top, new discharge piping, new control panel, FDOT gravity wall and new antenna. Also included in the project will be improvements to a portion of the pump station site including a new fence, new concrete driveway, stabilized access and gravel ground cover.

This office has reviewed the plans and has no objection to the changes shown unless noted under stipulations.

STIPULATIONS:

- Issuance of a development permit by a county does not in any way create any rights on the part of the applicant to obtain a permit from a state or federal agency and does not create any liability on the part of the county for issuance of the permit if the applicant fails to obtain requisite approvals or fulfill the obligations imposed by a state or federal agency or undertakes actions that result in a violation of state or federal law. This permit is conditioned on all other applicable state, or federal permits being obtained before commencement of the development.

- Per Ordinance 2021-48, onsite processing of construction demolition debris and crushing of inert waste materials from an off-site location is prohibited unless allowed in a previously approved conditional use or Board of County Commissioners approved development order.

SIGNAGE RESTRICTIONS:

- Please be advised that any permanent sign (wall, ground, monument, directory, etc.) requires a separate building permit and must meet the provisions of the Collier County Land Development Code, Section 5.06.00, and/or the applicable provisions of the governing Planned Unit Development (PUD) document, regardless of any sign placement, dimensions, or color depicted on the site and/or architectural plans approved by this letter.

Please contact Annis Moxam at (239) 252-5519 to coordinate possible addressing changes.

"Be advised that this project has been reviewed by staff in accordance with the applicant's description of work as identified in the cover letter. The applicant bears full responsibility for identifying all proposed work, and building permits for any work shown changed on the plans but not identified in the cover letter may be rejected pending further staff review."

Sincerely,

Development Review Division

Growth Management Department
2800 N. Horseshoe Dr.
Naples, Florida 34104
239-252-2400

Collier County

WATER – SEWER DISTRICT

REHABILITATION PLANS FOR PUMP STATION 308.06

Xylem Water Solution USA, Inc.
List of Provided Materials and Services

April 2025

Bowman

Note: The following quote provides a listing of materials and services to be provided by Xylem Water Solution USA, Inc. under separate contract with Collier County. The Contractor shall be responsible for all miscellaneous materials required for a complete system and for coordination of the telemetry system with the control panel and for all startup services.

Bowman Project No. 340342-01-001/2023.001

Xylem Water Solutions USA, Inc.
5771 Country Lakes Drive Fort Myers, Florida 33905
Phone: 239-693-5226 Fax: 239-693-1485

Date: March 21st, 2025

To: All Bidding Contractors Quote# 2025-FTM-0161

Subject: PS 308.06 – Collier Co

We are pleased to offer the following equipment.

(2) NP3171.185, 434 imp, 30hp/460v/3ph Flygt Pump w/50' Cable, Prepared for Flush Valve
(1) Flush valve
(1) Duplex Control Panel, 460V/30HP/3PH
(2) 25'x1/4" Lift Chain
(2) 6x6" Straight Through Discharge Connection
(2) Adhesive Anchoring
(2) Adhesive Nozzle
(8) Threaded Rod
(100) 2" Guide Rail
(2) 2" Upper Guide Bar Bracket
(1) Cable Holder
(2) 24x24x1/4" Base Plate
(1) AHD 42x82 Hatch (36x72" Clear Opening)
(1) Start Up Charge

Price: **$ 161,679.00**

Terms & Conditions

This order is subject to the Standard Terms and Conditions of Sale - Xylem Americas effective on the date the order is accepted which terms are available at http://www.xyleminc.com/en-us/Pages/terms- conditions-of-sale.aspx and incorporated herein by reference and made a part of the agreement between the parties.

Purchase Orders: Please make purchase orders out to: Xylem Water Solutions USA, Inc.

Freight Terms: 3 DAP - Delivered At Place 08 - Jobsite (per IncoTerms 2020)
See Freight Payment (Delivery Terms) below.

Taxes: State, local and other applicable taxes are not included in this quotation.

Back Charges: Buyer shall not make purchases nor shall Buyer incur any labor that would result in a back charge to Seller without prior written consent of an authorized employee of Seller.

Tariff Changes: The prices quoted herein are based on the current tariff rates, duties, government charges, and trade regulations as of the date of this quote. If any new tariffs, duties, taxes, or similar charges are imposed, or any existing tariffs, duties, or charges are increased or modified by any government or regulatory authority (collectively, "Tariff Changes"), and such Tariff Changes result in an increase in the cost of goods, Xylem reserves the right to adjust the pricing of the affected goods to reflect the increased costs.

Shortages: Xylem will not be responsible for apparent shipment shortages or damages incurred in shipment that are not reported within two weeks from delivery to the jobsite. Damages

FLYGT
a xylem brand

should be noted on the receiving slip and the truck driver advised of the damages. Please contact our office as soon as possible to report damages or shortages so that replacement items can be shipped and the appropriate claims made.

Validity: This Quote is valid for thirty (30) days unless extended in writing by Xylem Water Solutions USA, Inc.

Terms of Delivery: PP/Add Order Position

Terms of Payment: 100% N45 after invoice date. Xylem's payment shall not be dependent upon Purchaser being paid by any third party unless Owner denies payment due to reasons solely attributable to items related to the equipment being provided by FLYGT. Credit Card payments will be assessed a 3.5% surcharge fee on the invoice total.

Schedule: Please consult your local Flygt Branch to get fabrication and delivery lead times.

Thank you for the opportunity to provide this quotation. Please contact us if there are any questions.

Sincerely,

Chris Stewart
Branch Manager
Phone: 239-322-3257
Cell: 239-633-2553
Chris.stewart@xyleminc.com
Fax: 239-693-1485

Customer Acceptance

This order is subject to the Standard Terms and Conditions of Sale – Xylem Americas effective on the date the order is accepted which terms are available at http://www.xyleminc.com/en-us/Pages/terms-conditions-of-sale.aspx and incorporated herein by reference and made a part of the agreement between the parties.

A signed copy of this Quote is acceptable as a binding contract.

Purchase Orders: Please make purchase orders out to: Xylem Water Solutions USA, Inc.

Quote #: 2025-FTM-0161
Customer Name: All Bidding Contractors
Job Name: PS 308.06 – Coller Co

Signature:_____ Company/Utility: _____

Name:_____ Address: _____
(PLEASE PRINT)

Email: _____

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Date:_____ Phone: _____

PO#:_____ Fax:_____

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